

Sexual Reproduction in Flowering Plants

Very Short Answer Questions

1. Name the component cells of 'egg apparatus' in the embryo sac?

A: Egg and two synergids.

2. Name the part of gynoecium that determines the compatible nature of pollen grain?

A: Stigma.

3. Name the common functions that cotyledons and nucellus perform?

A: 1.Storage of reserve food material.

2. Nourishment – Cotyledons nourishes embryo.

-- Nucellus nourishes embryo sac.

4. Name the parts of pistil which develop into fruits and seeds?

A: Ovary develops into fruit.

Ovules develops into seeds.

5. In case of polyembryony, if an embryo develops from the synergid and another from the nucellus which is haploid and which is diploid?

A: Embryo developed from synergid is haploid.

Embryo developed from nucellus is diploid.

6. Can an unfertilized, apomictic embryo sac give rise to a diploid embryo? If yes then how?

A: Yes. If megaspore develops into embryo sac without meiotic division egg will be diploid. Diploid egg develops into embryo by mitotic divisions.

7. Which are the three cells found in a pollen grain when it is shed at the three celled stage?

A: Vegetative cell and two male gametes.

8. What is self-incompatibility?

A: It is a genetic mechanism which prevents self-pollen from fertilizing the ovules by inhibiting pollen germination or pollen tube growth in the pistil.

9. Name the type of pollination in self-incompatible plants?

A: Self-pollination is incompatible in self-incompatible plants.

Cross pollination is compatible in self-incompatible plants.

10. Draw the diagram of a mature embryo sac and show its 8-nucleate, 7-celled nature. Show the following part: antipodals, synergids, egg, central cell, polar nuclei?

A:

- 11. Which is the triploid tissue in a fertilized ovule? How is the triploid condition achieved?**
- A: Endosperm is the triploid tissue. It results from triple fusion involving union of one male gamete and two haploid polar nuclei.
- 12. Are pollination and fertilization necessary in apomixis? Give reasons?**
- A: Pollination and fertilization not necessary for apomixis.
1. Embryo sac can develop from megaspore without reduction division in which case egg is diploid that develops into embryo.
 2. Embryo sac can also develop from diploid nucellus cells in which case egg is diploid that develop into embryo.
- 13. How is pollination carried out in water plants?**
- A:
1. In water plants in which flowers emerge above the level of water pollination is by insects or wind.
 2. In aquatic plants with flowers at the surface pollination is by water—epihydrophily.
 3. In aquatic plants with flowers below the surface of water pollination is by water—hypohydrophily.
- 14. What is the function of two male gametes produced by each pollen grain in angiosperms?**
- A: One male gamete unites with egg forming embryo—Fertilization or syngamy.
Another male gamete unite with two polar nuclei resulting in the formation of endosperm—Triple fusion.
- 15. Name the parts of an angiosperm flower in which development of male and female gametophytes takes place?**
- A: Male gametophyte develops inside the pollen sac or microsporangium.
Female gametophyte develops in the ovule or megasporangium.
- 16. What is meant by monosporic development of female gametophyte?**
- A: Embryo sac formation from a single megaspore is called as monosporic development of female gametophyte.
- 17. Mention two strategies evolved to prevent self-pollination in flowers?**
- A:
1. Dicliny (unisexuality).
 2. Self-sterility (self-incompatibility).
 3. Dichogamy(different maturation periods of stamens and pistil).
 4. Herkogamy (different heights or angles of stamens and pistil).

18. Why do you think the zygote is dormant for some time in a fertilized ovule?

A: Immediately after the fertilization zygote does not find food material for its growth. It waits till certain amount of endosperm is formed for its nutrition.

19. If one can parthenocarpy through the application of growth substances, which fruits would you select to induce parthenocarpy and why?

A: Fruits with edible pericarp as it will be juicy and succulent. If seeds of the plant are economically useful and edible --- parthenocarpy is of no use as fruits will be without seeds.

20. Explain the role of tapetum in the formation of pollen grain wall.

A: Tapetal cells contain ubisch bodies which help in the formation of exine of pollen grains.

