1 Sexual Reproduction in Flowering Plants

Fastrack Revision

- Plants can reproduce both sexually and asexually.
- Flower, which brings the reproductive organ of a plant, plays the most important role in the process of sexual reproduction.
- **Structure of a Flower**
  - **Stalk:** Holds the flower.
  - **Thalamus:** Swollen upper portion of stalk.
  - **Petal:** Coloured part of a flower which attracts insects.
  - **Sepal:** Ensures protection.
  - **Stamen:** Male reproductive organ which produces male gametes (pollen grains).
  - **Carpel:** Female reproductive organ which produces female gametes (ovum/egg).

A typical flower consists of four whorls which are:

- **Calyx**
  - Outermost whorl.
  - Members are termed as **'sepals'.**
  - Green coloured.
  - Protect the bud which later becomes a flower.
- **Corolla**
  - Whorl before calyx.
  - Members are termed as **'petals'.**
  - Bright coloured.
  - Attract insects for pollination.

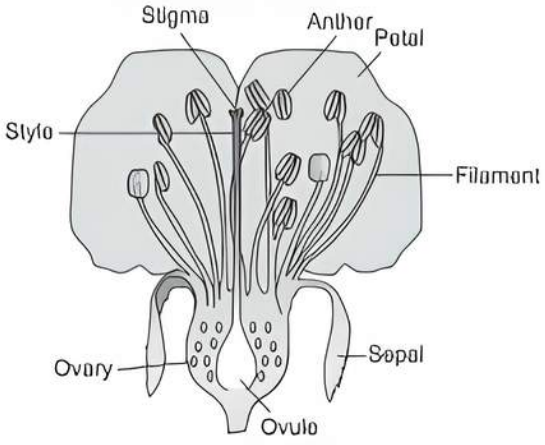

Fig. Longitudinal section of a flower

- **Androecium**
  - Inner whorl next to corolla.
  - Members are termed as **'stamens'.**
  - Male reproductive organ.
- **Gynoecium**
  - Innermost whorl.
  - Members are termed as **'carpels'.**
  - Female reproductive organ.

- **Pre-fertilisation Events in a Flower**

Events that take place before fertilisation are termed as pre-fertilisation events. Following events take place in a plant:

- **Gametogenesis**
  - Development of male and female reproductive structures.
  - Formation of male and female gametes.
- **Gamete Transfer**
  - Bringing together male and female gametes.
  - Pollination occurs in plants to facilitate gamete transfer.

- **Male Reproductive Structure in a Flower: Stamen**

Stamen is the male reproductive structure in a flower. The structure of a stamen consists of three important parts:

- **Filament**
  - Long and slender stalk that bears anthers.
- **Anther**
  - Terminal bi-lobed and dithecous structure at the tip of filament.
  - Each lobe has two pollen sacs/microsporangia located at the corners.
  - A total of four microsporangia are present in an anther.
  - Each microsporangium produce spores, which later develop into pollen grains.
- **Connective**
  - Part attached to the back of anther.

- **Structure of Microsporangium**

If the transverse section of a microsporangium is observed carefully, it appears circular in outline surrounded by four wall layers:

- Epidermis
- Endothecium
- Middle layers
- Tapetum

The first three layers ensure protection of the microsporangium, while the innermost layer, **tapetum**, provides nourishment to the developing pollen grains.

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Tapetum is of two types:

(i) Amoeboid tapetum is found in primitive angiosperms. *e.g. Typha*, *Alisma* etc.

(ii) Glandular tapetum is found in most of the flowering plants.

Sporogenous tissue is present at the centre of each microsporangium.

▸ **Microsporogenesis**

Microsporogenesis is the process of the formation of microspores from a pollen mother cell through meiosis. Microspores are formed inside microsporangium.

- ➤ Sporogenous cells differentiate to form meiocytes.
- ➤ Meiocytes undergo meiosis.
- ➤ Four haploid microspores are formed (Microspore tetrad).
- ➤ Microspores dissociate and develop to form pollen grains.
- ➤ Pollen grains are male gametophytes.

▸ **Pollen Grains**

Each pollen grain is a tiny spherical structure surrounded by two layers:

- ➤ **Exine**
  - Hard outer layer.
  - Composed of a resistant organic material, sporopollenin.
  - Has prominent apertures called germ pores with no sporopollenin.
- ➤ **Intine**
  - Thin and continuous inner layer.
  - Composed of cellulose and pectin.

Formation of a pollen grain from microspore involves the following changes:

- Expansion of the microspore.
- Formation of a large vacuole.
- Microspore nucleus displaced to an eccentric position against microspore wall.
- Nucleus undergoes first pollen mitosis.
- A large vegetative cell and a small generative cell are formed. This is the two-cell stage. In many plants, pollen grains are released at this two-celled stage. However, in some others, they are released at a three-celled stage.
- Generative cell detaches from pollen grain wall.
- Generative cell is engulfed by the vegetative cell.
- 'Cell within a cell' structure is formed.
- Generative cell again undergo mitosis.
- Two sperm cells (male gametes) are formed enclosed within the vegetative cell cytoplasm.

- ➤ **Characteristics of Vegetative and Generative Cell**
  - Vegetative cell is bigger in size, while the generative cell is smaller.
  - Vegetative cell has an irregularly shaped nucleus, while the generative cell is spindle-shaped with dense cytoplasm and a nucleus.
  - Vegetative cell is also termed as tube cell as it is responsible for growth of pollen tube.
  - Generative cell floats in the cytoplasm of vegetative cell.
- ➤ **Uses of Pollen Grains**
  - Rich in nutrients and so pollen tablets are used as food supplements.
  - Used as pollen banks in crop-breeding programmes.
- ➤ **Demerits of Pollen Grains**
  - Can cause chronic respiratory disorders.
  - Cause pollen allergy.

▸ **Female Reproductive Structure in a Flower: Carpel**

Carpel is the female reproductive structure in a flower. Flower with a single carpel is **monocarpellary** and that with more than one carpel is **multicarpellary**. Each carpel has three parts:

- ➤ **Ovary**
  - Basal enclosed part of carpel.
  - Ovarian cavity is present inside termed as **locule.**
  - Encloses ovule (megasporangium) in it.
  - Ovules are attached to cushion-like structure called **placenta**.
- ➤ **Style**
  - Tube-like structure that connects the ovary and stigma.
- ➤ **Stigma**
  - Located at the exposed end of style.
  - Acts as the receptive surface for pollen grains.

▸ **Megasporangium**

Megasporangium or ovule is the structure inside ovary where megaspore formation takes place.

The internal structure of the ovule consists of the following parts:

- ➤ **Funicle:** Stalk that attaches ovule to placenta.
- ➤ **Hilum:** Junction between ovule and funicle.
- ➤ **Integuments:** One or many protective envelopes around ovule.
- ➤ **Micropyle:** A small opening at the tip of integuments.
- ➤ **Chalaza:** Basal part of ovule opposite to the micropyler end.
- ➤ **Nucellus:** Mass of cells enclosed within integuments used for food storage.
- ➤ **Embryo Sac:** Female gametophyte located in nucellus.

▸ **Megasporogenesis**

Formation of megaspores is termed as Megasporogenesis. Megaspores are formed inside megasporangium.

- ➤ Ovule is an integumented megasporangium.

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- *Ovule having single integument is called unitegmic ovule. It is common in gamopetalae.*
- *Ovule having two integuments is called bitegmic ovule, e.g., members of polypetalae and monocots.*
- *When nucellus is not surrounded by integuments, the ovule is called ategmic, e.g., Santalum album, Loranthus.*

- ➤ Ovules differentiate to form one **Megaspore Mother Cell** (MMC).
- ➤ MMC undergoes meiosis.
- ➤ Four haploid megaspores are formed (Megaspore tetrad).
- ➤ One of these megaspores develops into **female gametophyte.** The other megaspores degenerate.
- ➤ Only the basal megaspore remains functional that develops into a female gametophyte *i.e.,* **embryo sac.**
- ➤ This process of formation of embryo sac from a single megaspore is termed as **monosporic development.**

Following changes lead to monosporic development:

- Nucleus undergoes mitotic division.
- Two-nucleate embryo sac is formed.
- Nuclei undergo mitotic division again.
- Four-nucleate embryo sac is formed.
- Nuclei undergo yet another mitotic division.
- Eight-nucleate embryo sac is formed.

- Cell wall formation takes place.
- Female gametophyte or embryo sac is formed.

The nuclei formed inside get rearranged to form the final structure of embryo sac as follows:

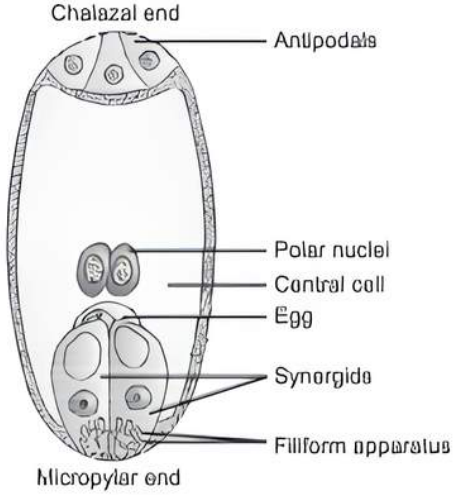

Fig. Mature embryo sac

- **Egg Apparatus**
  - 2 synergids, 1 egg cell
  - Located at micropylar end
- **Antipodals**
  - Three cells at basal end of ovule
  - Located at chalazal end
- **Central Cell**
  - Two polar nuclei fused together

▶ **Mature Embryo sac is 7-celled, but 8-nucleate**

- **Pollination**

Transfer of pollen grains from anther to stigma is termed as pollination. This transfer of pollen grains occurs with the help of pollinating agents like wind, water, insects, birds, etc.

There are different types of pollination:

- **Autogamy**
  - Transfer of pollen grains from anther to stigma of the same flower.
  - Seen in plants which produce **chasmogamous** and **cleistogamous** flowers.
  - **Chasmogamous Flowers:** Exposed anther and stigma.
  - **Cleistogamous Flowers:** Closed flower. Anther and stigma lie very close to each other *e.g., Viola* (common pansy), *Polygala.*
- **Geitonogamy**
  - Transfer of pollen grains from anther to stigma of another flower of same plant.
  - It is functionally cross-pollination, but genetically self-pollination.
- **Xenogamy**
  - Transfer of pollen grains from anther to stigma of a different plant.
  - Genetically as well as functionally cross-pollination.

▶ **Pollinating Agents**

Agents which carry pollen grains from anther to stigma of same/different plant are termed as pollinating agents. They are of two types:

- Biotic Agents
  - Living organisms which act as agents of pollination.
  - Insects, birds etc.
- **Abiotic Agents**
  - Non-living objects which act as agents of pollination.
  - Pollination occurs by chance.
  - Wind, water etc.

▶ **Pollination by Wind**

Pollen grains are carried by wind from anther to stigma. Wind pollination is very commonly seen in grasses. Characteristics of a plant pollinated by wind are:

- Light pollen grains.
- Non-sticky pollen grains.
- Well-exposed stamens.
- Large, feathery stigma.

▶ **Pollination by Water**

This is a less common mode of pollination. Water pollination can occur in a number of ways:

- Water acts as a medium for gamete transfer in lower plants *e.g.*, algae, bryophytes.
- Female flowers reach the water surface by a stalk where male gametes were already released *e.g., Vallisneria.*
- Male gametes are released inside water where flowers remain *e.g.,* Seagrass.

In water pollination, pollen grains are prevented from being wet by a mucilaginous covering.

▶ **Pollination by Insects**

Bees are the most common biotic pollinating agent. Not only insects, but some of the animals like rats, lizards, bats also help in pollination. Plants are specially adapted based on their pollinators. Therefore, not just any animal/ insect can pollinate a plant.

