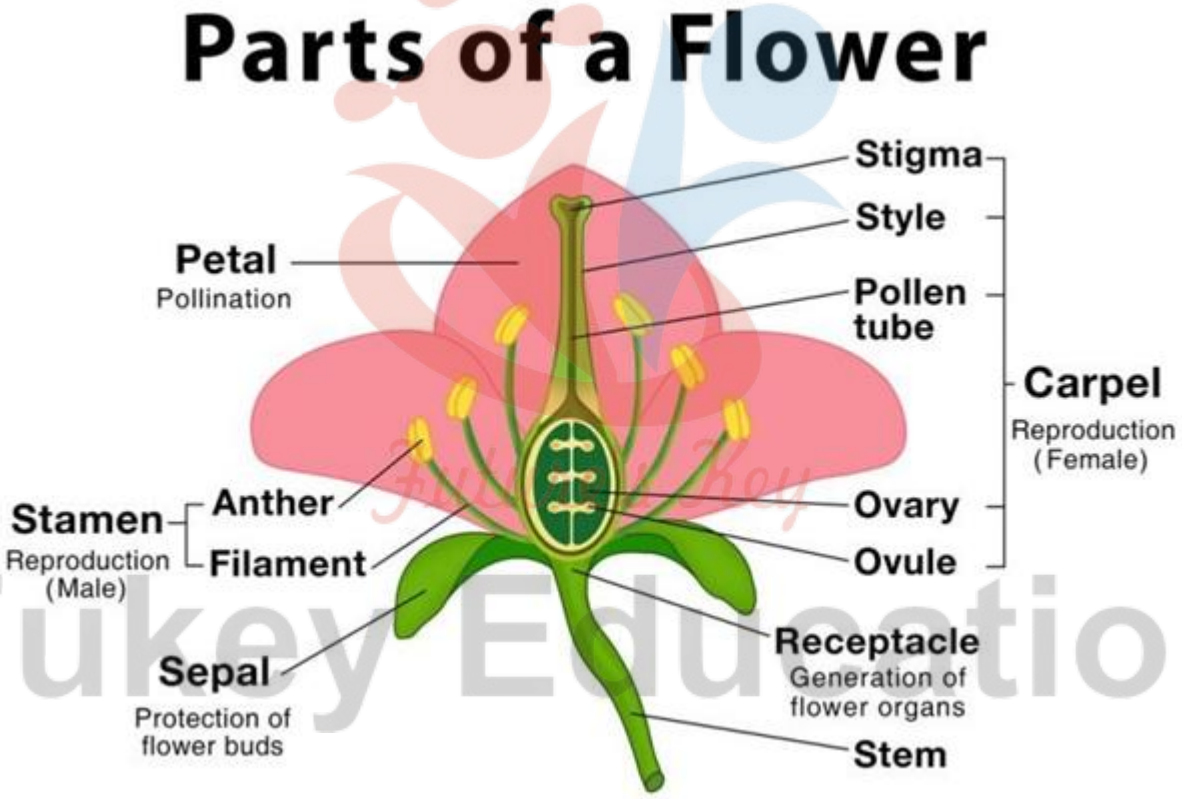
BIOLOGY

Chapter 1: Sexual Reproduction In Flowering Plants

Sexual Reproduction In Flowering Plants

Sexual Reproduction In Flowering Plants:

- Sexual reproduction is the process by which new organisms are formed from the fusion of male and female gametes from two parents.
- The flower is the primary reproductive structure. Within the flowers, the reproductive organs, or sporophylls, are produced.
- Sporophylls are classified into two types: microsporophylls (stamen) and megasporophylls (carpel).
- A carpel is an ovary that contains an ovule, a style, and a stigma.
- There are three types of stamen: filament, anther, and connective.
- Stamen is distinguished as filament, anther and connective.



Sexual reproduction in flowering plants can be broken down into three steps:

- Pre-fertilization
- Double fertilization
- Post-fertilization

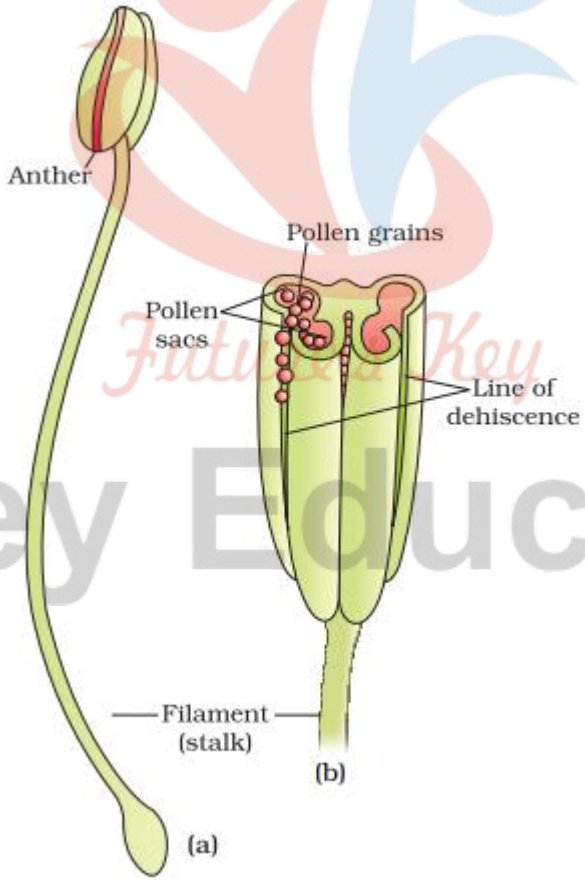
Pre-fertilization:

Several structural and hormonal changes lead to formation and development of the

floral primordium. Inflorescence is formed that bears floral buds and then flower. In flowers, male (androecium) and female (gynoecium) differentiate and develops in which male and female gametes are produced.

