CHAPTER

02

Sexual Reproduction in Flowering Plants

Sexual Reproduction

Sexual reproduction is a complex biological process that involves the fusion of male and female gametes to create a genetically diverse offspring.

In plants, sexual reproduction occurs through the use of flowers, which are the reproductive structures of *Angio spermic or flowering plants.* The process of sexual reproduction in plants starts with the production of male and female gametes. The male gametes, also known as *pollen grains*, are produced by the stamen of the flower, while the female gametes, also known as *ovules*, are produced by the ovary.

The male gametes are transferred to the female gametes through the process of pollination. This can occur through various methods, including wind, water, or animals. Once the pollen grain reaches the ovule, it fertilizes the egg cell within it, leading to the formation of a zygote. This zygote develops into a seed, which can then grow into a new plant.

Sexual reproduction in plants has several advantages. It leads to the production of genetically diverse offspring, which can better adapt to changing environments. Additionally, it allows for the exchange of genetic material between different individuals, which can lead to the creation of new traits and characteristics.

Overall, sexual reproduction is a critical process that plays a vital role in the development and evolution of various species, including plants.

Flower: Flowers are the *reproductive structures* of flowering plants and are responsible for the process o*f sexual reproduction*. They are complex structures consisting of four whorls of floral appendages that are attached to the receptacle.

* Calyx

* Corolla

* Androecium

* Gynoecium

The *outermost* whorl of the flower is known as the ***calyx***. This whorl provides protection to the developing flower bud and is usually green in color. The next whorl is the corolla, which consists of brightly colored and fragrant petals. The attractiveness of the ***corolla*** helps to attract pollinators, which are necessary for successful pollination.

The ***androecium*** Is the *third* whorl of the flower and is the *male reproductive part*. It consists of stamens, which in turn consists of anthers, filaments, and connectives. The anther is the site of pollen production, while the filament provides support to the anther.

The *fourth* and Innermost whorl is the ***gynoecium***, which is the *female reproductive part* of the flower. It consists of one or more carpels or pistils, which are composed of three parts*: stigma, style, and ovary. T*he stigma is the receptive surface for pollen grains, while the style provides a pathway for the pollen tube to reach the ovary. The ovary contains one or more ovules, which upon fertilization, develop into seeds.

Flowers have evolved to have a diverse range of shapes, colors, and sizes to attract a variety of pollinators such as bees, butterflies, birds, and bats.

Pre fertilization events

The pre-fertilization events are crucial steps in the sexual reproduction of plants. These events involve the development of ***male*** and ***female gametophytes***.

The *male reproductive part* consists of

- a stamen,
- microsporangium, and
- a pollen grains.

A typical ***stamen*** has two main parts, the *anther*, and a long slender structure called the *filament*. The anther is a bilobed structure with each lobe containing two thecae. Thus, it has four microsporangia that develop into pollen sacs containing pollen grains. The pollen mother cell in the anther is diploid.

The ***microsporangium*** Is generally circular in outline and surrounded by four layers, the *epidermis, endothecium, middle layer, and tapetum*. Pollen grains are known as male gametophytes and have a two-layered wall, the *sporoderm*. The outer layer, called *exine*, is made up of *sporopollenin*, and the inner layer, called *intine*, is composed of *cellulose* and *pectin*.

Microsporogenesis is the formation of microspores from a pollen mother cell through meiosis. These microspores later develop into mature pollen grains. Each pollen grain has two cells, the generative cell and the vegetative cell. The vegetative cell is large and irregular in shape, containing abundant reserve food. The generative cell is small, spindle-shaped, and floats in the cytoplasm of the vegetative cell.

The release of pollen grains from the anther is called *dehiscence*. Pollination occurs when pollen grains are transported from the anther to the stigma of the female reproductive part. This marks the beginning of the fertilization process, leading to the formation of a zygote and eventually a new plant.

The *female reproductive part* of a flower, known as the ***pistil***, is made up of three main parts: the ***stigma, style, and ovary***. The **stigma** is responsible for receiving pollen grains, while the **style** is the thin, elongated part that connects the stigma to the ovary. The **ovary** is the basal, swollen part of the pistil and is responsible for producing and housing the ovules.

Each **ovule**, also known as the *megasporangium*, is attached to the placenta by a stalk called the *funicle*. The junction between the ovule and funicle is called the *hilum*. Each ovule contains two protective envelopes, called integuments, which surround the embryo sac. The embryo sac is the female gametophyte that develops inside the ovule and contains the egg cell, along with other cells that support fertilization and early embryonic development.