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- *Pollination by snails is called malacophily e.g., Arisaema, etc.*
- *Pollination by ants is called myrmecophily e.g., some members of family Rubiaceae.*

Some of the factors that attract insects are attractive colour of the flower, fragrance and nectar. In some cases, the insect and the plant exhibit a mutual relationship. For example, the *Yucca*-moth relationship is a mutual one. The insect moth helps in pollinating the *Yucca* flower, whereas the flower provides a space in its locule for the moth to lay eggs. The larvae feed on the *Yucca* seed within the fruit.

▶ **Pollen-Pistil Interaction**

The pollen landing on stigma of pistil might be compatible or incompatible with the stigma. Therefore, the acceptance or rejection of the pollen by stigma depends on the compatibility and is mediated by chemical components of the pollen interacting with those of pistil.

If the pollen and pistil are compatible with each other, following events will take place:

- Pistil accepts pollen.
- Formation of pollen tube occurs.
- Pollen tube reaches ovary.
- Pollen grains move into pollen tube.
- Pollen tube enters ovule through micropyle.
- Pollen tube enters a synergid through filiform apparatus.
- Fertilisation occurs.

On the other hand, if the pollen and pistil are incompatible with each other, following events will take place:

- Pistil rejects pollen.
- Prevents pollen tube growth.
- Prevents fertilisation.

Thus, pollen-pistil interaction is a dynamic process of pollen recognition followed by promotion or inhibition of the pollen. Chemical components of the pollen interact with those of the pistil in this interaction.

Artificial Hybridisation

Knowledge on pollen-pistil interaction helps in crossing different species/genera to produce commercially superior varieties, the technique which is now known as artificial hybridisation.

Artificial hybridisation is the process in which only desired pollen grains are used for pollination and fertilisation. Artificial hybridisation is achieved using the following techniques:

- **Emasculation**
  - Removal of anthers from bisexual flowers of female parent plant.
  - This is done before anthers mature.
  - Prevents self-pollination.
- **Bagging**
  - Covering the emasculated flower to prevent contamination.
  - Prevents contamination of stigma with unwanted pollen.
  - Desired pollen grains are dusted on stigma.
  - Flowers are bagged again and the fruits allowed to develop.

Fertilisation

Fusion of male and female gametes is termed as fertilisation. In a flowering plant, two male gametes enter into the cytoplasm of synergid through the micropylar end of ovule. These two male gametes undergo fusion inside the ovule as follows:

- **Syngamy**
  - One male gamete fuses with egg cell.
  - A diploid cell, zygote is formed.
  - Zygote later develops into embryo.
  - This fusion is termed as syngamy.
- **Triple Fusion**
  - Other male gamete fuses with two polar nuclei in the central cell.
  - A triploid **Primary Endosperm Cell** (PEC) is formed.
  - PEC later develops into endosperm.
  - This fusion is termed as triple fusion as three haploid nuclei fuse together.

Antipodal Cells Degenerate, Synergids Degenerate

Since two types of fusion take place inside the embryo sac, therefore this fertilisation is said to be **double fertilisation** in flowering plants.

Post-fertilisation Events in a Flowering Plant

Events which take place in a flowering plant after double fertilisation are termed as post-fertilisation events. Important post-fertilisation events are:

- Development of endosperm from PEC
- Development of embryo from zygote
- Development of seed from ovule
- Development of fruit from ovary

Endosperm

Primary Endosperm Cell (PEC) formed as a result of triple fusion undergoes repeated divisions and a triploid endosperm tissue is formed. The main purpose of endosperm is to provide nutrition to the developing embryo.

- Endosperm can be free-nuclear or cellular. Free-nuclear endosperm is the most common type of endosperm development. The best example to understand is the tender coconut.
- In a tender coconut, water present inside is the free-nuclear endosperm. Multiple nuclei float in this highly nutritious clear fluid. Gradually cell walls develop enclosing several nuclei. These cells and nuclei start settling at the periphery, and layers of cellular endosperm start appearing. Therefore, in a completely mature coconut, water turns milky surrounded by cellular part, kernel and it does not contain free nuclei.
- Based on the presence or absence of endosperm, seeds are classified into two types:

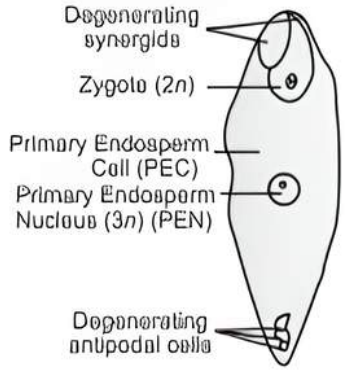


Fig. Fertilised embryo sac

1. Endospermic Seeds

- Seeds which have endosperm.
- Albuminous seeds.
- **Examples:** wheat, rice.

2. Non-endospermic Seeds

- Seeds which lack endosperm at maturity.
- Non-albuminous seeds.
- **Examples:** pea, bean.

Embryo

- Embryo is a diploid cell developing from zygote. It starts to develop at the micropylar end. Development of zygote to form embryo starts only after endosperm formation has started. This is because endosperm provides nutrition needed for the embryo to develop.
- Stages of embryo development are same in both monocot and dicot embryo.
- **Embryogeny:** It refers to the early stages of embryo development. The embryo development starts with the fertilised egg (zygote), then passes through the 2-cell stage, 8-cell stage, globular, heart shaped stage, torpedo stage and finally the mature embryo.
- The structure of a dicotyledonous embryo is little different from that of a monocotyledonous embryo.
- **Dicotyledonous Embryo:** It has the following important parts:

1. **Embryonal Axis**
   - Main axis of the embryo which divides it into different regions.
2. **Cotyledons**
   - Seed leaves.
   - Helps in food storage.
   - Provide nourishment to the developing radicle and plumule.
3. **Epicotyl**
   - Part of embryonal axis above the cotyledons.
   - Terminates at plumule or stem tip.
4. **Hypocotyl**
   - Part of embryonal axis below the cotyledons.
   - Terminates at radicle or root tip.
5. **Plumule:** Stem tip.
6. **Radicle:** Root tip.
7. **Root Cap:** Covering of root tip.

➤ **Monocotyledonous Embryo:** It has the following important parts:

1. **Embryonal Axis:** Main axis of the embryo which divides it into different regions.
2. **Cotyledon**
   - Only one seed leaf exists.
   - Termed as scutellum.

➤ Located at one side of embryonal axis.

3. **Plumule:** Shoot tip.
4. **Radicle:** Root tip.
5. **Coleorrhiza:** Sheath enclosing radicle and root cap.
6. **Coleoptile:** Sheath enclosing plumule and a few leaf primordial enclosed in a hollow foliar structure.

▸ Seed

Seed is a fertilised ovule. Integuments of ovule harden to form seed coat, however, micropyle is still present on the seed coat.

➤ Basic structure of a seed consists of the following parts:
   - **Seed Coat:** Hard outer covering of the seed.
   - **Radicle:** Root tip which later gives rise to the entire root system.
   - **Plumule:** Shoot tip which later gives rise to the entire shoot system.
   - **Cotyledons:** Seed leaves.

➤ Based on the number of cotyledons, there are two types of seeds:
   - **Dicotyledonous Seed:** Seed with 2 cotyledons.
   - **Monocotyledonous Seed:** Seed with 1 cotyledon.

➤ A dicotyledonous seed has the following important parts:

1. **Seed Coat**

Outer covering of the seed which is composed of two layers:
   - **Testa:** Thick outer layer.
   - **Tegmen:** Thin inner layer.

2. **Hilum:** Scar on seed coat through which the seed was attached to the fruit.
3. **Micropyle:** A small pore in the seed coat through which oxygen and water exchange occurs during seed germination.
4. **Cotyledons**
   - Seed leaves.
   - Thick and swollen due to food storage.
   - Provide nourishment to the developing radicle and plumule.
5. **Radicle:** Embryonic root.
6. **Plumule:** Embryonic shoot.

➤ A monocotyledonous seed has the following important parts:

1. **Seed Coat**
   - Fused with pericarp.
   - Bulky part within which lies the small embryo.
   - Massive and starchy endosperm.
   - Aleurone layer.
   - Special tissue surrounding the endosperm.
2. **Cotyledon**
   - Single cotyledon termed as **scutellum.**
   - In contact with endosperm through an epithelial layer.
3. **Plumule:** Embryonic shoot covered by protective layer **coleoptile.**
4. **Radicle:** Embryonic root covered by protective layer **coleorrhiza.**

➤ **Advantages of Seeds:** Seeds are extremely useful in agriculture. Some of the important advantages of seeds are:
   - Help plant species to be colonized in different areas.
   - Provide nourishment to young seedlings.
   - Ensure protection to the young embryo.
   - Results in variations with new genetic combinations.
   - Can be easily stored for future usage.
   - Long term viability of most of the seeds.

▸ Apomixis and Polyembryony

➤ **Apomixis** is a mechanism to produce seeds without fertilisation. This mechanism produces clones, hence, can be considered as a form of asexual reproduction.

➤ Apomixis can occur in a number of ways, some of which are mentioned below:
   - Nucellar cells which are diploid and located outside the embryo sac continuously divide and enter inside embryo sac and later develop into embryos. In this way, multiple embryos can exist inside one ovule. This is termed as **polyembryony.** It is seen commonly in *Citrus*, Mango, etc.
   - Sometimes, the egg cell is not formed as a result of reduction division, hence, it is diploid. This diploid egg cell later directly develops into an embryo.

➤ Apomixis is extremely useful these days because of the following reasons:
   - Clonal reproduction through seeds.
   - New hybrids produced in lesser time.
   - Disease free plants can be produced.
   - Cost-effective.

▸ Parthenocarpy

➤ It is the formation of fruit without fertilisation (Nitsch, 1965).

➤ Parthenocarpy is of three types: genetic, environmental and chemically induced.

➤ **Genetic Parthenocarpy:** It is due to genetic alternation caused by mutation or hybridisation. It is also called natural parthenocarpy, *e.g.*, navel orange, banana, pineapple, grapes, pear, etc.

➤ **Environmental Parthenocarpy:** Low temperature, frost and fog have been known to induce parthenocarpy in a number of plants, *e.g.*, pear, olive, capsicum, tomato, etc.

- **Chemically Induced Parthenocarpy:** Spray or paste of auxins and gibberellins has been found to induce parthenocarpy in several plants, *e.g.*, tomato, cucurbits, *Citrus*, fig, etc.

▶ **Significance of Seed Dispersal and Fruit Formation**

- The scattering of seed away from the parent plant is called seed dispersal.
- Seed dispersal is a must for plants because:
  - Plants are fixed.
  - It helps in spreading the plants far and wide throughout the area of favourable climate.
  - Dispersal forms a mixed population where competition for the same resources is less.
  - Dispersed plants have higher chances of cross pollination.
  - It provides protection against drought, epidemic spread of a disease and pest in an area.
- Formation of fruit has provided added advantage to angiosperms:
  - Fruit protects the seeds in their delicate developmental stage.
  - Many fruits help the seeds in their dispersal.
  - Seed germination is facilitated by remains of the fruit.
  - Fleshy edible parts of fruits are a source of food and energy.