Short answer Questions

1. List three strategies that a bisexual chasmogamous flower can evolve to prevent self pollination (autogamy)?

A. **A) Dichogamy:** "Pollen release and stigma receptivity are not synchronized". In sunflower, 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 are 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 which prevents the self pollen from fertilizing the ovules by inhibiting pollen germination or pollen tube growth in the pistil.

E.g : *Abutilon*.

2. Given below are the events that are observed in an artificial hybridization programme? Arrange them in the correct sequential order in which they are followed in the hybridization programme?

a) Re – bagging

b) Selection of parent

c) Bagging

d) Dusting the pollen on stigma

e) Emasculation

- f) Collection of pollen from male
- A.
- a) Selection of parents
 - b) Emasculation
 - c) Bagging
 - d) Collection of pollen from male
 - e) Dusting the pollen on stigma
 - f) Re – bagging

3. **Vivipary automatically limits the number of off-springs in a litter. How?**

A.



Vivipary is defined as the seed germination while the fruit is still attached to the mother plant. Plants which 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. As the chances are more for the seedling survival the number in each litter is small.

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

- A. Self incompatibility will encourage the ways for cross pollination. It imposes restrictions on autogamy.

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.

e.g : *Abutilon*

5. **What is polyembryony and how can it be commercially exploited?**

A. Occurrence of more than one embryo in a seed is called polyembryony.

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 main 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.

Cultivation of hybrids has tremendously increased productivity.

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

A. Yes. Apomixis and parthenocarpy are different phenomena.

Significance of Apomixis :

1) During Apomixis, chromosomal segregation and recombinations does not occur. So characters are stable for several generations.

2) It simplifies commercial hybridized production because isolation would not be necessary to produce F_1 or maintain or multiply parental generation.

3) Adventive embryony is being used in producing uniform root- stock and virus free scion material.

Significance of parthenocarpy :

1) The fruit production without fertilization of the ovary is called parthenocarpy. This phenomenon is applied for the commercial production of seedless fruits.

E.g. : Banana, Grapes.

2) This is more useful to juice industries.

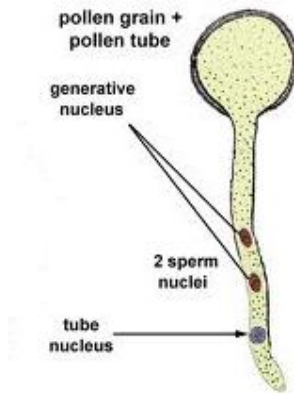
7. Why does the zygote begin to divide only after the division of Primary endosperm cell (PEC)?

A. 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 nutrition of the

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

8. The generative cell of two – celled pollen divides in the pollen tube but not in three celled pollen. Give reasons?

A.



Pollen grain at maturity, divides periclinally and produce two unequal cells. The large cell is vegetative cells, has abundant food reserve and a large irregularly shaped nucleus. The smaller cell is generative cell and floats in the cytoplasm of vegetative cell which is spindle shaped nucleus. The smaller cell is generative cell and floats in the cytoplasm of vegetative cell which is spindle shaped with dense cytoplasm and a nucleus. In over 60% of angiosperms, pollen grains are shed at this 2-celled stage. In the remaining species, the generative cell divides mitotically to give rise to the 2 male gametes before pollen grains are shed (3 celled stage).

The pollen grains further germinate on the stigma to produce a pollen tube through one of the germ pores. The contents of the pollen grains move into the tube. Pollen tube grows through the tissues of the stigma and style and reaches the ovary.

In plants, when pollen grains are shed at 2 celled stage the generative cell divides and forms two male gametes, during the growth of the pollen tube in the stigma.

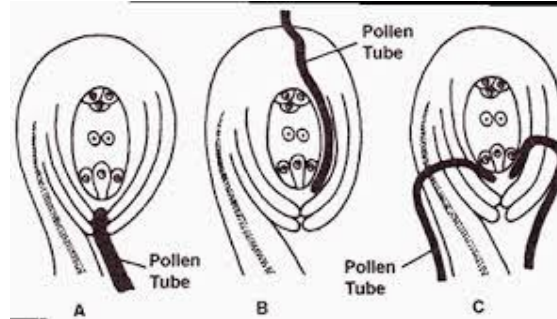
9. Discuss the various types of pollen tube entry into ovary with the help of diagrams?