Stamen, Microsporangium and Pollen Grain:

- Stamen consists of long and slender stalk called filament and generally bilobed anthers. Each lobe contains two theca (dithecious).
- The anther is four-sided structure consisting of four microsporangia, two in each lobes.
- Microsporangia develop further and become pollen sacs which contain pollen grains.
- A typical angiosperm anther is bilobed with each lobe having two theca, i.e., they are dithecous.
- The anther is a four-sided (tetragonal) structure consisting of four microsporangia located at the corners, two in each lobe.
- The microsporangia develop further and become pollen sacs.



Structure of microsporangium:

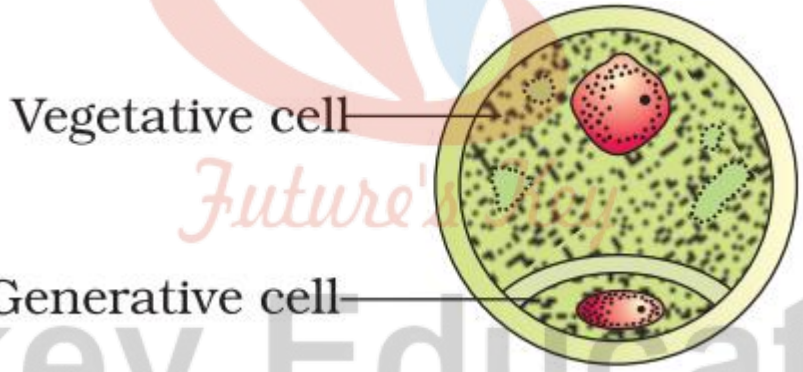
A typical microsporangium appears near circular in outline It is generally surrounded by

four wall layers epidermis, endothecium, middle layers and the tapetum. The outer three wall layers perform the function of protection and help in dehiscence of anther to release the pollen. The innermost wall layer is the tapetum. It nourishes the developing pollen grains. When the anther is young, a group of compactly arranged homogenous cells called the sporogenous tissue occupies the center of each microsporangium.

Microsporogenesis: The process of formation of microspores from a pollen mother cell through meiosis is called microsporogenesis The microspores, as they are formed, are arranged in a cluster of four cells–the microspore tetrad As the anthers mature and dehydrate, the microspores dissociate from each other and develop into pollen grains.

Pollen grain: The pollen grains represent the male gametophytes Pollen grains are generally spherical measuring about 25-50 micrometers in diameter. It has 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 materials known. It can withstand high temperatures and strong acids and alkali. Pollen grain exine has prominent apertures called germ pores the inner wall of the pollen grain is called the intine. It is a thin and continuous layer made up of cellulose and pectin.

When the pollen grain is mature it contains two cells, the vegetative cell and generative cell The generative cell is small and floats in the cytoplasm of the vegetative cell.



The Pistil, Megasporangium (ovule) and Embryo sac:

The gynoecium represents the female reproductive part of the flower.

Monocarpellary or Multicarpellary: The gynoecium may consist of a single pistil Monocarpellary or may have more than one pistil multicarpellary.

Syncarpous or Apocarpous: When there are more than one, the pistils may be fused together syncarpous or may be free apocarpous.

Each pistil has three parts: The stigma, style, and ovary.

The stigma serves as a landing platform for pollen grains. The style is the elongated

slender part beneath the stigma. The basal bulged part of the pistil is the ovary.

Inside the ovary is the ovarian cavity The placenta is located inside the ovarian cavity Arising from the placenta are the megasporangia, commonly called ovules.

The Megasporangium:

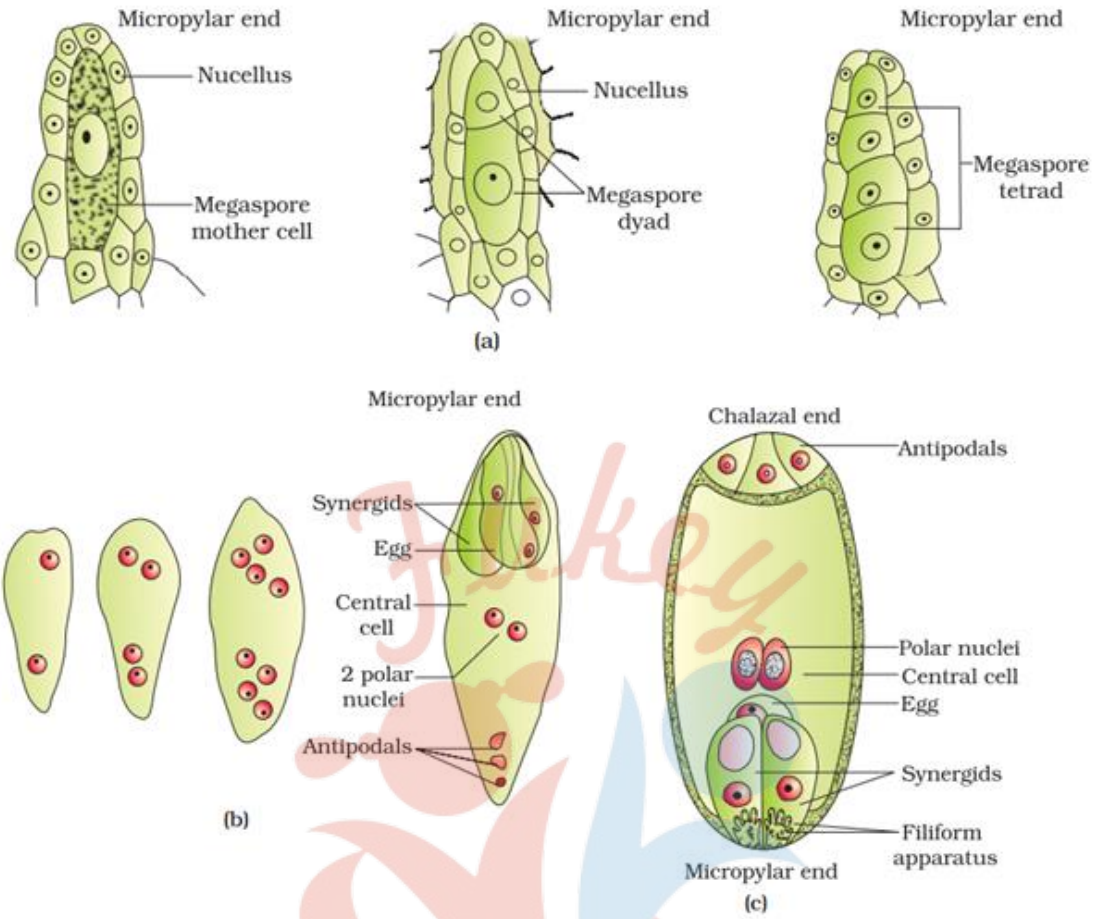
The ovule is a small structure attached to the placenta by means of a stalk called funicle. The body of the ovule fuses with funicle in the region called hilum Each ovule has one or two protective envelopes called integuments. Integuments encircle the ovule except at the tip where a small opening called the micropyle is organized. Opposite the micropylar end, is the chalaza, Enclosed within the integuments is a mass of cells called the nucellus. Located in the nucellus is the embryo sac or female gametophyte.