Practice Exercise

Multiple Choice Questions

Q 1. Cleistogamous flowers are self-pollinated because: *(CBSE 2020)*

a. they are bisexual flowers which do not open at all
b. they are bisexual and open flowers
c. they are unisexual
d. their stigma matures before the anthers dehisce

Q 2. Development of haploid plants from pollen is:

a. emasculation b. parthenocarpy
c. androgenesis d. somatic hybridisation

Q 3. The structure of bilobed anther consists of: *(CBSE SQP 2021, Term-1)*

a. 2 thecae, 2 sporangia b. 4 thecae, 4 sporangia
c. 4 thecae, 2 sporangia d. 2 thecae, 4 sporangia

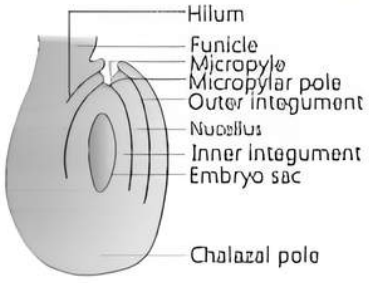
Q 4. Pollen grains are well preserved as fossils because of presence of: *(CBSE SQP 2021, Term-1)*

a. sporopollenin b. cellulose
c. lignocellulose d. pectocellulose

Q 5. Commonly in a mature fertilised ovule n, 2n, 3n conditions are respectively found in: *(CBSE SQP 2021, Term-1)*

a. antipodal, zygote and endosperm
b. zygote, nucellus and endosperm
c. endosperm, nucellus and zygote
d. antipodals, synergids and integuments

Q 6. In the figure of anatropous ovule given below, choose the correct option for the characteristic distribution of cells within the typical embryo sac. *(CBSE SQP 2021, Term-1)*



	Number of cells at chalazal end	Number of cells at micropylar end	Number of nuclei left in central cell
a.	3	2	3
b.	3	3	2
c.	2	3	3
d.	2	2	4

Q 7. After fertilisation, ovule develops into:

a. integument b. seed
c. embryo d. endosperm

Q 8. An orthotropous ovule is one in which micropyle and chalaza are:

a. oblique to funiculus
b. at right angles to funiculus
c. in straight line with funiculus
d. parallel to funiculus

Q 9. Stalk of ovule is called:

a. funicle b. caruncle
c. nucellus d. pedicel

Q 10. Enclosed within the integuments of a typical anatropous ovule is a diploid mass of cellular tissue known as: *(CBSE 2021, Term-1)*

a. megaspore mother cell b. nucellus
c. synergids d. embryo sac

Q 11. The aquatic plant having long and ribbon like pollen grains is: *(CBSE 2021, Term-1)*

a. *Vallisneria* b. *Hydrilla*
c. *Eichhornia* d. *Zostera*

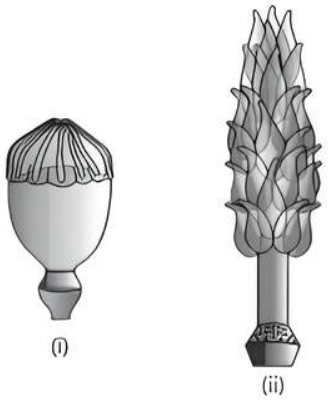
Q 12. Pollen grains retain viability for months in plants belonging to different families given below: *(CBSE 2021, Term-1)*

(i) Solanaceae **(ii) Leguminosae**
(iii) Gramineae **(iv) Rosaceae**
(v) Liliaceae

The correct option is :

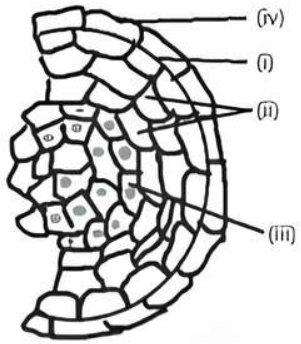
a. (i), (ii) and (v) b. (i), (ii) and (iv)
c. (ii), (iv) and (v) d. (i), (iii) and (v)

Q 13. Which condition of gynoecium (pistil) is shown in the figures (i) and (ii)? *(CBSE 2021, Term-1)*



a. (i) multicarpellary apocarpous
   (ii) multicarpellary syncarpous
b. (i) multicarpellary syncarpous
   (ii) multicarpellary apocarpous
c. (i) bicarpellary apocarpous
   (ii) bicarpellary syncarpous
d. (i) bicarpellary syncarpous
   (ii) bicarpellary apocarpous

Q 14. In the transverse section of a young anther shown below, identify the correct sequence of wall layers from outside to inside: *(CBSE 2021, Term-1)*



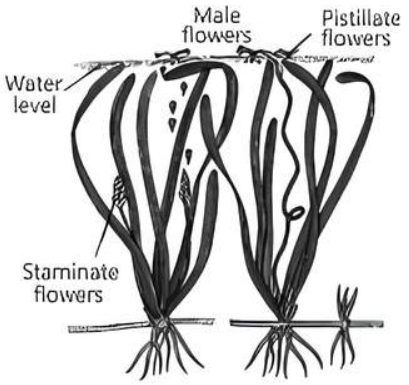
	(I)	(II)	(III)	(Iv)
a.	Middle layers	Endothecium	Epidermis	Tapetum
b.	Tapetum	Middle layers	Endothecium	Epidermis
c.	Epidermis	Endothecium	Middle layers	Tapetum
d.	Endothecium	Middle layers	Tapetum	Epidermis

Q 15. Pollination by bats is called:
a. Ornithophily b. Entomophily
c. Chiropterophily d. Hydrophily

Q 16. A typical angiospermic embryo sac is usually:
a. one-celled b. two-celled
c. five-celled d. seven-celled

Q 17. How many meiotic divisions are necessary to produce 100 pollen grains?
a. 100 b. 50 c. 25 d. 20

Q 18. In the dioecious aquatic plant shown, identify the characteristics of the male flowers that reach the female flowers for pollination: *(CBSE SQP 2021, Term-1)*



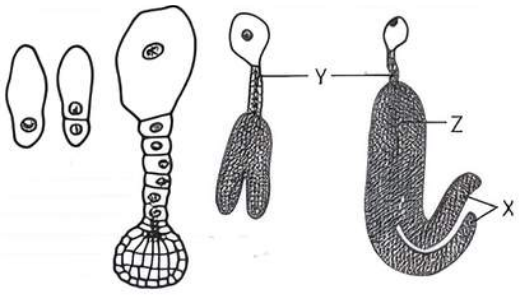
	Size of the flower	Colour of flower	Characteristic feature of pollen grain
a.	small	brightly coloured	Light weight and non-sticky
b.	large	colourless	large and sticky
c.	small	white	small, covered with mucilage
d.	large	colourless	non sticky

Q 19. The thalamus contributes to the fruit formation in: *(CBSE SQP 2021, Term-1)*
a. banana b. orange
c. strawberry d. guava

Q 20. A botanist studying *Viola* (common pansy) noticed that one of the two flower types withered and developed no further due to some unfavourable condition, but the other flower type on the same plant survived and it resulted in an assured seed set. Which of the following will be correct? *(CBSE SQP 2021, Term-1)*
a. The flower type which survived is cleistogamous and it always exhibits autogamy.
b. The flower type which survived is chasmogamous and it always exhibits geitonogamy.
c. The flower type which survived is cleistogamous and it exhibits both autogamy and geitonogamy.
d. The flower type which survived is chasmogamous and it never exhibits autogamy.

Q 21. To overcome incompatible pollinations so as to get desired hybrids, a plant breeder must have the knowledge of ..... *(CBSE 2021, Term-1)*
a. pollen — nucellar interaction
b. pollen — egg cell interaction
c. pollen — pistil interaction
d. pollen — embryo sac interaction

Q 22. Choose the correct labellings for the parts X, Y and Z in the given figure of the stages in embryo development in a dicot: *(CBSE 2021, Term-1)*



a. X is suspensor, Y is radicle and Z is cotyledon
b. X is radicle, Y is cotyledon and Z is suspensor
c. X is cotyledon, Y is suspensor and Z is radicle
d. X is zygote, Y is radicle and Z is cotyledon

Q 23. Which of the following outbreeding devices are used by majority of flowering plants to prevent inbreeding depression?

(i) Pollen release and stigma receptivity are not synchronised.
(ii) Different positions of anther and stigma.
(iii) Production of different types of pollen grains.
(iv) Formation of unisexual flowers along with bisexual flowers.
(v) Preventing self-pollen from fertilising the ovules by inhibiting pollen germination.

(CBSE 2021, Term-1)

a. (i), (ii) and (v) b. (ii), (iii) and (v)
c. (i), (iii) and (v) d. (iii), (iv) and (v)

Q 24. The coconut water from tender coconut is:

(CBSE SQP 2021, Term-1)

a. cellular endosperm
b. free-nuclear endosperm
c. Both cellular and nuclear endosperm
d. free nuclear embryo

Q 25. Floral reward's provided by insect pollinated flowers to sustain animal visit is/are:

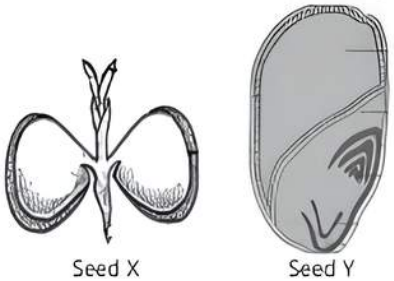
(CBSE 2021, Term-1)

a. nectar and fragrance
b. nectar and pollen grains
c. pollen grains and fragrance
d. fragrance and bright colour

Q 26. Double fertilisation means:

a. fusion of two eggs.
b. fusion of nucleus of male gamete with the egg nucleus.
c. fusion of two polar nuclei with one male gamete.
d. fusion between synergid cells and male gamete.

Q 27. Which of the following statements are true related to seed X and Y? *(CBSE SQP 2021, Term-1)*



Seed X Seed Y

(i) Seed X is dicot and endospermic or albuminous.
(ii) Seed X is dicot and non-endospermic or non-albuminous.
(iii) Seed Y is monocot and endospermic or albuminous.
(iv) Seed Y is monocot and non-endospermic or non-albuminous.

Choose the correct option with respect to the nature of the seed.

a. (i), (iii) b. (ii), (iii) c. (i), (iv) d.(ii), (iv)

Q 28. In a typical dicotyledonous embryo, the portion of embryonal axis above the level of cotyledons is:

(CBSE 2021, Term-1)

a. plumule b. coleoptile
c. epicotyle d. hypocotyle

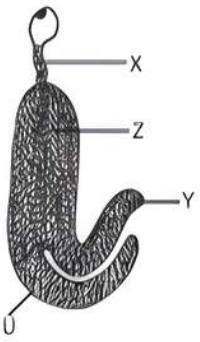
Q 29. Remnants of nucellus are persistent during seed development in: *(CBSE SQP 2023-24)*

a. pea b. groundnut
c. wheat d. black pepper

Q 30. The wall layer of microsporangium which nourishes the pollen grain is: *(CBSE SQP 2023-24)*

a. epidermis b. endothecium
c. middle layers d. tapetum

Q 31. Select the option that shows the correctly identified 'U', 'X', 'Y' and 'Z' in a developing dicot embryo. *(CBSE 2023)*



a. X — Plumule ($2n$), Y — Suspensor (n), Z — Cotyledon ($2n$), U — Radicle ($2n$).
b. X — Plumule ($2n$), Y — Suspensor ($2n$), Z — Radicle ($2n$), U — Cotyledon ($2n$).
c. X — Suspensor ($2n$), Y — Cotyledon ($2n$), Z — Radicle ($2n$), U — Plumule ($2n$).
d. X — Cotyledon ($2n$), Y — Radicle (n), Z — Plumule (n), U — Suspensor (n).

Assertion & Reason Type Questions

Directions (Q.Nos. 32-37): *Each of the following questions consists of two statements, one is Assertion (A) and the other is Reason (R). Select the correct answer to these questions from the codes a, b, c and d as given below.*

a. Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
b. Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c. Assertion is true but Reason is false.
d. Assertion is false but Reason is true.

Q 32. Assertion (A): Angiospermic flowers perform the function of sexual reproduction.
Reason (R): The male and female reproductive structures are found in the flowers.