A. Pollen tube enters into the ovule by any one of the three ways:

1) Porogamy : Pollen tube enters into ovule through micropyle and then enters into embryosac by destroying one of the synergids. It is the normal feature in plants.

2) Chalazogamy : Pollen tube enters into ovule through chalaza.

3) **Mesogamy** : Pollen tube enters into ovule through this integuments.



10. Differentiate between microsporogenesis and megasporogenesis? Which types of cell division occurs during these events? Name the structures formed at the end of these two events?

A.

Microsporogenesis	Megasporogenesis
1) The sporogenous tissue divides meiotically to form microspore tetrads is called Microsporogenesis.	1) The process of formation of megaspores from the megaspore mother cell is called Megasporogenesis.

In both these events meiosis occurs. At the end of these events, microspores and megaspores are formed.

11. What is bagging technique? How is it useful in a plant breeding programme ?

A.



Covering the emasculated flower with a bag made of butter paper is called Bagging.

In artificial hybridization technique, after the selection of parents, anthers are to be removed from bisexual flower of a female parent is called Emasculation. After this, these emasculated flowers have to be covered with a bag of suitable size, generally made of butter paper. It is to be done to prevent contamination of the stigma with unwanted pollen. This process is called Bagging. Bagging technique is useful in producing new cultivar.

12. What is triple fusion? Where and how does it take place? Name the nuclei involved in triple fusion?

A: Fusion of second male gamete with secondary nucleus (fusion of product of two polar nuclei) is called Triple fusion.

It occurs in the embryo sac. Pollen tube with two male gametes enters into embryo sac by destroying one of the synergids.

The tip of the pollen tube dissolves and releases two male gametes in the vicinity of the egg.

In triple fusion, one male gamete and secondary nucleus (two polar nuclei) are involved.

13. Differentiate between?

a) Hypocotyl and Epicotyl

b) Coleoptile and Coleorhiza

c) Integument and Testa

d) Perisperm and Pericarp

A. a)

Hypocotyl	Epicotyl
1. The cylindrical portion of embryonal axis below the level of cotyledons is called hypocotyl. 2. It is smooth.	1. The portion of embryonal axis above the level of cotyledons is called epicotyls. 2. It is covered by tiny hairs.

b)

Coleoptile	Coleorhiza
The epicotyl has a shoot apex and a few leaf primordia enclosed in a hollow foliar structure called coleoptiles.	The embryonal axis has the radicle and root cap is enclosed in an undifferentiated sheath called coleorhizae.

c)

Integument	Testa
Protective envelope around the ovule	After fertilization, the outer integument, of the

is called integument.	ovule develops into Testa (outer seed coat).
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d)

Perisperm	Pericarp
Remnant of nucellus is called perisperm. Ex : Black pepper.	The outer wall of a fruit is called pericarp.

14. What is meant by emasculation? When and why does a plant breeder employ this technique?

Ans. "Removal of anthers from the bisexual flower of a female parent, when the flower is in bud condition, with the help of a forceps" is called emasculation. The technique is employed, when only the desired pollen grains and used for pollination and the stigma is protected from contamination.

15. What is apomixis ? What is its importance?

Ans. Production of seeds without fertilization is called Apomixis. It is a form of asexual reproduction that mimics sexual reproduction. In some species, the diploid egg cell is formed, without meiosis and develops into embryo without fertilization. It is an assured reproduction in the absence of pollinators such as in extreme environments.

Importance:

1) Apomixis does not involve meiosis. Hence segregation and recombination of chromosomes do not occur.

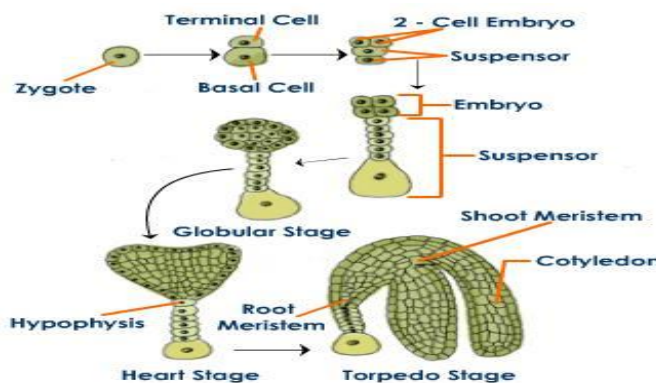
Thus Apomixis helps in preserving desirable characters for indefinite periods.