Megasporogenesis:

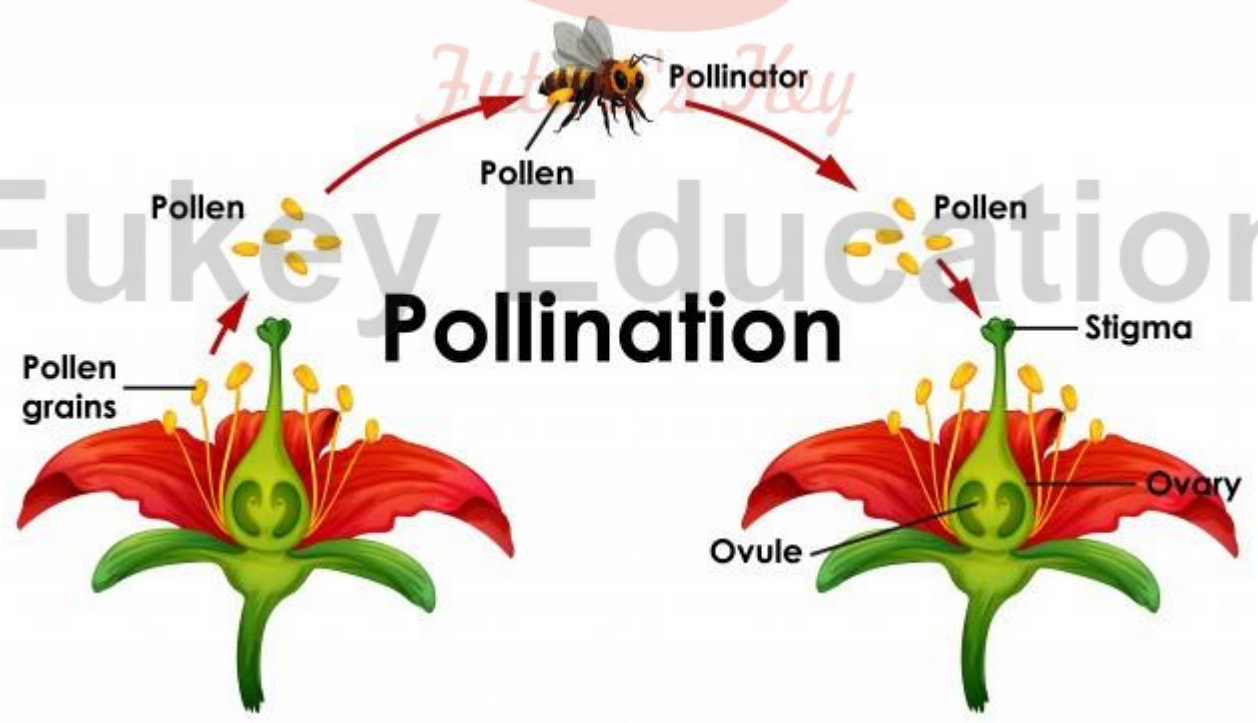
The process of formation of megaspores from the megaspore mother cell is called megasporogenesis. Ovules generally differentiate a single megaspore mother cell (MMC) in the micropylar region of the nucellus. It is a large cell containing dense cytoplasm and a prominent nucleus. The MMC undergoes meiotic division. Meiosis results in the production of four megaspores.

Embryo Sac:

This method of embryo sac formation from a single megaspore is termed monosporic development. The nucleus of the functional megaspore divides mitotically to form two nuclei which move to the opposite poles, forming the 2-nucleate embryo sac. and the formation of the 4-nucleate and later the 8-nucleate stages of the embryo sac. After the 8-nucleate 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 the remaining two nuclei, called polar nuclei are situated below the egg apparatus in the large central cell. Three cells are grouped together at the micropylar end and constitute the egg apparatus. consists of two synergids and one egg cell. Three cells are at the chalazal end and are called the antipodals. a typical angiosperm embryo sac, at maturity, though 8-nucleate is 7-celled.



Pollination



Transfer of pollen grains from anther to stigma.

Autogamy: Transfer of pollen grain from anther to stigma of same flower. Produce two types of flower.

Cleistogamous: Flower which do not open. cleistogamous flowers are autogamous as there is no chance of cross-pollen landing on the stigma. Cleistogamous flowers produce assured seed-set even in the absence of pollinators. e.g., Viola (common pansy), Oxalis, and Commelina.

Chasmogamous: Flowers which are similar to flowers of other species with exposed anthers and stigma

Geitonogamy: Transfer of pollen grains from anther to stigma of different flower of same plant. Geitonogamy is functionally cross-pollination involving a pollinating agent, genetically it is similar to autogamy since the pollen grains come from the same plant.

Xenogamy: Transfer of pollen grain from anther to stigma of different plant's flower of same species.

Agents of pollination: It includes abiotic (water, wind) and biotic (insects, butterfly, honeybee etc. large number of pollen grains are produced by plants using abiotic mode of pollination as most of pollen grains are wasted during transfer.

Adaptations in flowers for Pollination

Wind Pollination:

- **Pollen grains:** Light, non- sticky, winged
- **Anther:** Well exposed
- **Stigma:** Large and feathery
- **Flower:** One ovule, arranged as inflorescence

Example: corn cob, cotton, date palm

Water Pollination:

Bryophytes, Pteridophytes, Algae.