Q 33. Assertion (A): Nuclear endosperm is formed by subsequent nuclear division without wall formation.
Reason (R): Coconut is an example of such endosperm, where the endosperm remains nuclear throughout the development of the fruit.

Q 34. Assertion (A): Chasmogamous flowers require pollinating agents.
Reason (R): Cleistogamous flowers do not expose their sex organs.

Q 35. Assertion (A): The two cotyledons in seed are embryonic leaves.
Reason (R): The embryo contains radicle and plumule.

Q 36. Assertion (A): Many plants are propagated vegetatively even though they bear seeds.
Reason (R): Potatoes multiply by tubers and apple by cutting.

Q 37. Assertion (A): Primary endosperm nucleus is diploid.
Reason (R): It is the product of double fertilisation.

(CBSE SQP 2023-24)

Answers

1. (a) they are bisexual flowers which do not open at all
Cleistogamy is the phenomenon, where flowers never open and in such flowers, only self-pollination occurs within the bud (unopen flower). Bisexual flowers which do not open at all are called cleistogamous. In such flowers, anthers and stigma lie close to each other. When the anthers dehise in the flower buds, pollen grains come in contact with the stigma and pollination occurs.

2. (c) androgenesis
Pollen culture is a technique of production of haploid plants by the culture of pollen grains obtained from an anther of a plant under the aseptic condition on artificial media of known composition. It is also known as androgenesis because it involves the culture of male gametophyte of the plant. The technique was discovered by Guha and Maheshwari.

3. (d) 2 thecae, 4 sporangia
Anther is a bilobed and tetragonal structure. It is dithecous because each anther lobe has two chambers or thecae and long and cylindrical pollen sacs or microsporangia are present in the two chambers of an anther lobe. Hence, we can say that a bilobed anther is tetrasporangiate. The four microsporangia are located at the four corners and they are arranged parallelly to one another. Thus, the structure of bilobed anther consists of 2 thecae and 4 sporangia.

4. (a) sporopollenin
Pollen grains are well preserved as fossils because of the presence of sporopollenin. Pollen grains have a prominent two-layered wall. The hard outer layer called the exine is made up of sporopollenin which is one of the most resistant organic material known.

5. (a) antipodal, zygote and endosperm
Angiosperms or flowering plants are characterised by the process of double fertilisation. It involves the fusion of one male gamete (n) with egg (n) resulting in the formation of a diploid zygote ($2n$). The other male gamete (n) fuses with a secondary nucleus ($2n$) to form a triploid endosperm ($3n$) respectively. So in a fertilised ovule, n, $2n$ and $3n$ conditions occur respectively in antipodal, zygote and endosperm nucleus.

6. (b) 3, 3, 2
In an anatropous ovule, there are 3 cells in chalazal end, 3 in the micropylar end and 2 nuclei are present in the central cell of the typical embryo sac.

7. (b) seed

8. (c) in straight line with funiculus

9. (a) funicle

10. (b) nucellus
Enclosed within the integuments is a mass of cells called nucellus. It encloses the embryo sac. They have abundant food reserves and therefore act as nutritive tissues for the embryo in some plants.

11. (a) *Vallisneria*

12. (b) (i), (ii) and (iv)
In dicot families like Solanaceae, Rosaceae and Leguminosae the viability of pollen grains remain months together after their release.

13. (b) (i) multicarpellary syncarpous
(ii) multicarpellary apocarpous

14. (d) (i) Endothecium, (ii) Middle layers
(iii) Tapetum (iv) Epidermis

15. (c) Chiropterophily

16. (d) seven-celled

17. (c) 25
Meiotic divisions are responsible for gamete formation. Pollen grains are microscopic bodies that contain the male reproductive cell of plant.
1 meiotic division produces = 4 pollen grains.
To produce 100 pollen grains = meiotic divisions required are $= \frac{100}{4} = 25$.

18. (c) small, white, small covered with mucilage
In the given dioecious aquatic plant, the characteristics of the male flowers are:
Size of the flower — small
Colour of flower — white
Characteristic feature of pollen grain — small covered with mucilage.

19. (c) strawberry
Thalamus is the globular part of the stem from where the parts of the flower grow. This thalamus may sometimes contribute to the formation of fruit in strawberry.

20. (a) The flower type which survived is cleistogamous and it always exhibits autogamy.

21. (c) pollen — pistil interaction

22. (c) X is cotyledon, Y is suspensor and Z is radicle.

23. (a) (i), (ii) and (v)

24. (b) free-nuclear endosperm

Tender coconut water is a clear liquid found inside of the young tender coconut. During the nuclear phase of development, it provides as a termination for the endosperm of the coconut. In the nuclear endosperm formation, free-nuclear divisions are repeatedly done. If a cell wall is developed it will form after free nuclear divisions. Commonly referred to as liquid endosperm. Coconut water from a tender coconut is an example of this process *i.e.*, free nuclear endosperm.

25. (b) nectar and pollen grains

26. (c) fusion of two polar nuclei with one male gamete.

27. (a) (i), (iii)

28. (c) epicotyle

29. (d) black pepper

30. (d) tapetum

31. (c) X—Suspensor (2*n*), Y—Cotyledon (2*n*), Z—Radicle (2*n*), U—Plumule (2*n*).

32. (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Angiospermic flowers perform the process of sexual reproduction. This is because they contain the male and female sex organs of the plant.

33. (c) Assertion is true but Reason is false.

In free nuclear or nuclear type of endosperm, first and further divisions of primary endosperm nucleus are not followed by cytokinesis or wall formation and thus these free nuclear divisions lead to formation of a large number of free nuclei in embryo sac. This type of endosperm formation is observed in coconut. Here the primary endosperm nucleus undergoes a number of free nuclear divisions. When the fruit is about 50 mm long the embryo sac remains filled with a watery fluid or milk containing free nuclei and fine cytoplasmic particles. At a later stage when the fruit becomes about 100 mm in length the liquid shows in addition to free nuclei, several cells each enclosing variable number of nuclei. Thus coconut has multicellular endosperm (called coconut meat) in the outer part and free nuclear as well as vacuolate endosperm (called coconut milk) in the centre.

34. (b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

Flowers that have open petals such that the reproductive organs are exposed to allow cross-pollination. Therefore, chasmogamous flowers require pollinating agents to facilitate and ensure transfer of pollens. For example, wind, insect, water and animals serve as pollinating agents. The chasmogamous flowers are large, conspicuous colourful flowers with nectar/scent to attract pollinators. This makes Assertion correct. Flowers that remain close to avoid cross pollination and exhibit modifications to facilitate self-pollination are referred to as cleistogamous flowers. They are small, bisexual, colourless flowers and do not secrete nectar; the adaptations to facilitate self-pollination.

35. (b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

36. (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

The most common form of asexual reproduction in plants is called vegetative propagation. It is the formation of new plants from vegetative units (propagules) such as buds, tubers, rhizomes, roots, stem, leaf etc. Besides the natural method of vegetative propagation, there are a number of techniques for artificial vegetative propagation of economically and aesthetically important plants. Potatoes are produced by tubers and not by seeds. Stem tubers are found in potato and artichoke. They have buds in the region of nodes or eyes for vegetative multiplication. Root cuttings are used in propagation of lemon, apple, orange, blackberry etc.

37. (d) Assertion is false but Reason is true.

Case Study Based Questions

Case Study 1

Microsporangium

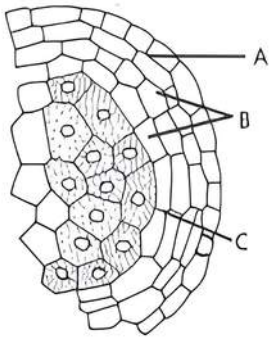
The anther is a four-sided structure consisting of four microsporangia located at the corners two in each lobe. The microsporangia develop further and become pollen sacs. In a transverse section, a typical microsporangium appears near circular in outline. It is generally surrounded by four wall layers–the epidermis, endothecium, middle layers and the tapetum.

Q 1. A dithecous anther consists of (A) ..... microsporangia, (B) ..... in each lobe.

Select the option that correctly fills the blanks.

	A	B
a.	four	two
b.	two	one
c.	two	two
d.	four	one

Q 2. The given diagram shows microsporangium of a mature anther. Identify A, B and C.



a. A-Middle layer B-Endothecium C-Tapetum

b. A-Endothecium B-Tapetum C- Middle layer

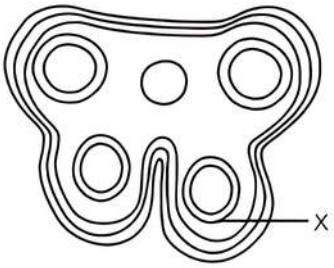
c. A-Endothecium B-Middle layer C-Tapetum

d. A-Tapetum B-Middle layer C-Endothecium

Q 3. The labelled part X is:

a. dehiscence b. endothecium

c. epidermis d. tapetum



Q 4. Select the incorrect statement:

a. Microsporangium is generally surrounded by four wall layers-epidermis, endothecium, middle layers and tapetum.

b. Outer three layers perform functions of protection and dehiscence of anthers.

c. Cells of tapetum possess dense cytoplasm and generally have more than one nucleus.

d. Cells of tapetum undergo meiosis and produce microspore tetrads.

Q 5. Which function of tapetum is correct?

a. Helps in pollen wall formation.

b. Transportation of nutrients to inner side of anther.

c. Synthesis of callase enzyme for separation of microspore tetrads.

d. All of the above

Answers

1. (a) **2.** (c) **3.** (d) **4.** (d) **5.** (d)

Case Study 2

Pollen-Pistil Interaction

Pollen-pistil interaction is the group of events that occur from the time of pollen deposition over the stigma to the time of pollen tube entry into ovule. It is a dynamic process which has checks at several places for promotion or inhibition of pollen growth. Pollen-pistil interaction is a safety measure to ensure that illegitimate crossings do not occur. Compatibility and incompatibility of the pollen-pistil is determined by special proteins.

The compatible pollens are able to absorb water and nutrients from the surface of the stigma. They germinate and produce pollen tubes. Pollen tubes grow into the style. Their growth and path through the style are also determined by specific chemicals.

Q 1. Which of the following parts of gynoecium determines the compatible nature of pollen?

a. Stigma b. Style

c. Ovary d. Thalamus

Q 2. In *Trifolium*, which type of self-incompatibility is found?

a. Gametophytic Self-Incompatibility (GSI)

b. Sporophytic Self-Incompatibility (SSI)

c. Both GSI and SSI

d. None of the above

Q 3. Select the incorrect statement:

a. In Asteraceae, incompatibility is due to the genotype of the sporophytic stigmatic tissues.

b. In members of Brassicaceae, incompatibility is due to the genotype of the pollen.

c. Nature has imposed self-incompatibility to avoid highly homozygous individuals which have a very low survival value.

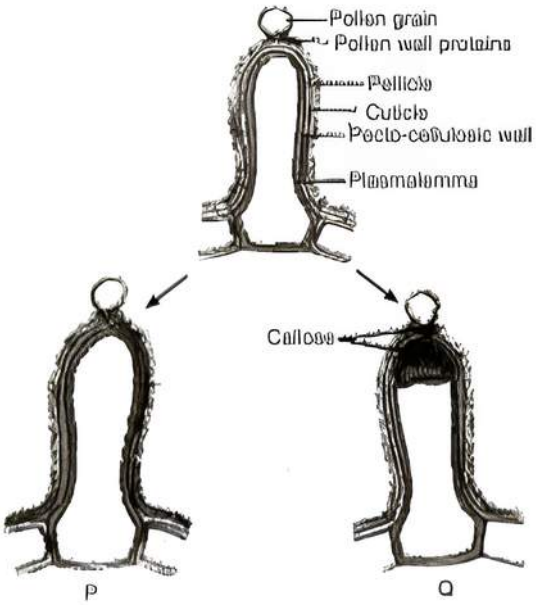
d. None of the above

Q 4. Which of the following are examples of self-incompatibility?

a. Tobacco b. Potato

c. Crucifers d. All of these

Q 5. Given figures show the pollen-stigma interaction, where pollen wall proteins are released onto the pellicle of stigmatic papillae, where recognition reaction occurs.