The female reproductive structure of a flower includes the ***micropyle***, which is located at the tip, and the chalaza, which lies opposite to the micropylar end and represents the basal part of the nucellus. The nucellus is responsible for storing food reserves.

The process of ***megasporogenesis*** involves the formation of megaspores through meiotic division of the megaspore mother cell. Out of the four megaspores formed, only one is functional and develops into the female gametophyte or embryo sac, while the other three typically degenerate in most angiosperms. This is referred to as ***monosporic development.***

The ***embryo sac*** Is formed when the nucleus of the functional megaspore undergoes mitotic division to form two nuclei, which move to opposite poles and result in the formation of a 2-nucleate embryo sac. This eventually develops into a 4-nucleate and later 8-nucleate stage, a process known as ***mega gametogenesis***.

The **mature embryo sac** typically contains *7 cells and 8 nuclei* arranged in a polygonum type pattern. Of the 8 nuclei, 6 are surrounded by a cell wall and organized into cells. Three cells located towards the micropylar end of the embryo sac form the *egg apparatus*, consisting of two *synergids* and *one egg cell*. The 3 cells located at the chalazal end of the embryo sac are called *antipodals*.

Pollination

Pollination is the process of transferring pollen grains from the anther to the stigma. After pollination, the stamen and other whorls fall down.

There are two types of pollination:

A. ***Self-Pollination***: This occurs when pollen grains reach the stigma of the same flower (*autogamy*) or the stigma of another flower of the same plant (*geitonogamy*). Self-pollination can occur in both unisexual and bisexual flowers.

B. ***Cross-Pollination*** or Allogamy (*Xenogamy*): This occurs when pollen grains from one plant reach the stigma of a flower on another plant of the same species. Two plants of the same species are required to produce seeds.

Specific adaptations in flowering parts to prevent self-pollination are *unisexuality, dichogamy, self-sterility and dioecy.* These adaptations are known as ***outbreeding devices***. Pollen grains require certain environmental conditions, such as wind, water, or pollinators like insects, birds, and mammals, to reach the stigma of another plant.

There are various agents of pollination that can help transfer pollen from one flower to another. Here are some of the most common agents of pollination:

Agents of Pollination

Insects: (entomophily) are the most important agents of pollination, with bees being the most effective pollinators.

Birds: (ornithophily) Certain species of birds, such as hummingbirds and sunbirds, are important pollinators.

Wind: Wind pollination(Anemophily) is common in grasses, cereal crops, and trees such as oak and pi

Water: Water pollination (hydrophilic) is rare but occurs in aquatic plants, such as The flowers Vallisneria and hydrilla.

Pollen-pistil interaction

This interaction is a crucial step in the process of sexual reproduction in plants, as it allows for the fusion of the male and female gametes, ultimately leading to the formation of a seed.

The pollen grain, which contains the male gametes, must first land on the stigma, the receptive surface of the pistil. From there, it must germinate and grow a tube down through the style, the long, narrow part of the pistil, in order to reach the ovary, where the female gametes are located.

Along the way, the pollen grain must also navigate various barriers and obstacles, such as the sticky substance on the stigma, which helps to capture and hold the pollen grain in place, and the complex molecular signaling that occurs between the pollen and pistil to ensure that the right pollen grain fertilizes the right ovule.

Successful pollen-pistil interaction is essential for the production of *healthy, viable seeds* and is crucial for the continuation of plant species.

Artificial hybridization

Artificial hybridization is a technique used in crop improvement programs to generate a new offspring by crossing different species and combining desirable traits found in commercially superior varieties. This process involves two key steps: ***emasculation*** and ***bagging***.

Emasculation involves removing the anthers of a flower before they release pollen. This step is crucial to ensure that only the desired pollen is used in the cross, rather than unwanted pollen from the same plant or other nearby plants.

After emasculation, the flower is ***bagged*** and covered to prevent contamination by unwanted pollen. This helps to ensure that the desired pollen, is the only pollen that reaches the stigma and fertilizes the ovules.

Fertilization

Fertilization in flowering plants involves the fusion of male and female gametes, leading to the formation of a zygote and an endosperm.

Double fertilization

Double fertilization is a unique process that occurs in flowering plants during sexual reproduction, during double fertilization, *one sperm cell* fertilizes the *egg cell* to form the *diploid zygote* (***syngamy***), which will develop into the embryo, while the other *sperm cell* fuses with the *polar nuclei* to form the **primary endosperm nucleus (PEN)**, called as(**triple fusion**.)

The *endosperm(3n) i*s an essential component of seeds and provides nutrients for the growing embryo.