Pollen grains: protected by mucilaginous covering.

Example: Fresh water plants- Vallisneria, Hydrilla Sea grass- Zostera

Main features of wind and water pollinated plants:

- Produce pollen grains in large no.

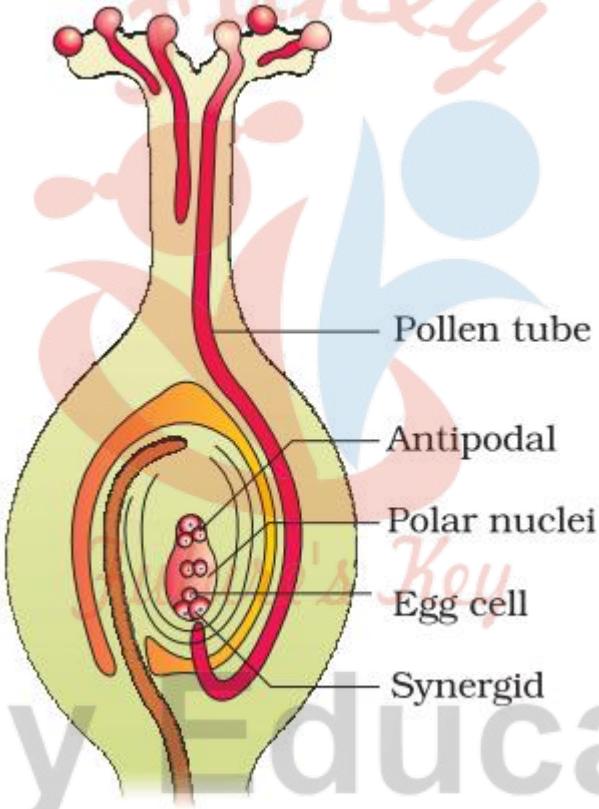
- Do not produce nectar.

Insect Pollination:

- **Flowers:** Large, colorful, fragrant, rich in nectar.
- **Pollen grains:** Sticky.
- **Stigma:** Sticky.

Certain rewards to pollinators

- Nectar and (edible) pollen grains as foods.
- Provide safe place for laying eggs.
- **Example:** Amorphophallus, Yucca.



Outbreeding Devices:

The various mechanisms take discourage self-pollination and encourage cross pollination as continued self-pollination leads to inbreeding depression. It includes

- Pollen release and stigma receptivity not synchronized.
- Anther and stigma are placed at different position.
- Inhibiting pollen germination in pistil.
- Production of unisexual flowers.

Pollen pistil interaction:

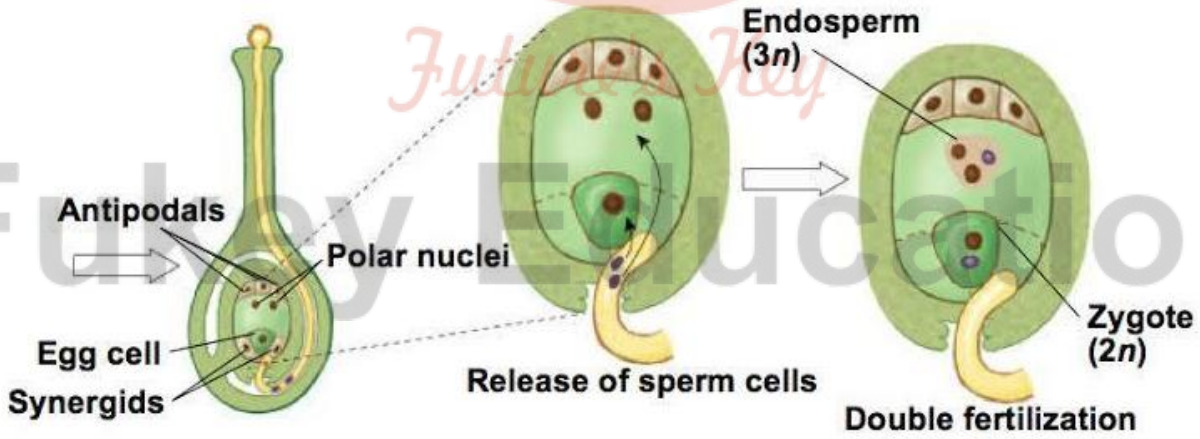
The pistil has ability to recognize the compatible pollen to initiate post pollination events that leads to fertilization. Pollen grain produce pollen tube through germ pores to facilitate transfer of male gametes to embryo sac.

Artificial Hybridization:

- Crossing diff varieties of species- Hybrid individual- with desirable characters of the parent plants
- Desired pollen grains for pollination- stigma protected from contamination
- **Emasculation:** Removal of anther.
- **Bagging:** Flower covered- bag made up of butter-prevent contamination of stigma from unwanted pollen.
- Bagged flower- attains receptivity- mature pollen grains- dusted on the stigma – rebagged- fruits allowed to develop.

Double Fertilization:

After entering the one of the synergids, each pollen grain releases two male gametes. One male gametes fuse with egg (Syngamy) and other male gametes fuse with two polar nuclei (triple fusion) to produce triploid primary endosperm nucleus (PEN). Since two types of fusion takes place in an embryo sac the phenomenon is called double fertilization. The PEN develops into the endosperm and zygote develops into embryo.



Post fertilization events: Include endosperm and embryo development, maturation of ovules into seeds and ovary into fruits.

Endosperm: The primary endosperm cell divides many times to forms triploid endosperm tissue having reserve food materials.

Two types of endosperm development:

- Free nuclear type (common method).
- Cellular type.

Non-albuminous: Endosperm completely utilized- before maturation of seeds. e.g pea, groundnut.

Albuminous: A portion of endosperm remain in mature seeds. e.g wheat, maize, castor.

Embryo:

Embryo develops at the micropylar end of the embryo sac where the zygote is located.

Embryogeny: Early stages of embryo development. The zygote gives rise to the proembryo and subsequently to the globular, heart-shaped, and mature embryo.