Which of the following statements drawn from given figures is incorrect?

a. P indicates compatible reaction in which the pollen tube penetrates the cuticle and grows down the papilla.

b. Development of callose plug between the plasma membrane and pectocellulosic layer of stigmatic papillae results in the incompatibility reaction in Q.

c. A callose plug which appears at the tip of pollen in Q, is dissolved by callose enzyme secreted by stigma resulting in compatibility reaction.

d. Deposition of callose can be employed as a reliable bioassay to detect compatibility or incompatibility reactions of pollen and stigma.

Answers

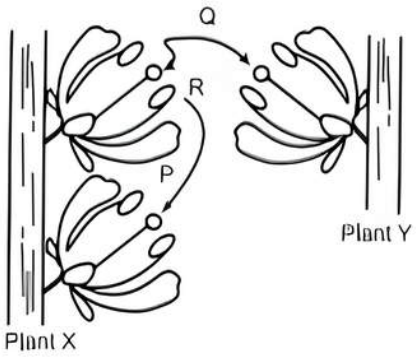
1. (a) **2.** (a) **3.** (b) **4.** (d) **5.** (c)

Case Study 3

Pollination

In angiosperms, the pollen grains are being transferred from the anther to the stigma and is termed pollination. This phenomenon was first discovered by Camerarius (1694) in the end of seventeenth century. Pollen grains are immobile. They can not reach the stigma by themselves. An external agent is required for this. The pollination is mainly of two types—self-pollination and cross pollination.

The diagram given below shows two plants of the same species showing different types of pollination.



Read the given passage carefully and give the answer of the following questions:

Q 1. What do you mean by pollination?

Ans. Transfer of pollen grain from the anther to the stigma of the carpel is called pollination.

Q 2. Who discovered pollination phenomenon?

Ans. The phenomenon was first discovered by Camerarius in 1694.

Q 3. What is transferred between the plants in the process indicated by arrow P?

Ans. Here, transfer of pollen takes place.

OR

Write the name of processes P, Q and R indicated in the above figure.

Ans. P : Geitonogamy

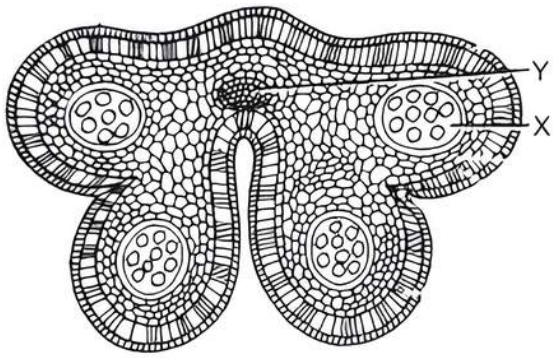
Q : Xenogamy

R : Autogamy

Case Study 4

Pollination By Insects

Many adaptations are found in flowers to achieve certain kind of pollination. The pollination achieved by insects is known as entomophily. The given diagram shows the cross-section of an anther of an insect pollinated flower.



Read the given passage carefully and give the answer of the following questions:

Q 1. What are the functions of structure Y?

Ans. The functions of structure Y are:

(i) To transport food and mineral salts to the anther.

(ii) To supply water to the anther.

Q 2. How can you accurately describe the structures found in compartment X?

Ans. The structures found in compartment X contain two haploid nuclei resulting from mitosis.

Q 3. What are the likely characteristics of the structures found in X and stamens of this plant?

Ans. The structures found in X have rough surfaces and stamens of this plant are non-pendulous.

OR

Give some examples of insect pollinated plants.

Ans. Rose, papaya, sunflower, lotus, etc., are some examples of insect pollinated plants.

Case Study 5

Cross Pollination

Cross pollination is the transfer of pollen grains from the anther of one flower to the stigma of a genetically different flower. It is performed with the help of an external agency which may be abiotic (*e.g.*, wind, water) or biotic (*e.g.*, insects, birds, bats, snails).

Read the given passage carefully and give the answer of the following questions:

Q 1. What is the most likely reason for non-germination of pollen grain?

Ans. The most likely reason for non-germination of pollen grain is that it comes from a flower of an incompatible species.

Q 2. What is the function of the pollen tube?

Ans. Pollen tube acts as a conduit to transport male gametes from the stigma to the ovule.

Q 3. What is entomophily?

Ans. Pollination of a flower in which the pollen is carried by an insect is called entomophily.

OR

Where is pollen kitt generally found?

Ans. Pollen kitt is generally found in entomophilous flowers.

Very Short Answer Type Questions

Q 1. Give an example of a plant which came into India as a contaminant and is a cause of pollen allergy.

Ans. *Parthenium* or Carrot grass.

Q 2. The microscopic pollen grains of the past are obtained as fossils. Mention the characteristic of the pollen grains that makes it happen.

Ans. The exine of pollen grains have an outermost hard layer composed of a chemical sporopollenin. It is highly resistant to high temperature, strong acids and alkali. So, pollen grains are obtained as fossils.

Q 3. State the function of filiform apparatus found in mature embryo sac of an angiosperm. *(CBSE 2015)*

Ans. The filiform apparatus guides the pollen tube into the synergid.

Q 4. *Papaver* and *Michelia* both have multicarpellary ovaries. How do they differ from each other? *(CBSE 2015)*

Ans. *Papaver* has syncarpous gynoecium whereas *Michelia* has apocarpous gynoecium.

TiP

Only name of type of gynoecium is sufficient so there is no need to write the definition.

Q 5. An anther with malfunctioning tapetum often fails to produce viable male gametophytes. Give any one reason.

Ans. A malfunctioning tapetum does not provide enough nourishment to the developing male gametophytes and thus fail to produce viable male gametophytes.

Q 6. How is it possible in *Oxalis* and *Viola* plants to produce assured seed-sets even in the absence of pollinators?

Ans. Assured seed-sets are possible to be produced in *Axalis* and *Viola* Plants by the presence of cleistogamous flowers.

Q 7. The meiocyte of rice has 24 chromosomes. How many chromosomes are present in its endosperm?

Ans. 36 chromosomes are present in its endosperm.

Q 8. A bilobed, dithecous anther has 100 microspore mother cells per microsporangium. How many male gametophytes this anther can produce?

Ans. The bilobed anther can produce 1600 male gametophytes.

TiPS

- *Each microsporangium has 100 microspore mother cells which form 400 microspores by meiosis (100 × 4 = 400).*
- *In an anther, there are four microsporangia. So, the total number of microspores will be 4 × 400 = 1600.*
- *As each microspore forms one male gametophyte, 1600 male gametophytes can be produced.*

Q 9. How many pollen grains and ovules are likely to be formed in the anther and the ovary of an angiosperm bearing 25 microspore mother cells and 25 megaspore mother cells respectively?

Ans. 100 pollen grains and 100 ovules are likely to be formed.

COMMON ERROR

Sometimes calculations are not proper and if there are a number of meiosis divisions for seeds, then normally students calculate that wrongly.

Q 10. The flower of brinjal is referred to as chasmogamous while that of beans is cleistogamous. How are they different from each other? *(CBSE 2018)*

Ans. Brinjal has chasmogamous flowers, as they are open with exposed stamen and stigma. Such flowers show cross-pollination as well as self-pollination. On the other hand, beans have cleistogamous flowers, as they never open at all, even at maturity and they also show self- pollination.

Q 11. Name the type of flower which favours cross pollination.

Ans. Chasmogamous flower favours cross pollination.

Q 12. How do the pollen grains of *Vallisneria* protect themselves?

Ans. Pollen grains of *Vallisneria* have mucilaginous covering to prevent them from getting wet.

Q 13. How do flowers of *Vallisneria* get pollinated?

Ans. In *Vallisneria*, the female flower stalk is coiled to reach the water surface for receiving the pollen grains carried by water currents.

Q 14. The following statements (i), (ii) and (iii) seem to describe the water-pollinated submerged plants. Which one of these statements is incorrect?

(i) The flowers do not produce nectar.

(ii) The pollen grains have mucilaginous covering.

(iii) The brightly coloured female flowers have long stalk to reach the surface.

Ans. The brightly coloured female flowers have long stalk to reach the surface.

Q 15. Mention the pollinating agent of an inflorescence of small dull coloured flowers with well exposed stamens and large feathery stigma. Give any one characteristic of pollen grains produced by such flowers.

Ans. Pollinating agent of such flowers is wind. Pollen grains produced by these flowers are light, dry and non-sticky.

Q 16. Name the type of pollination as a result of which genetically different types of pollen grains of the same species land on the stigma.

Ans. Xenogamy.

Q 17. What is pollen-pistil interaction and how is it mediated?

Ans. The ability of the pistil to recognise the pollen followed by its acceptance or rejection is called pollen–pistil interaction. It is mediated by chemical components of pollen interacting with those of pistil.

Q 18. How many microsporangia are present in a typical anther of an angiosperm?

Ans. Four microsporangia

Q 19. Why are non-albuminous seeds so called?

Ans. Non-albuminous seeds have no residual endosperm as it is completely consumed during embryo development. *e.g.*, seeds of pea and groundnut.

Q 20. Name the part of the flower which the tassels of the corn-cob represent.

Ans. The tassels of the corn-cob represent style and stigma.

Q 21. Write the function of coleoptile.

Ans. Coleoptile protects the plumule of the monocot embryo.

Q 22. Write the function of scutellum.

Ans. Scutellum provides nourishment and protection to the developing embryo.

Short Answer Type Questions

Q 1. Gynoecium of a flower may be apocarpous or syncarpous. Explain with the help of an example each. *(CBSE 2019)*

Ans. The gynoecium represents the female reproductive part of the flower. When there are more than one pistil, if the pistils are fused together, the flower is said to be syncarpous and if the pistils are free, it is said to be apocarpous. For example, pistil of *Papaver* is syncarpous and that of *Michelia* is apocarpous.

Q 2. In a flowering plant, a microspore mother cell produce four male gametophytes while a megaspore mother cell form only one female gametophyte. Explain. *(CBSE 2017)*

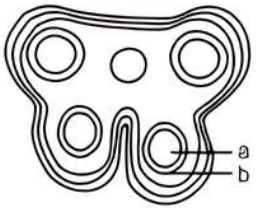
Ans. 4 male gametophytes are formed by meiosis of single microspore mother cell whereas female gametophytes are formed by meiosis of single megaspore mother cell to produce 4 megaspores, out of which 3 degenerate and only one survives. The surviving megaspore undergoes mitotic division to form the female gametophyte.

Q 3. Differentiate between the two cells enclosed in a mature male gametophyte of an angiosperm.

Ans.

S. No.	Basis of difference	Vegetative cell	Generative cell
(i)	Size	It is bigger in size.	It is smaller and floats in the cytoplasm of vegetative cell.
(ii)	End product	It has food reserves.	It gives rise to two male gametes.

Q 4. In the T.S. of a mature anther given below, identify 'a' and 'b' and mention their function. *(CBSE 2016)*



Ans. 'a'- Sporogenous tissue: It forms pollen grains.
'b'- Tapetum: It provides nourishment to the developing pollen grains.

Q 5. Name all the haploid cells present in an unfertilised mature embryo sac of a flowering plant. Write the total number of cells in it.