2) Apomixis, simplified commercial hybrid seed production.

LONG ANSWER TYPE QUESTIONS:

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

A.



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

A. **Chasmogamy:** The pollination that occurs in opened flowers is called chasmogamy. It is the most common type of pollination in all types of flowers. There are two types of chasmogamy.

- 1) Self pollination
- 2) Cross pollination

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

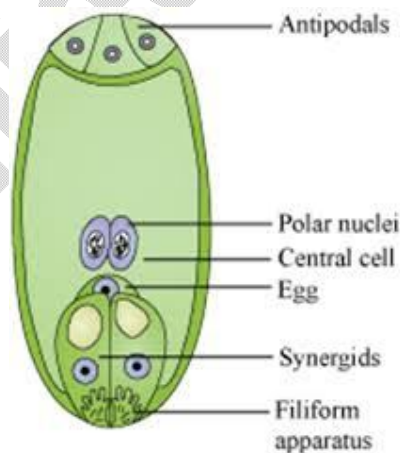
2) **Cross pollination or allogamy :** The transfer of pollen grains from anther to stigma of another flower is called a cross pollination. It is 2 types. (a) Geitonogamy (b) Xenogamy.

a) **Geitonogamy :** The transfer of pollen grains from anther to the stigma of another flower of the same plant. It is functionally cross pollination involving a pollinating agent, genetically. It is similar to autogamy. Since the pollen grains come from the same plant.

b) **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 which 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?**

A.



Megaspore is the mother cell for the development of female gametophyte (embryo sac). The nucleus of the functional megaspore divides mitotically to form two nuclei, which moves to the opposite poles forming 2 nucleus embryo sacs. Two more mitotic nuclear divisions occur

in two nuclei results the formation of 8 nucleate embryo sac. After this stage, cell walls are laid down leading to the organization of the typical female gametophyte or embryo sac. Six of the eight nuclei are surrounded by cell walls and organized into cells. Three cells present towards the micropylar and grouped together, constitute the egg apparatus. The egg apparatus, in turn consists of two synergids and one egg cell. 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.

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 angiospermic embryo sac, at maturity consists of 8 nuclei and 7 cells. This embryo sac is formed from the single megaspore, so called Monosporic embryo sac.

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

A.