Embryo consists of:

- Embryonal axis.
- Cotyledons.
- Plumule
- Radicle

Seed:

Fertilized and mature ovule develops into seed.

Monocotyledonous Seed:

- **Scutellem:** Cotyledon
- **Coleorrhiza:** Undifferentiated sheath covering radical & root cap
- **Coleoptile:** Sheath covering plumule

Seed consists of: Cotyledon(s), embryonal axis, Seed coat- double layered- formed by integuments. Testa (outer coat), Tegmen (inner coat).

Micropyle: Small opening on seed coat, it facilitates entry of H_2O & O_2 into seeds (for germination).

Hilum: Scar on seed coat.

Seed: Albuminous/ Non-Albuminous.

Perisperm: Remnants of nucellus that is persistent. e.g., Black pepper.

Dormancy: State of inactivity.

Pericarp: The wall of ovary develops into wall of fruit called pericarp. In true fruits only ovary contributes in fruit formation by in false fruit thalamus also contributes in fruit formation.

Apomixis: Form of asexual reproduction- mimics sexual reproduction- seed formed without fertilization

Formation of apomictic seeds: Diploid cell (formed without meiosis)- develop into embryo without fertilization. Cells of nucellus (2n) surrounding embryo sac- protrude into embryo sac- develop into embryos. e.g., Citrus and Mango.

Polyembryony: Occurrence of more than one embryo in a seed, often associated with apomixes. Ex: Citrus, groundnut.

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Chapter- 2 : Sexual Reproduction in Flowering Plants

Sexual Reproduction in Flowering Plants

- Flower Structure
  - Stigma
  - Style
  - Pollen tube
  - Carpel — Reproduction (Female)
  - Ovary
  - Ovule
  - Receptacle — Generation of flower organs
  - Stem
  - Petal — Pollination
  - Stamen — Reproduction (Male)
    - Anther
    - Filament
  - Sepal — Protection of flower buds
- Male gametophyte
  - Epidermis, Endothecium, Middle layers, Microspore mother cells, Tapetum, Connective, Epidermis, Endothecium, Sporogenous tissue, Middle layers, Tapetum, Pollen grains
- Female gametophyte
  - Stigma, Style, Stigma, Carpels, Syncarpous ovary, Ovary, Thalamus, Hilum, Funicle, Micropyle, Micropylar pole, Outer integument, Inner integument, Nucellus, Embryo sac, Chalazal pole
- Pre-fertilisation events
- Pollination
  - Types
    - Autogamy
    - Xenogamy
    - Geitonogamy
  - Agencies
    - Abiotic
      - Wind
      - Water
    - Biotic
      - Animals
  - Example
    - Winter Pollinated: Grasses Water Pollinated: Vallisneria and Hydrilla Insect Pollinated: Yucca
  - Outbreeding Devices
    - Devices for promoting cross pollination
      - Self-incompatibility
        - Arrangement of anther and stigma at different positions.
        - Production of unisexual flowers (Decliny)
        - Pollen release and stigma receptivity not synchronised.
  - Pollen-pistil interaction
    - It is a dynamic process involving pollen recognition followed by pollen tube growth
    - Artificial Hybridisation
      - It is one of the major approaches of crop improvement by using desired pollen grains for pollination.
      - Achieved by
        - Emasculation
        - Bagging
    - Pollen tube, Antipodal, Polar nuclei, Egg cell, Synergid
- Post-fertilization Events
  - Double fertilization
    - Degenerating synergids, Zygote (2n), Primary endosperm cell (PEC), Primary endosperm nucleus (3n) (PEN), Degenerating antipodal cells
    - Syngamy + Triple fusion = Double fertilization.
  - Formation of fruit
    - False Fruit
      - When parts other than ovary contribute to the fruit formation. Ex : Apple
    - True Fruit
      - When fruit develops from ovary Ex : Mango
  - Development of endosperm
    - Albuminous seeds (Endospermic)
    - Non-albuminous seeds (Non-endospermic)
  - Development of embryo
    - Dicot embryo
      - Plumule, Cotyledons, Hypocotyl, Radicle, Root cap
    - L.S. of Monocot embryo
      - Scutellum, Coleoptile, Shoot apex, Epiblast, Radicle, Root cap, Coleorhiza
  - Development of Seed
- Special modes
  - Occurrence of more than one embryo in a seed
    - Polyembryony
  - Production of seed without fertilization
    - Apomixis
  - Development of fruit without fertilization
    - Parthenocarpy
      - Thalamus, Seed, Endocarp, Mesocarp
- Significance of seed dispersal and fruit formation
  - Seed dispersal help the species to colonize in other areas and many fruits have mechanisms for dispersal of seeds

Important Questions

➢ Multiple Choice Questions:

1. Among the terms listed below those that of are not correct names for a floral whorl are:

(i) Androecium
(ii) Carpel
(iii) Corolla
(iv) Sepal.

(a) (i) and (iv)
(b) (iii) and (iv)
(c) (ii) and (iv)
(d) (i) and (iii)

2. Embryo sac is to ovule as is to an anther.

(a) Stamen
(b) Filament
(c) Pollen grain
(d) Androecium.

3. in a typical complete, bisexual and hypogynous flower the arrangements of floral whorls on the thalamus from the outer most to the inner most is:

(a) Calyx, corolla, androecium and gynoecium
(b) Calyx, corolla, gynoecium and androecium
(c) Gynoecium, androecium, corolla and calyx
(d) Androecium, gynoecium, corolla and calyx

4. A dicotyledonous plant bears flowers but never produces fruits and seeds. The most probable cause for the above situation is :

(a) Plant is dioecious and bears only pistillate flowers
(b) Plant is dioecious and bears both pistillate and staminate flowers
(c) Plant is monoecious
(d) Plant is dioecious and bears only staminate flowers.

5. The outermost and innermost wall layers of microsporangium in an anther are respectively:

(a) Endothecium and tapetum
(b) Epidermis and endodermis
(c) Epidermis and middle layer

(d) Epidermis and tapetum.

6. During microsporogenesis, meiosis occurs in :

(a) Endothecium
(b) Microspore mother cells
(c) Microspore tetrads
(d) Pollen grains.