Ans. The haploid cells in an unfertilised mature embryo sac are: egg cell, synergids, antipodals. There are 7 cells in total.

Q 6. 'Pollen grains in wheat are shed at 3-celled stage while in peas they are shed at 2-celled stage.' Explain. Where are germ pores present in a pollen grain? *(CBSE 2017)*

Ans. At the time of shedding, wheat pollen consists of one vegetative and two male gametes, which is the 3-celled stage. While pea pollen consists of one vegetative and one generative cell which is the 2-celled stage.

Germ pores are present on the exine where sporopollenin is absent.

Q 7. A pollen grain in angiosperm at the time of dehiscence from an anther could be 2-celled or 3-celled. Explain.

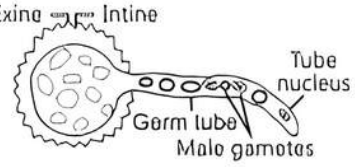
How are the cells placed within the pollen grain, when shed at a 2-celled stage? *(CBSE 2016)*

Ans. In majority of angiosperms, pollens are released in 2-celled stage whereas in other species, the generative cell divides into 2 male gametes and forms 3-celled stage.

When the pollen grain is shed at 2-celled stage, it has two unequal cells-bigger vegetative cell and smaller generative cell.

Q 8. Draw a diagram of pollen grain with germ tube and two male gametes.

Ans. Pollen grain with germ tube and two male gametes is as shown



TiP

Practice making diagrams with correct labelling otherwise marks will be deducted.

Q 9. Mention the ploidy of the different types of cells present in the female gametophyte of an angiosperm.

Ans.

S.No.	Cells in female gametophyte	Ploidy
(i)	Synergids	Haploid
(ii)	Egg	Haploid
(iii)	Polar nuclei	Haploid
(iv)	Antipodals	Haploid

Q 10. Name the organic materials the exine and intine of angiosperm pollen grains are made up of. Explain the role of exine.

Ans. Exine is made up of sporopollenin and intine is made up of cellulose and pectin.
Exine is the most resistant organic material and can withstand high temperature, acidic and alkali environment.

Q 11. Where is sporopollenin present in plants? State its significance with reference to its chemical nature.

Ans. Sporopollenin is present in the exine of pollen grains. It is the most resistant organic material in nature. It provides protection to the pollen/gamete/gametophyte from unfavourable conditions or chemicals (acids, enzymes and high temperature).

Q 12. Explain giving two reasons, why pollen grains can be best preserved as fossils?

Ans. Pollen grains can be best preserved as fossils due to the following two reasons:
(i) Pollens are produced in large numbers.
(ii) The sporopollenin in exine protects the pollen from harsh conditions.

Q 13. List the two steps that are essential for carrying out artificial hybridisation in crop plants and why?

Ans. The two steps essential for carrying out artificial hybridisation in crop plants are:
(i) Selection of Parents: Only those plants should be selected which have desired traits.
(ii) Crossing Over: Pollen grains from selected male plant is collected and transferred to the female plant after which it is bagged.

COMMON ERROR
Students mention only the steps and not the reason for importance in carrying out artificial hybridisation.

Q 14. Explain the steps that ensure cross pollination in an autogamous flower.

Ans. The steps are:
(i) An autogamous or a bisexual flower is emasculated at unopened stage to prevent self-pollination in the flower.
(ii) It is bagged after emasculation to prevent contact of unwanted pollen grain with the stigma of the flower.
(iii) Artificial pollination is then performed when the stigma is ready.
(iv) The flower is then rebagged.

Q 15. State one advantage and one disadvantage of cleistogamy.

Ans. Advantage: Self-pollination as well as seed production is assured.
Disadvantage: Least variations are observed and it leads to inbreeding depression.

Q 16. Name the product of fertilisation that forms the kernel of coconut. How does the kernel differ from coconut water?

Ans. Endosperm forms the kernel of coconut.
The coconut water is free-nuclear endosperm whereas kernel is cellular endosperm.

Q 17. List the post-fertilisation events in angiosperms.

Ans. The post-fertilisation events are:
(i) Development of endosperm
(ii) Embryogeny/development of embryo
(iii) Seed formation
(iv) Fruit formation.

Q 18. List the differences between the embryos of dicot (pea) and monocot (grass family).

Ans.

S. No.	Basis of difference	Dicot embryo	Monocot embryo
(i)	Number of cotyledons	It has two cotyledons.	It has one cotyledon.
(ii)	Radicle and plumule coverage	Radicle and plumule are not covered with sheath.	Radicle is covered with coleorhiza and plumule is covered by coleoptile.

Q 19. Define parthenocarpy.

Ans. Parthenocarpy is the production of fruits without fertilisation of ovules. Fruits like banana and figs are developed without fertilisation and do not produce any viable seeds. A parthenocarpic fruit is devoid of embryo and endosperm and therefore does not have any seeds. That is why they are also known as seedless or virgin fruits.

Q 20. What are the importance of seed dispersal?

Ans. Some importance of seed dispersal are given as below:
(i) Seed dispersal promotes the survival of plant species.
(ii) It allows plants to unfold in an extensive area.
(iii) Thus, preventing plants from competing for light, water and nutrients from the soil, which occur when plants grow closer to each other.

Long Answer Type-I Questions

Q 1. Make a list of any three outbreeding devices that flowering plants have developed and explain how they help to encourage cross-pollination. *(CBSE 2015)*

Ans. The outbreeding devices that flowering plants have developed are:

(i) Production of unisexual flowers/dioecious plants, that has ensured cross pollination.

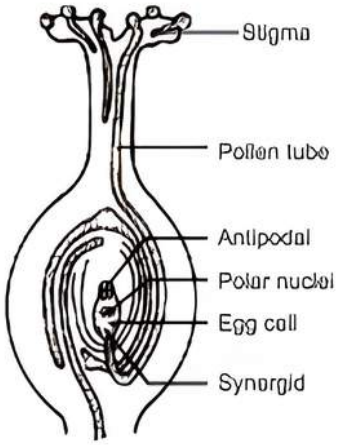
(ii) Self-incompatibility, a genetic mechanism which prevents the pollen germination on the stigma of the same flower.

(iii) Anther and stigma are placed at different positions, so that the pollen cannot come in contact with the stigma of the same flower.

Q 2. (i) Draw a labelled diagram of L.S. of a flower to show the growth of pollen tube reaching egg apparatus.

(ii) Pistil of a flower does not accept pollen from any plant other than from its own kind. How does it happen? Explain. *(CBSE 2019)*

Ans. (i) Longitudinal section of a flower showing growth of pollen tube:



(ii) The pistil has the ability to recognise pollen, whether it is of right type (compatible) or of the wrong type (incompatible). It is mediated by chemical components of the pollen interacting with those of the pistil.

Q 3. Explain the process of artificial hybridisation to get improved crop variety in:

(i) Plants bearing bisexual flowers.

(ii) Female parent producing unisexual flowers.

Ans. (i) In plants bearing bisexual flowers, the anthers are removed from the flower before they dehisce. This is called emasculation. The emasculated flowers are covered with a bag of butter paper to prevent contamination of stigma with unwanted pollen. This process is called bagging. When this stigma attains receptivity, mature pollen grains are dusted on the stigma and the flowers are rebagged to allow the fruits to develop.

(ii) If the female parent produces unisexual flowers, emasculation is not done. The flower buds are bagged before the flowers open. When the stigma becomes receptive, pollen is dusted on stigma and the flower is rebagged.

Q 4. Write the differences between wind-pollinated and insect-pollinated flowers. Give an example of each type.

Ans.

S. No.	Basis of difference	Wind-pollinated flowers	Insect-pollinated flowers
(i)	Number of pollen grains	These produce large numbers of pollen grains.	These produce less number of pollen grains.
(ii)	Appearance	These are dull, nectarless and scentless.	These are bright, scented and have nectar.
(iii)	Stamens	Stamens are long and protrude above petals.	Stamens lie within the corolla tube.
(iv)	Nature of pollen grains	The pollen grains are dry, light, small and smooth. For example, ragweed.	The pollen grains are larger, heavier with appendages like hooks and barbs. For example, rose, sweet pea.

TiP

Always give such type of difference in tabular form instead of a paragraph. Also provide the bases for differentiating both types of flowers.

Q 5. (i) Can a plant flowering in Mumbai be pollinated by pollen grains of the same species growing in New Delhi? Provide explanations to your answer.

(ii) Draw the diagram of a pistil where pollination has successfully occurred. Label the parts involved in reaching the male gametes to its desired destination. *(CBSE 2017, 19)*

OR

Draw a longitudinal section of the pistil from a flowering plant, where pollination has occurred. Label the following: *(CBSE 2020)*

(i) Stigma showing germinating pollen grains

(ii) Style

(iii) Pollen tube reaching the micropyle of the ovule

(iv) Embryo sac

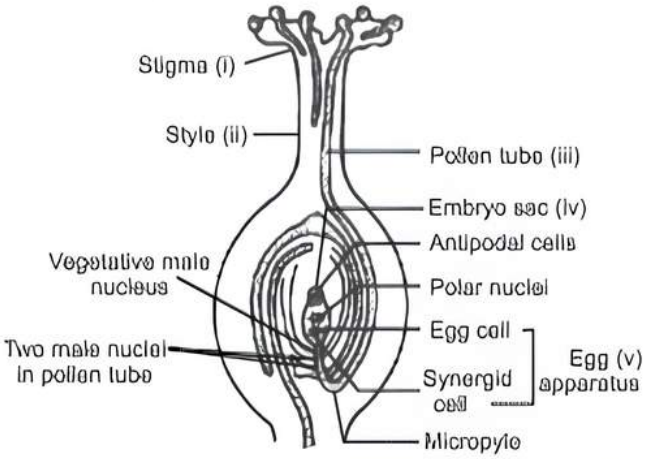
(v) Components of the egg apparatus

Ans. (i) It is possible by artificial hybridisation where pollen grain of one flower is introduced artificially on the stigma of another flower. But there should not be self-incompatibility.

(a) In one flower, emasculation is done by removal of anthers and then flower is bagged.

(b) After some time, the bag is removed and then desired pollen grains are introduced on its stigma.

(ii) **Diagram of a pistil with successful pollination:**



The parts involved in reaching the male gametes to its desired location are:

stigma, pollen tube, synergid cell, micropyle.

Q 6. One of the major approaches of crop improvement programme is artificial hybridisation. Explain the steps involved in making sure that only the desired pollen grain pollinate the stigma of a bisexual flower by a plant breeder. *(CBSE 2023)*

Ans. When the desired pollen grains are used for pollination and fertilisation to get desired progeny, it is called artificial hybridisation.

Steps of Artificial Hybridisation:

(i) Emasculation: In this step, the anthers (male part) are removed from a bisexual flower to avoid unwanted fertilization from the anthers of the same flower. Unisexual flowers do not require this step.

(ii) Bagging: In this, the flowers are covered with a bag to avoid landing of unwanted pollen grains on the stigma. The bagging is done till the flower attains receptivity.

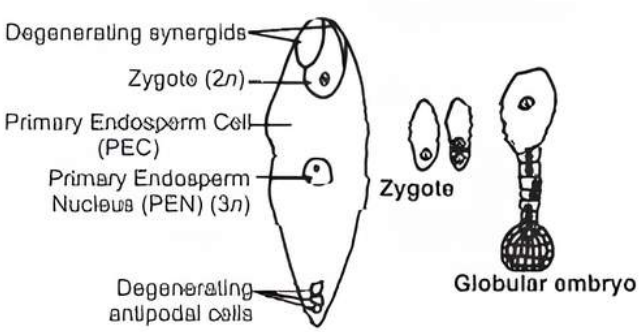
(iii) Pollination: Pollens with desired traits are dusted onto the flower after the flower is ready to receive the pollens.