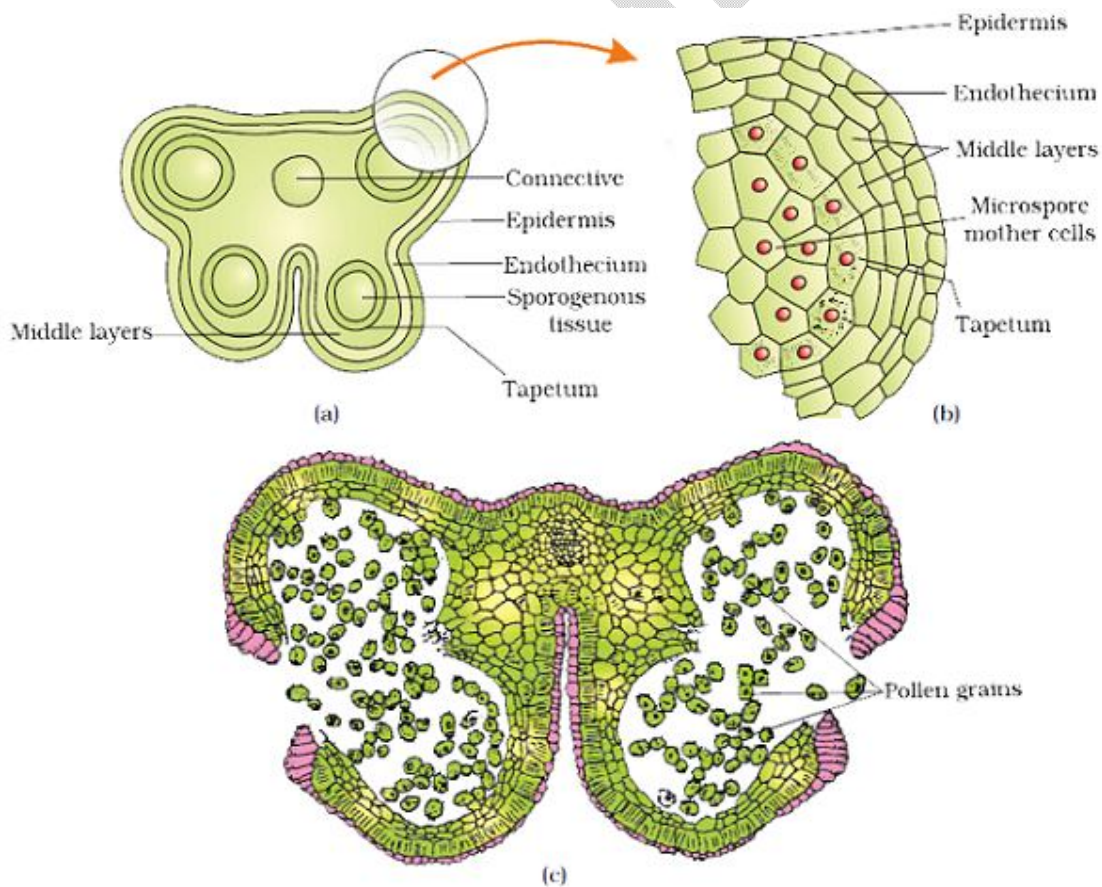


Figure (a) Transverse section of a young anther; (b) Enlarged view of one microsporangium showing wall layers; (c) A mature dehiscent anther

A typical angiospermic anther is bilobed with each lobe having two theca. The anther is a four sided structure consisting of four microsporangia located at the corners, two in each lobe.

In a transverse section, a typical microsporangium is circular in outline and is surrounded by four wall layers, the a) Epidermis b) Endothecium c) Wall Layers d) Tapetum.

a) **Epidermis:** The epidermis is one called thick, the cells present between the pollen sacs are thin walled and their region is called as stomium which is useful for the dehiscence of pollen sacs.

b) **Endothecium :** It is present below the epidermis and expands radically with fibrous thickenings, at maturity these cells loose water and contract and help in dehiscence of pollen sacs.

c) **Wall layers:** Beneath of endothecium, there are thin walled cells, arranged in one to five layers, which also help in dehiscence of anther.

d) **Tapetum :** The innermost wall layer is tapetum, the cells are large, with thin cell walls, abundant cytoplasm and have more than one nuclei. Tapetum is a nutritive tissue which 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?

A. Replacement of the normal sexual reproduction by asexual reproduction without fertilization is called apomixis. It does not mention meiosis. Replacement of the seed by a plant, or replacements of the flower by bulbils are types of apomixis. Apomictically produced offsprings are genetically identical to the parent plant. In flowering plants, apomixis is used in a restricted sense to mean angiosperms i.e., asexual reproduction through seeds. In some plant families, apomixis is common.

Ex : Asteraceae, Poaceae.

In some species, the diploid egg cell is formed without reduction division and develops into embryo without fertilization. It is an asexual reproduction in the absence of pollinators such as in extreme environments. In some species like citrus, some of the nuclear cells surrounding the embryo sac start dividing and develop into embryos.

If the megaspore mother cell does not enter meiosis and produces diploid embryo sac through mitotic divisions.

Importance: Apomixis does not involve meiosis. Hence segregation and recombination of chromosomes do not occur. It helps in the preserving desirable characters for indefinite periods.

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

6. Describe the process of fertilization in angiosperms?

Ans: After entering into the embryo sac, the pollen tube bursts and releases the two male gametes into the cytoplasm of the synergid. One of the male gametes moves towards the egg cell and the nucleus of the male cell fuses with egg nucleus, thus completing the syngamy or fertilization. This results in the formation of a diploid cell, the zygote. The other male gamete moves towards the two polar nuclei, located in the central cell and fuses with them to produce a triploid primary endosperm nucleus. In this, the fusion occurs between three nuclei so called Triple function. Since two types of fusions syngamy and triple fusion occurs in an embryo sac, the phenomenon is termed as double fertilization. The primary endosperm cells develop into endosperm while the zygote develops into an embryo.