7. From among the sets of terms given below, identify those that are associated with the gynoecium.

(a) Stigma, ovule, embryo sac, placenta
(b) Thalamus, pistil, style, ovule
(c) Ovule, ovary, embryo sac, tapetum
(d) Ovule, stamen, ovary, embryo sac

8. Starting from the innermost part, the correct sequence of parts in an ovule is :

(a) egg, nucellus, embryo sac, integument
(b) egg, embryo sac, nucellus, integument
(c) embryo sac, nucellus, integument, egg
(d) egg, integument, embryo sac, nucellus.

9. From the statements given below choose the option that is true for a typical female gametophyte of a flowering plant:

(i) It is 8-nucleate and 7-celled at maturity
(ii) It is free-nuclear during the development
(iii) It is situated inside the integument but outside the nucellus
(iv) It has an egg apparatus situated at the chalazal end

(a) (i) and (iv)
(b) (ii) and (iii)
(c) (i) and (ii)
(d) (ii) and (iv)

10. Autogamy can occur in a chasmogamous flower if:

(a) Pollen matures before maturity of ovule
(b) Ovules mature before maturity of pollen
(c) Both pollen and ovules mature simultaneously
(d) Both anther and stigma are of equal lengths.

11. Choose the correct statement from the following:

(a) Cleistogamous flowers always exhibit autogamy

(b) Chasmogamous flowers always exhibit geitonogamy
(c) Cleistogamous flowers exhibit both autogamy and geitonogamy
(d) Chasmogamous flowers never exhibit autogamy.

12. A particular species of plant produces light, non-sticky pollen in large numbers and its stigmas are long and feathery. These modifications facilitate pollination by:

(a) Insects
(b) Water
(c) Wind
(d) Animals.

13. From among the situations given below, choose the one that prevents both autogamy and geitonogamy.

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

14. In a fertilised embryo sac, the haploid, diploid and triploid structures are :

(a) Synergid, zygote and primary endosperm nucleus
(b) Synergid, antipodal and polar nuclei
(c) Antipodal, synergid and primary endosperm nucleus
(d) Synergid, polar nuclei and zygote.

15. In an embryo sac, the cells that degenerate after fertilisation are :

(a) Synergids and primary endosperm cell
(b) Synergids and antipodals
(c) Antipodals and primary endosperm cell
(d) Egg and antipodals.

➢ Very Short Question:

1. In a young anther, a group of compactly arranged homogenous cells were observed in the centre of each microsporangium. What is the name given to these cells?
2. Give the scientific name of a plant which came to India as a contaminant with imported wheat and causes pollen allergy.
3. Pollen grains of water pollinated species have a special characteristics for protection from water. What is that?
4. Why are pollen grains produced in enormous quantity in Maize?
5. In same species of Asteraceae and grasses, seed are formed without fusion of

gametes. Mention the scientific term for such form of reproduction.

6. Arrange the following in correct developmental sequence : Male gamete, Potential pollen mother cell, sporogenous tissue, Pollen grains, Microspore tetrad.
7. If the diploid number of chromosomes in an angiospermic plant is 16. Mention number of chromosomes in the endosperm and antipodal cell.
8. What kind of structures is formed at the end of microsporogenesis and megasporogenesis?
9. What is funiculus?
10. Define parthenocarpy.

➢ Short Questions:

1. In angiospermic plant before formation of microspore sporogenous tissue undergo cell division

   (a) Name the type of cell division.

   (b) What would be the ploidy of the cells of tetrad?
2. Outer envelop of pollen grain made of a highly resistant substance. What is that substance? At which particular point the substance is not present?
3. Fruits generally develops from ovary, but in few species thalamus contributes to fruit formation.

   (a) Name the two categories of fruits.

   (b) Give one example of each.
4. Among the animal, insects particularly bees are the dominant pollinating agents. List any four characteristic features of the insect pollinated flower.
5. Why pollen grains can remain well preserved as fossils?
6. How are the cells arranged in an embryo sac?
7. Why are cleistogamous flowers invariably autogamous?
8. State any one advantage and disadvantage of pollen grains to humans.

➢ Long Questions:

1. Give an account of a structure of typical anther?
2. Write about the structure of microsporangium?
3. Describe the development of microspore in angiosperms?

➢ Assertion & Reason Questions:

1. For two statements are given-one labelled Assertion and the other labelled Reason.

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.

Assertion: Helobial endosperm is found in monocots.

Reason: Two chambers are formed in this endosperm.

2. For two statements are given-one labelled Assertion and the other labelled Reason. 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.

Assertion: In angiosperms, the first fertilization is called syngamy.

Reason: Second fertilization is called vegetative fertilization.

➢ Case Study Questions:

1. Read the following and answer any four questions from (i) to (v) given below:

The pollen grains or microspores are the male reproductive bodies of a flower and are contained in the pollen sac or microsporangia. Each pollen grain consists of a single microscopic cell, possessing two coats: the exine and the in tine. The exine of a pollen grain is made of chemically stable material. Because of this, pollen grains are often very well preserved for thousands of years in soil and sediments.

i. One of the most resistant biological material present in the exine of pollen grain is:

a. Pectocellulose.
b. Sporopollenin.
c. Suberin.
d. Cellulose.

ii. The exine possesses one or more thin places known as:

a. Raphe.
b. Germ pores.
c. Hilum.
d. Endothecium.

iii. What is the function of germ pore?

a. Emergence of radicle.
b. Absorption of water for seed germination.
c. Initiation of pollen tube.
d. All of these.

iv. What is the key advantage to the plant for having such strong pollen grain walls?