Q 7. Answer the following questions:

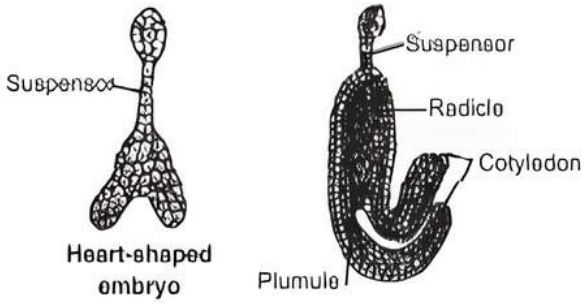
(i) With labelled diagrams, depict stages of embryo development of a dicotyledonous plant.

(ii) Endosperm development precedes embryo development. Why? *(CBSE 2017)*

Ans. (i) The stages of embryo development in a dicotyledonous plant are shown as under:



Fertilised embryo sac



Mature embryo

(ii) Endosperm is filled with reserve food materials which are used for nutrition of the developing embryo.

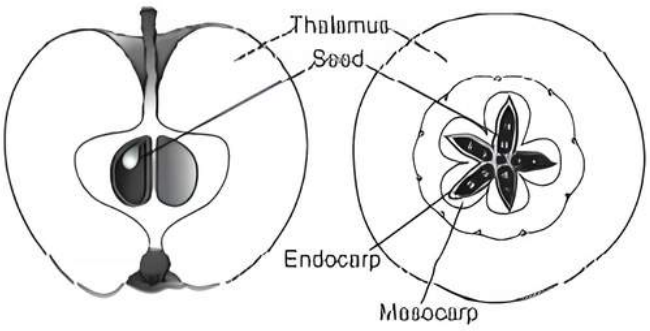
Q 8. Draw a transverse sectional view of an apple and label the following parts along with their technical names:

(i) edible part

(ii) encloses the embryo

(iii) forms the fruit wall *(CBSE 2019)*

Ans. Transverse sectional view of an apple:



(i) Edible part—**Thalamus**

(ii) Encloses the embryo—**Endocarp**

(iii) Forms the fruit wall—**Mesocarp**

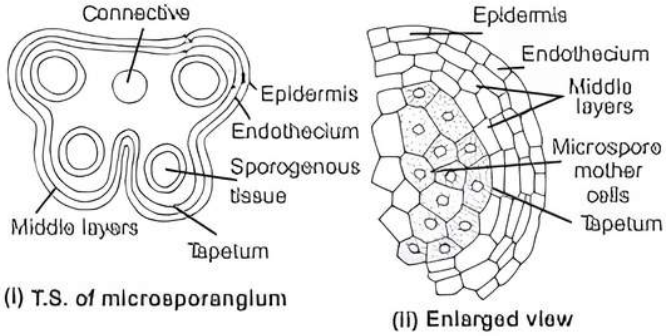
Long Answer Type-II Questions

Q 1. Draw a labelled diagram of an anther lobe at microspore mother cell stage. Mention the role of different wall layers of anther. *(CBSE 2015)*

Ans. An anther lobe at microspore mother cell stage is shown by:

(i) Transverse section of a young anther.

(ii) Enlarged view of one microsporangium showing wall layers of anther.



(i) T.S. of microsporangium (ii) Enlarged view

Roles of different wall layers of anther:

(i) Epidermis, endothecium and middle layers perform the function of protection and help in dehiscence of anther to release the pollen.

(ii) Tapetum is the innermost wall layer and it provides nourishment to the developing pollen grains.

Q 2. Describe in sequence the events that lead to the development of a 3-celled pollen grain from microspore mother cell in angiosperms.

(CBSE 2015, 18)

Ans. The events leading to the development of a 3-celled pollen grain from microspore mother cell in angiosperms are:

(i) Each cell of the sporogenous tissue in a microsporangium acts as a potential Pollen Mother Cell (PMC) or microspore mother cell.

(ii) PMC undergoes meiotic divisions to form cluster of four cells called microspore tetrad.

(iii) On maturity, the anther dehydrates and the microspores separate from each other to form pollen grains.

(iv) The newly differentiated pollen grain has a central nucleus and dense cytoplasm.

(v) The protoplast mitotically divides into two unequal cells—bigger vegetative cell which is rich in food reserve and smaller spindle-shaped generative cell with dense cytoplasm and a nucleus. This is called 2-celled stage.

(vi) In majority of angiosperms, pollens are released in this 2-celled stage, whereas in other species, the generative cell divides into 2 male gametes and thus pollen is said to be in 3-celled stage.

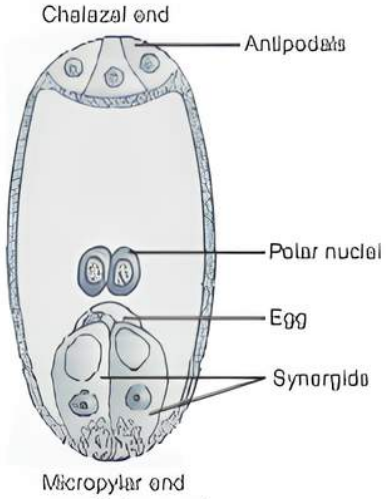
Q 3. (i) Explain the monosporic development of embryo sac in the ovule of an angiosperm.

(CBSE 2023)

(ii) Draw a diagram of the mature embryo sac of an angiospermic ovule and label any four parts in it.

Ans. (i) The formation of the embryo sac or female gametophyte from a single functional megaspore is called as monosporic development. The nucleus of functional megaspore divides mitotically to form two nuclei which move to opposite poles. This form a two-nucleate embryo sac. Two more sequential mitotic nuclear divisions result in the formation of four-nucleate and eight-nucleate stages of embryo sac. These mitotic divisions are free nuclear type in which karyokinesis is not followed immediately by cytokinesis. After the eight-nucleate stage, the walls are laid down leading to the organisation of the typical female gametophyte. Six of eight nuclei are surrounded by cell walls and organised into cells. The remaining two nuclei called polar nuclei are situated below the egg apparatus in the large central cell. A typical angiosperm embryo sac at maturity is eight nucleated and seven celled structure. Three cells lie at micropylar end forming egg apparatus. Three cells lie at chalazal end called as antipodal cells. A single large central cell which has two polar nuclei is as shown.

(ii)

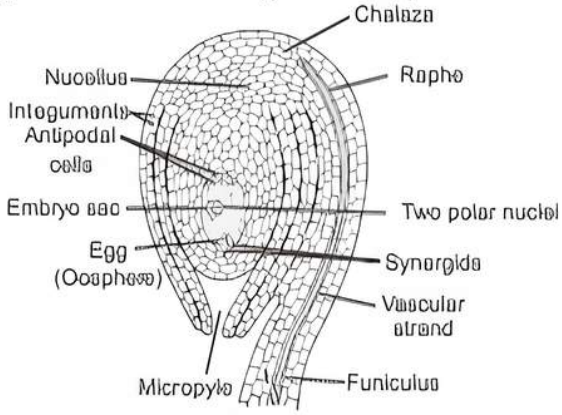


Mature embryo sac

Q 4. (i) Draw a diagrammatic sketch of the sectional view of a typical anatropous ovule.

(ii) List the components of the embryo sac and mention their fate on fertilisation.

Ans. (i) **Sectional view of a typical anatropous ovule:**



(ii) **Components of embryo sac:** 2 polar nuclei, 1 egg cell, 2 synergids and 3 antipodal cells.

Fate of embryo sac components on fertilisation

(a) After positive pollen-pistil interaction, the pollen tube develops and enters the ovule through synergids guided by filiform apparatus.

(b) One of the male gamete fertilises the female gamete to form diploid zygote.

(c) The other male gamete fuses with the secondary nucleus (polar nuclei if they are already fused) to form a triploid Primary Endosperm Nucleus (PEN) that develops into endosperm.

(d) The three antipodals at chalazal end and synergids at micropylar end start degenerating.

Q 5. Trace the events that would take place in a flower from the time the pollen grain of the same species fall on the stigma up to the completion of fertilisation. *(CBSE 2015)*

Ans. The events that take place in a flower are:

(i) When pollen grain lands over the stigma, it starts germinating and produces a pollen tube through a germ pore. Pollen tube passes through style and reaches the ovule.

(ii) The generative cell divides and forms two male gametes. Finally the pollen tube enters the embryo sac through micropyle.

(iii) Now the pollen tube enters the egg apparatus through one of the synergids with the help of filiform apparatus. The vegetative nucleus degenerates while pollen tube leaves two male gametes in embryo sac.

(iv) Now one of the male gamete fuses with the egg cell to form diploid zygote known as syngamy.

(v) The other male gamete fuses with the two already fused polar nuclei (called secondary nucleus) and forms triploid Primary Endosperm Nucleus (PEN) which later gives rise to endosperm. This is called triple fusion.

Hence, syngamy and triple fusion together are known as double fertilisation.

Q 6. (i) Describe any two devices in a flowering plant which prevent both autogamy and geitonogamy.

(ii) Explain the events up to double fertilisation after the pollen tube enters one of the synergids in an ovule of an angiosperm. *(CBSE 2015)*

Ans. (i) **Autogamy:** It is the transfer of pollen grains from anther to the stigma of same flower.

Geitonogamy: It is the transfer of pollen grains from anther to the stigma of another flower of same plant.

Two devices that prevent both autogamy and geitonogamy are:

(a) Self-incompatibility: This is a genetic mechanism and prevents self-pollen from fertilising the ovules by inhibiting pollen germination or pollen tube growth in the pistil.

(b) Dioecious Plants: Male and female flowers are present on different plants, that is, each plant is either male or female.

(ii) The events seen after the pollen tube enters one of the synergids in an ovule are as follows:

(a) Pollen tube, after reaching the ovary, enters the ovule through the micropyle and thus enters one of the synergids through filiform apparatus.

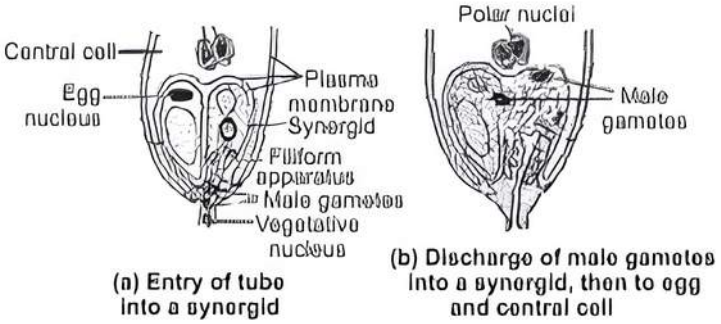
(b) After entering one of synergids, the pollen tube releases the two male gametes into the cytoplasm of the synergid.

(c) One of the male gametes moves towards the egg cell and fuses with its nucleus thus resulting in the formation of zygote (diploid cell). This is syngamy.

(d) The other male gamete move towards the two polar nuclei located in the central cell and fuses to form triploid Primary Endosperm Nucleus (PEN). This involves fusion of three haploid nuclei and hence termed as triple fusion.

(e) Two types of fusions, syngamy and triple fusion takes place in an embryo sac and hence the phenomenon is termed as double fertilisation.

(f) After fertilisation, PEN becomes the Primary Endosperm Cell (PEC) and develops into endosperm while zygote develops into an embryo.