Double fertilization is a complex process that is precisely controlled by a series of molecular mechanisms.

Post-fertilization events

After fertilization, several significant events take place such as the *development of the endosperm and embryo*, *maturation of ovules into seeds, and ovary into fruits*. These events occur soon after double-fertilization.

Endosperm development occurs in three types, namely *nuclear, cellular, and helobial.* The nuclear type is the most prevalent, where the PEN undergoes repeated mitotic divisions without cytokinesis, and the endosperm is referred to as a free endosperm nucleus at this stage.

Embryo development occurs at the micropylar end of the embryo sac, and the zygote gives rise to a proembryo, which then develops into a *globular, heart-shaped, and mature embryo.* There are two types of embryos, **dicot**, which consists of *two cotyledons*, and **monocot**, which consists of only one cotyledon, also known as ***scutellum***.

Development of seed

It begins after fertilization and involves the maturation of *ovules* into seeds. The fertilized ovule develops into a seed, consisting of an embryo, endosperm, and a seed coat. The endosperm, which provides nourishment to the developing embryo, can either be absorbed by the embryo or remain as a part of the mature seed. The seed coat protects the embryo and endosperm from damage and dehydration. As the seed develops, it undergoes changes in size, color, and texture, indicating the attainment of maturity. Once mature, the seed is dispersed by various means, such as wind, water, or animals, and can remain dormant until conditions are favorable for germination.

Apomixis

Apomixis refers to a mode of reproduction in plants where the offspring are produced asexually, without the formation of gametes or fertilization. This process results in genetically identical offspring to the parent plant, as the offspring are developed from somatic cells of the maternal plant. Unlike sexual reproduction, which involves the fusion of gametes and genetic recombination, apomixis results in clonal formation. Apomixis occurs naturally in some plant species, and can also be induced through genetic manipulation or tissue culture techniques.

Polyembryo

Polyembryony refers to a phenomenon in plants where more than one embryo develops from a single fertilized egg or from different fertilized eggs within a single seed.

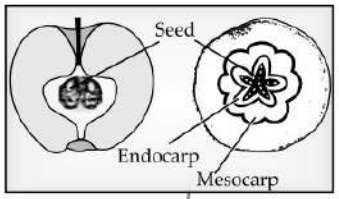
Fruit formation

The formation of fruit in flowering plants involves several stages and can be described as follows:

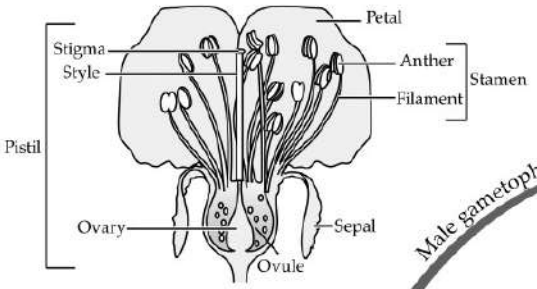
1. After fertilization, the ovary swells and enlarges to form the fruit.
2. The ovules inside the ovary develop into seeds, which are enclosed by the fruit wall.
3. The fruit wall consists of three layers: th***e exocarp, mesocarp, and endocarp. T***he exocarp is the outermost layer, followed by the fleshy middle layer, the mesocarp, and the innermost layer, the endocarp.
4. The type of fruit that develops depends on the ovary's position in the flower and the number of carpels present. Simple fruits develop from a single ovary, while *aggregate* fruits form from several ovaries in a single flower.
5. Fruits can also be classified based on their texture, such as fleshy fruits, dry fruits, or accessory fruits.

Once mature, fruits can aid in seed dispersal through various means, such as animals, wind, or water.

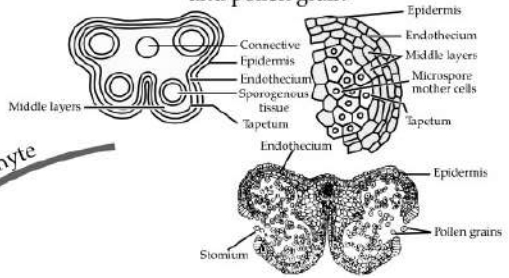
Sexual Reproduction in Flowering Plants



Seed dispersal help the species to colonise in other areas and many fruits have mechanisms for dispersal of seeds.