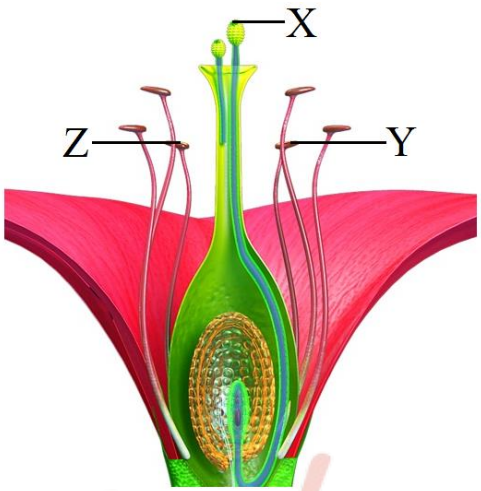
a. It protects the vital genetic material in the pollen grain.
b. It allows pollen to serve as a valuable fossil record for the study of ancient plants.
c. It prevents the pollen tube from growing out before the pollen grain reaches the stigma of a compatible species.
d. It gives weight to the pollen grain, allowing it to cling better to the body surfaces of insect pollinators.

v. The number of germ pores in dicots and monocots respectively are:

a. One and three.
b. Three and two.
c. Two and three.
d. Three and one.

2. Read the following and answer any four questions from (i) to (v) given below:

Cross pollination is the transfer of pollen grains from the anther of a 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). The diagram shows the carpel of an insect pollinated flower.



i. What is the most likely reason for non germination of pollen grain Z?

a. Pollen grains X and Y were brought to the stigma earlier, therefore, their germination inhibited the germination of pollen grain Z.
b. Pollen grain Z was brought to the flower by wind, while pollen grains X and Y were brought to the flower by insect.
c. Pollen grain Z lacks protrusions that allow it to adhere properly onto the stigma surface.
d. Pollen grain Z comes from a flower of an incompatible species.

ii. Which of the following best describes the function of the pollen tube?

a. It acts as a conduit to transport male gametes from the anther to the ovule.
b. It acts as a conduit to transport male gametes from the stigma to the ovule.
c. It contains key nutrients that serve to nourish the newly-formed zygote.
d. It digests the tissues of the stigma, style, and ovary.

iii. Pollination of a flower in which the pollen is carried by an insect is called:

a. Anemophily.
b. Ornithophily.
c. Entomophily.
d. Malacophil.

iv. Refer to the given characteristics of some flowers.

a. The stamens hang out of the flower, exposing the anthers to the wind.
b. The pollen grains are tiny and light.
c. The flower has a sweet scent.
d. The flower petals are brightly colored.

v. Pollenkitt is generally found in:

a. Anemophilous flowers.
b. Entomophilous flowers.
c. Ornithophilous flowers.
d. Malacophilous flowers.

✓ Answer Key-

➢ Multiple Choice Answers:

1. (c) (ii) and (iv)
2. (c) Pollen grain
3. (a) Calyx, corolla, androecium and gynoecium
4. (d) Plant is dioecious and bears only staminate flowers.
5. (d) Epidermis and tapetum.
6. (b) Microspore mother cells
7. (a) Stigma, ovule, embryo sac, placenta
8. (b) egg, embryo sac, nucellus, integument
9. (c) (i) and (ii)
10. (c) Both pollen and ovules mature simultaneously
11. (b) Chasmogamous flowers always exhibit geitonogamy
12. (c) Wind
13. (b) Dioecious plant bearing only male or female flowers
14. (a) Synergid, zygote and primary endosperm nucleus
15. (b) Synergids and antipodals

➢ Very Short Answers:

1. Sporogenous tissue
2. Parthenium
3. Presence of mucilagenous covering
4. To ensure pollination because Maize is pollinated by wind.
5. Apomixis
6. Sporogenous tissue Potential pollen mother cell microspore tetrad Pollen grain male gamete.
7. Chromosomes in endosperm and 16 chromosomes in antipodal cell.
8. Microsporogenesis results into formation of four haploid pollen grains arranged

generally in a tetrahedral tetrad while Megasporogenesis forms four megaspores arranged in linear tetrad.

9. The stalk of the ovule is called funiculus.
10. Production and development of seedless fruit is called parthenocarpy.

➢ Short Answer:

1. (a) meiosis division (b) haploid
2. Sporopollenin; at germpore sporopollenin is absent.
3. Two categories of fruits are

   (i) True fruits e.g., Mango

   (ii) False fruit e.g., Apple
4. Answer.

   i. Flowers are large.

   ii. Colorful petals of flower.

   iii. Presence of fragrance.

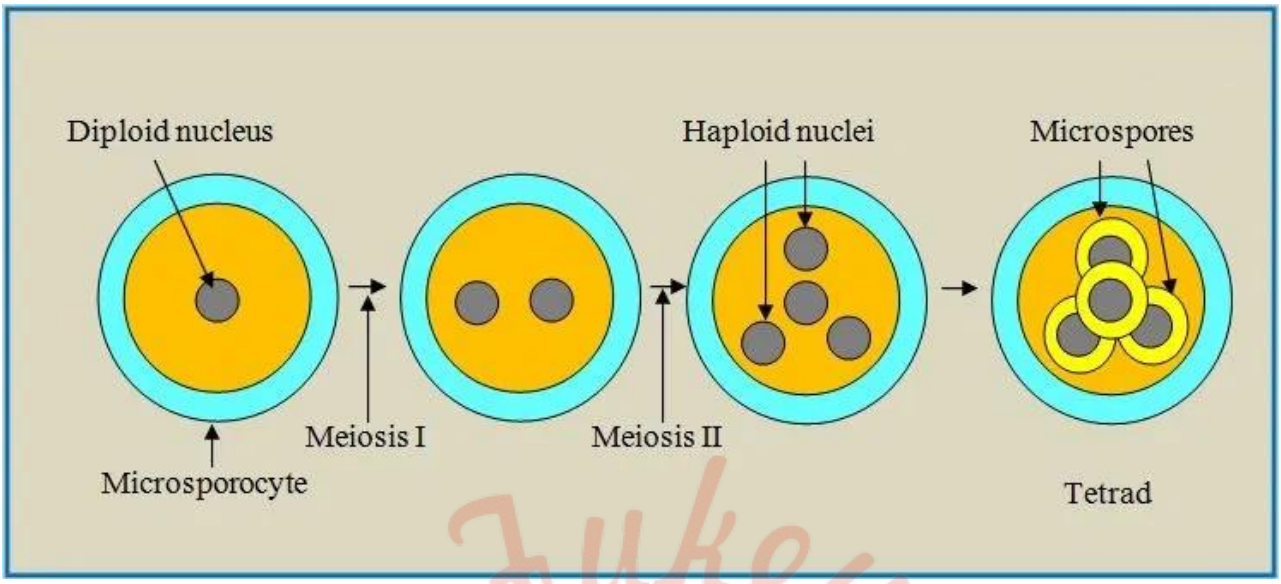
   iv. Rich in nectar.
5. Pollen grains are well preserved as fossils because the exine of the pollens is composed of a chemical, sporopollenin which can withstand high temperature, strong acids and alkalies and strong enzymes
6. An embryo sac is a 7 celled and 8 nucleated structure. At the micropylar end is present a group of three cells; two synergids and one egg cell. The chalazal end consists of three cells called antipodals. There is a central cell with two polar nuclei.
7. In a cleistogamous flower, the flower never opens and when the anther dehisce in the bud the pollen grains fall on the stigma of the same flower and thus it is strictly autogamous.
8. Advantage: Pollen grains are rich in nutrients and therefore in the western world pollen tablets are used as food supplements. Disadvantage: Pollens of many species cause severe allergies and bronchial afflictions leading to chronicle respiratory disorder.