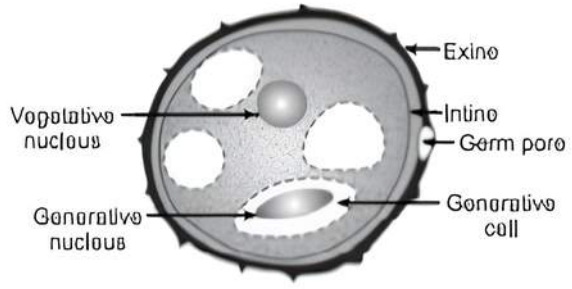


(a) Entry of tube into a synergid

(b) Discharge of male gametes into a synergid, then to egg and central cell

Q 7. Draw a labelled diagram of the sectional view of a mature pollen grain in angiosperms. Explain the functions of its different parts.

Ans. Sectional view of a mature pollen grain in angiosperms:



Functions:

(i) Pollen grains are generally spherical with a prominent two-layered wall. The hard outer layer is called exine made up of sporopollenin, which is a resistant organic material.

(ii) Exine can withstand high temperature, strong acids and alkali, and thus provide protection. It has prominent aperture called germ pore, through which pollen tube comes out.

(iii) Vegetative cell has abundant food reserve.

(v) Generative cell divides mitotically giving rise to two male gametes, before pollen grains are shed (3-celled stage).

TiP

Practice the sectional view diagrams along with their labelling. Also learn thoroughly the functions of its labelled parts.

Q 8. Explain the events upto fertilisation that occur in a flower after the pollen grain has landed on its compatible stigma.

Ans. The events upto fertilisation that occur in a flower after the pollen grain has landed on its compatible stigma are:

(i) All the events from pollen deposition on the stigma until the entry of the pollen tubes into the ovule are together called pollen–pistil interactions.

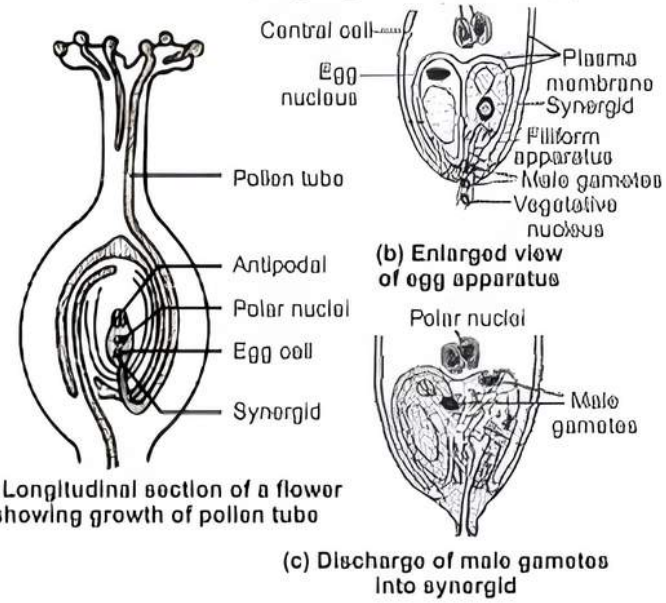
(ii) It is a dynamic process involving pollen recognition by stigma/pistil for compatible pollen.

(iii) Incompatible pollens or sterile pollens are rejected by the pistil and do not allow growth of pollen tube.

(iv) Compatible pollens are encouraged by pistil for growth and development of pollen tubes.

(v) The pollen tube grows through stigma and style to reach the ovary.

(vi) It then enters the ovule through micropyle and reaches the synergids, guided by filiform apparatus.



(a) Longitudinal section of a flower showing growth of pollen tube

(b) Enlarged view of egg apparatus

(c) Discharge of male gametes into synergid

(vii) On reaching the synergid, pollen tube releases the two male gametes into cytoplasm of synergid.

(viii) One of the male gamete fuses with egg nucleus to form a diploid cell called zygote. This event is called syngamy.

(ix) Other male gamete fuses with polar nuclei at the centre to produce a triploid Primary Endosperm Nucleus (PEN). This is termed as triple fusion.

(x) As syngamy and triple fusion take place simultaneously in the embryo sac, it is termed as double fertilisation.

TiP

Learn the events of fertilisation in sequence and practice the associated diagrams.

Q 9. Explain double fertilisation and trace the post-fertilisation events in sequential order leading to seed formation in a typical dicotyledonous plant.

OR

Double fertilisation is an event unique to all flowering plants. Explain the process. *(CBSE 2023)*

Ans. Double Fertilisation:

(i) On reaching synergid, pollen tube releases the two male gametes into cytoplasm of synergid.

(ii) One of the male gamete fuses with egg nucleus to form a diploid cell called zygote. This event is called syngamy.

(iii) Other male gamete fuses with polar nuclei at the centre to produce a triploid Primary Endosperm Nucleus (PEN). This is termed as triple fusion.

(iv) As syngamy and triple fusion take place simultaneously in the embryo sac. Because of the involvement of two fusions, this event is termed as double fertilisation. This is a unique event to angiosperms.

(v) The central cell after triple fusion forms Primary Endosperm Cell (PEC) which later develops into endosperm.

(vi) The zygote later develops into an embryo.

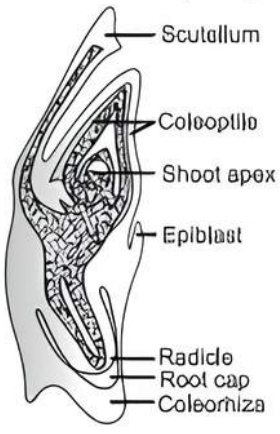
Post-fertilisation Events:

(i) Development of Embryo: Embryo develops in fertilised ovule, from the zygote. The early stages of embryo development from a zygote are known as embryogeny. The formation of embryo starts only after certain amount of endosperm formation to assure the nutrition supply, for development and growth of embryo.

(ii) Development of Seeds: As a result of double fertilisation, number of changes takes place in an ovule such as 2-cell stage, 8-cell stage, globular, heart shaped stage, torpedo stage and finally the mature embryo due to which ovule is converted into seeds.

Q 10. Draw a labelled diagram of the L.S. of embryo of grasses. How does it differ from that of bean?

Ans. Longitudinal Section of embryo of grasses:



Differences between embryo of grass and bean:

S. No.	Basis of difference	Embryo of grass	Embryo of bean
(i)	Number of cotyledons	The seed has a single cotyledon (scutellum), *i.e.*, it is monocotyledonous.	The seed has two cotyledons, *i.e.*, it is dicotyledonous.
(ii)	Plumule protection	The plumule is protected by a foliaceous sheath called coleoptile.	There is no such protection for the plumule in bean.
(iii)	Radicle protection	The radicle is protected by coleorhiza.	There is no such protective covering for the radicle.

Q 11. (i) When a seed of an orange is squeezed, many embryos, instead of one are observed. Explain how is it possible.

(ii) Are these embryos genetically similar or different? Comment. *(CBSE 2017)*

Ans. (i) It is possible due to polyembryony. Occurrence of more than one embryo in a seed is called as polyembryony.

In orange, the nucellar cells, synergid or integument cells develop into a number of embryos of different sizes.

Example: *Citrus*.

Sometimes formation of more than one egg in an embryo sac can lead to polyembryony.

(ii) In such embryos, parental characters are maintained hence they are genetically similar. In this process, there is no segregation of characters in the offspring (progeny).

Q 12. (i) Explain any two ways by which apomictic seed can develop. *(CBSE 2018)*

(ii) List one advantage and one disadvantage of an apomictic crop.

(iii) Why do farmers find production of hybrid seeds costly?

Ans. (i) The two ways in which apomictic seeds can develop are:

(a) **Recurrent Apomixis:** An embryo sac develops from the megaspore mother cell with disturbed meiosis due to which the egg-cell is diploid. The embryo subsequently develops directly from the diploid egg-cell without fertilisation.

(b) **Adventive Polyembryony:** Embryos arise from a cell or a group of cells either in the nucellus or in the integuments, *e.g.*, in oranges and roses. Since it takes place outside the embryo sac, it is not grouped with recurrent apomixis. Embryo within the embryo sac may also develop simultaneously, thus, giving rise to polyembryony condition, as in *Citrus*, *Opuntia*.

(ii) An advantage of apomictic crop is that the vigour is maintained and these seeds can be raised to grow new crop year after year resulting in tremendous crop production.

A disadvantage of the apomictic crop is that it reduces genetic diversity.

(iii) The production of hybrid seeds involves a process of artificial hybridisation that comes along with steps such as emasculation, bagging, raising of seedlings in nursery beds, etc. This process requires intensive labour and is also not feasible economically for all farmers. Also, the hybrid seeds can not be used for the next season. This further adds to their cost.

Chapter Test

Multiple Choice Questions

Q 1. In a fully developed male gametophyte of flowering plants, the number of nuclei is:

a. one b. two c. three d. four

Q 2. The filiform apparatus is present in:

a. synergids b. egg cell
c. antipodal cell d. secondary nucleus

Q 3. Part of the gynoecium which receives the pollen is called:

a. style b. stigma
c. ovule d. ovary

Assertion and Reason Type Questions

Directions (Q.Nos. 4-5): *Each of the following questions consists of two statements, one is Assertion (A) and the other is Reason (R). Select the correct answer to these questions from the codes a, b, c and d as given below:*

a. Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
b. Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c. Assertion is true but Reason is false.
d. Both Assertion and Reason are false.

Q 4. Assertion (A): Pollen wall is made up of two walls the intine and the exine.

Reason (R): Both the walls have depositions of sporopollenin.

Q 5. Assertion (A): Cross pollination is the only means of pollination in unisexual flowers.

Reason (R): Self-sterility is the only way to prevent self-pollination in bisexual flowers.

Case Based Questions

Case Study 1

Q 6. The ovule or the megasporangium develops as a small protuberance of the placental tissue. In the very young ovule, a single hypodermal cell is differentiated as the archesporium. This archesporium cell may or may not cut off some parietal cells and then becomes the Megaspore Mother Cell (MMC). The MMC undergoes division to form megaspore cells. Meanwhile two integuments develop from the base of the ovule.

(i) An ovule is a:

a. differentiated megasporangium
b. dedifferentiated megasporangium
c. integumented megasporangium
d. redifferentiated megasporangium

(ii) Embryo sac is called:

a. female gamete b. synergids
c. female gametophyte d. egg of angiosperm

(iii) Megasporogenesis is the:

a. formation of fruits
b. formation of seeds
c. formation of megaspores
d. Both b. and c.

(iv) Megaspore mother cell is found near the region of:

a. micropyle b. chalaza
c. nucellus d. integuments

Case Study 2

Q 7. Pollination is the act of transferring pollen grains from male anther of a flower to the female stigma.

The goal of every living organism including plants is to create offspring for the next generation. One of the ways that plants can produce offspring is by making seeds which then germinate to produce new plants. Two types of flowers with their pollination seen in plants are chasmogamy and cleistogamy. Chasmogamous flowers have strikingly coloured petals and nectar guides/ nectaries in contrast to cleistogamous flowers which are minute bud-like.

Read the given passage carefully and give the answer of the answer of the following questions:

(i) Define pollination.

(ii) Are cleistogamous flowers strictly autogamous?

(iii) What is the advantage of cleistogamy?

OR

What are chasmogamous flowers?

Very Short Answer Type Questions

Q 8. What is meant by emasculation?

Q 9. Why is apple called a false fruit? Which part of the flower forms the fruit.

Q 10. Name the structures formed at the end of microsporogenesis and megasporogenesis?

Short Answer Type Questions

Q 11. Mention two strategies evolved to prevent self-pollination in flowers.

Q 12. Why do you think zygote is dormant for sometime in a fertilised ovule?

Long Answer Type-I Question

Q 13. Arrange the following terms in correct developmental sequence: pollen grain, sporogenous tissue, microspore tetrad, pollen mother cell, male gametes.

Long Answer Type-II Question

Q 14. With a neat diagram, explain the 7-celled, 8-nucleate nature of female gametophyte.