Stamen, Microsporangium and pollen grain



Male gametophyte

Female gametophyte

Pre-fertilisation events

Flower Structure

Significance of seed dispersal and fruit formation

When parts other than ovary contribute to the fruit formation. e.g.: Apple

False fruit

When fruit develops from ovary e.g.: Mango

True fruit

Occurrence of more than one embryo in a seed

Polyembryony

Development of fruit without fertilisation

Parthenocarpy

Production of seed without fertilisation

Apomixis

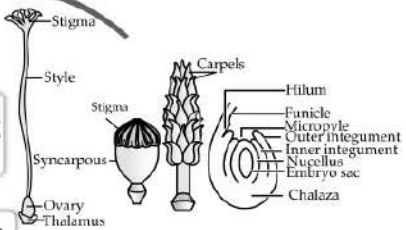
Special modes

Types

Autogamy: pollen transfer from the anther to the stigma of the same flower

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

Xenogamy : pollen transfer from anther to the stigma of a different plant.



Pistil, megasporangium, embryo sac

Pollination

Agencies

Abiotic

- Wind (Anemophily) e.g. grasses;
- Water (Hydrophily) e.g. *Vallisneria, Hydrilla.*

Biotic

- Insects (Entomophily) e.g. *Yucca*
- Birds (Ornithophily) e.g.Daylilies

Outbreeding Devices

Devices for promoting cross pollination

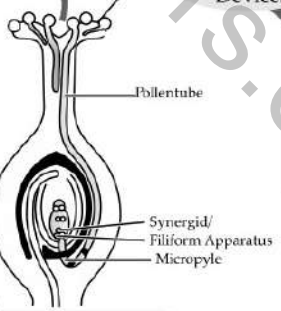
Self–incompatibility

Arrangement of anther and stigma at different positions.

Production of unisexual flowers (Dicliny)

Pollen release and stigma receptivity not synchronised.

Pollen-pistil interaction

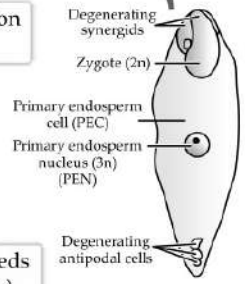


It is a dynamic process involving pollen recognition followed by pollen tube growth.

Post- Fertilisation Events

Double fertilisation

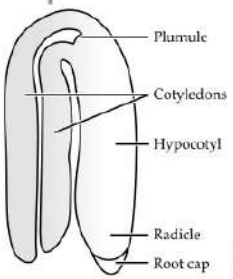
Syngamy + Triple fusion =Double fertilisation.



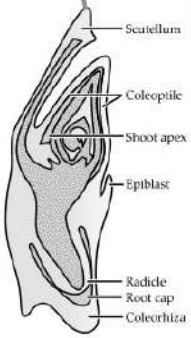
Development of seed

Development of embryo

Dicot embryo



L.S. of Monocot embryo



Albuminous seeds (Endospermic)

Non-albuminous seeds (Non-endospermic)

Development of fruit

Formation of fruit

Development of endosperm

It provides nutrition to growing embryo

Consumed completely in seed e.g..; pea, groundnut,

Persist in some seed e.g.; castor , coconut .

Artificial Hybridisation

It is one of the major approaches of crop improvement by using desired pollen grains for pollination.

Achieved by

Emasculation

Bagging

Trace the Mind Map

First Level · Second Level · Third Level

Practice Questions

1.Which of the following is the process of fusion of male and female gametes in flowering plants?

a) Pollination
b) Fertilization
c) Double fertilization
d) None of the above

2.In angiosperms, the male reproductive organ is known as:

a) Stamen b) Carpel c) Pistil d) all of the above

3.In angiosperms, the female reproductive organ is known as:

a) Stamen b) Carpel c) Pistil d) Ovary

4.The transfer of pollen from the anther to the stigma is known as:

a) Pollination b) Fertilization c) Double fertilization d) None of the above

5.Which of the following is the male gamete in flowering plants?

a) Sperm cell b) Egg cell c) Pollen grain d) Embryo sac

6.Which of the following is the female gamete in flowering plants?

a) Sperm cell b) Egg cell c) Pollen grain d) Embryo sac

7. In angiosperms, double fertilization involves the fusion of:

a) Two sperm cells with the egg and the polar nuclei

b) Two egg cells with the sperm and the polar nuclei

c) One sperm cell with the egg and the other with the polar nuclei

d) None of the above

8. The fusion of the sperm cell with the egg cell during fertilization results in the formation of:

a) Embryo b) Endosperm c) Fruit d) None of the above

9.The process of embryo development in flowering plants involves the formation of:

a) Root and shoot meristems b) Cotyledons

c) Epicotyl and hypocotyl d) All of the above

10.Which of the following is the structure that develops from the ovary after fertilization in flowering plants?