➢ Long Answer:

1. Answer: Structure of anther. A typical angiosperm anther is bilobed with each lobe having two cells or theca, i.e. they are dithecous. Often a longitudinal groove runs lengthwise separating the theca. The bilobed nature of an anther is very distinct in the transverse section of the anther. The anther is a four-sided (tetragonal) structure consisting of four microsporangia located at the corners, two in each lobe.

The microsporangia develop further and become pollen sacs. They extend longitudinally all through the length of an anther and are packed with pollen grains.

2. Answer: A microsporangium is more often circular in outline and is surrounded by a four-layered wall:
   i. The outermost layer is the single layer of the epidermis.
   ii. The second layer is endothecium, where cells develop thickenings.
   iii. The middle layer is of 2-4 cells.
   iv. Tapetum, the innermost layer, is of large diploid/polyploid and binucleate or multinucleate cells.
   v. There are four pollen sacs.
   vi. Each pollen sac has sporogenous tissue.
3. Answer: Microsporogenesis and formation of pollen grains:
   i. Every cell of the sporogenous tissue is a potential pollen mother cell (PMC) and can give rise to microspore tetrad/ pollen grains.
   ii. But some of them forego this potential and differentiate into the pollen mother cells of microspore mother cells.
   iii. Each microspore mother cell undergoes meiosis to form a cluster of four haploid cells, called microspore tetrad.
   iv. As the anther matures, the microspores dissociate from the tetrad and develop into pollen grains.
   v. The tetrad may be tetrahedral, isobilateral, T-shaped, L-shaped and linear.
   vi. The nucleus of the microspore undergoes mitosis to form large vegetative cell and a small spindle-shaped generative cell that floats in the cytoplasm of the vegetative cell.



➢ Assertion & Reason:

1. (b) Both assertion and reason are true, but reason is not the correct explanation of assertion.

   Explanation:

   Helobial endosperm is restricted largely to the monocotyledons. The primary endosperm nucleus moves to the chalazal end of the embryo sac, where it divides, fanning a large micropylar chamber and a small chalazal chamber.

2. (b) Both assertion and reason are true, but reason is not the correct explanation of assertion.

   Explanation:

   Fusion of the egg nucleus with sperm nucleus is called syngamy. As, in this process fusion product is diploid zygote or oospore, it is called generative fertilization. It is also called first fertilization as the first sperm fuses with the egg. The second male gamete fuses with the diploid secondary nucleus of the central cell to form a triploid primary endosperm cell. It is known as vegetative fertilization.

➢ Case Study:

1.

   (i) - (b) Sporopollenin.

   Explanation:

   Outer layer (exine) of pollen grain is made of a highly resistant substance called sporopollenin. It is not degraded by any enzyme and not affected by high temperature, strong acid or strong alkali.

   (ii) - (b) Germ pores.

(iii) - (c) Initiation of pollen tube.

Explanation:

One or more thin areas present in the exine of pollen grains are known as germ pores. The germ pores are apertures in the exine layer of the pollen grain where the sporopollenin is absent. The germ pore helps in the formation of the pollen tube and the release of the male gametes during fertilization. There are usually three germ pores in dicots (tricolpate) and one in monocots (monocolpate).

(iv) - (a) It protects the vital genetic material in the pollen grain.

Explanation:

The pollen grain wall helps to protect the male gametes from drying up or chemical attack, thus protecting the DNA in the male gametes. This helps to maintain the integrity of genetic material that would be inherited by subsequent generations.

(v) - (d) Three and one.

Explanation:

One or more thin areas present in the exine of pollen grains are known as germ pores. The germ pores are apertures in the exine layer of the pollen grain where the sporopollenin is absent. The germ pore helps in the formation of the pollen tube and the release of the male gametes during fertilization. There are usually three germ pores in dicots (tricolpate) and one in monocots (monocolpate).

2.

(i) - (d) Pollen grain Z comes from a flower of an incompatible species.

Explanation:

Pollen grains can only germinate if the pollen grain and style tissues are compatible, i.e., of the same or closely related species. Pollen grains X and Y must have come from a compatible species.

(ii) - (b) It acts as a conduit to transport male gametes from the stigma to the ovule.

(iii) - (c) Entomophily.

Explanation:

Entomophily is the type of pollination that takes place through the agency of insects. The insect-loving flower possesses various adaptations by which they attract insects and use them as carrier of pollen grains for the purpose of cross pollination.

(iv) - (b) The pollen grains are tiny and light.

Explanation:

Pollen grains are microscopic structures that carry the male reproductive cell of plants. The inside of the grain contains cytoplasm along with the tube cell (which becomes the pollen tube) and the generative cell (which releases the sperm nuclei).

(v) - (b) Entomophilous flowers.

Explanation:

Insect-fertilizable or Entomophilous flowers are those which are sought by insects, for pollen or for nectar, or for both.