a) Seed b) Fruit c) Cotyledon d) Embryo

11.The transfer of pollen from the anther to the stigma of a flower is known as:

a) Fertilization b) Pollination c) Double fertilization d) None of the above

12.Pollination by wind is known as:

a) Anemophily b) Entomophily c) Ornithophily d) None of the above

13.Pollination by insects is known as:

a) Anemophily b) Entomophily c) Ornithophily d) None of the above

14.The structure in flowers that produces pollen is called:

a) Anther b) Stigma c) Style d) Ovary

15. Insect-pollinated flowers are typically:

a) Small and inconspicuous

b) Brightly colored and scented

c) Green and odorless

d) None of the above

16. In double fertilization, one sperm fertilizes the egg cell while the other sperm fertilizes the:

a) Endosperm nucleus b) Style c) Stigma d) Stamen

17. Double fertilization occurs in which part of the flower?

a) Anther b) Stigma c) Ovary d) Petal

18. In artificial hybridization, the pollen from one plant is transferred to the stigma of:

a) The same plant

b) A different plant of the same species

c) A different plant of a different species

d) None of the above

19.Which of the following is a method of artificial hybridization?

a) Grafting b) Budding c) Cross-pollination d) All of the above

20.Artificial hybridization can be used to:

a) Create new plant varieties

b) Improve plant traits

c) Produce disease-resistant plants

d) All of the above

21.Which of the following is an advantage of artificial hybridization?

a) It results in plants with improved traits

b) It is a natural process

c) It produces genetically identical plants

d) None of the above

22. What is the purpose of emasculation in artificial hybridization?

a) To remove the stigma from the plant b) To remove the anthers from the plant

c) To remove the ovules from the plant d) None of the above

23.Which of the following is a disadvantage of artificial hybridization?

a) It can result in plants with reduced genetic diversity

b) It can be a time-consuming process

c) It can be expensive

d) None of the above

24.Which of the following is an example of a plant created through artificial hybridization?

a) Banana b) Carrot c) Tomato d) All of the above

25.Which of the following is true about apomixis?

a. It is a type of sexual reproduction.

b. It involves fusion of gametes.

c. It produces offspring that are genetically identical to the parent.

d. It produces offspring that have genetic variation.

26.Which of the following is an advantage of apomixis?

a. It produces offspring with genetic variation.

b. It allows for the creation of new plant species.

c. It ensures that offspring are genetically identical to the parent.

d. It allows for the production of offspring without the need for pollinators.

27.Which of the following is an example of apomixis?

a. Self-pollination in tomato plants. b. Vegetative propagation in strawberries.

c. Cross-pollination in corn plants.

d. Germination of a seed from a sexual reproduction event.

28.Which of the following is true about polyembryony?

a. It is a type of asexual reproduction.

b. It involves the production of multiple embryos from a single fertilization event.

c. It results in offspring that are genetically identical to the parent.

d. It is a common phenomenon in angiosperms.

29.Which term refers to the lengthwise running groove on an anther that separates the theca?

a) Rupture line b) Line of dehiscence

c)Suture of anther d) None of the above

30.How many microsporangia are present in an angiospermic anther?

a) 1 b) 2 c) 3 d) 4

31.What does a microsporangium develop into?

a) Pollens b) Microgametes (c) Megagametes d) Pollen sac

32.What is the innermost layer of the microsporangium?

(a) Tapetum (b) Endothecium (c) Middle layer (d) Epidermis

33.What occupies the center of each microsporangium?

(a) Sporogenous tissue (b) Tapetum

(c) Central tissue (d) Microspore mother cell

34.What is the outermost wall layer of the microsporangium in an anther?

(a) Endothecium (b) Tapetum (c) Middle layer (d) Epidermis

35.What is responsible for microsporogenesis?

(a) Microspore mother cell (b) Pollen mother cell

(c) Both (a) and (b) (d) None of these

36.What is the result of the microspore mother cell undergoing meiotic cell division?

(a) Mitotic cell division (b) Meiotic cell division

(c) Both (a) and (b) (d) None of these

37.Which of the following statements is true about the chalazal pole?

(a) It is located opposite to the micropyle.

(b) It originates from the integuments.

(c) It is located opposite to the nucellus.

(d) It is located near the embryo sac

38.The mass of cells enclosed by the integuments is called

(a) nucellus (b) embryo (c) ova (d) pollen

39. The embryo sac is also called

(a) female gamete (b) synergids (c) female gametophyte (d) egg of angiosperm

40. Megasporogenesis is the process of

(a) formation of fruits (b) formation of seeds

(c) formation of megaspores (d) Both (b) and (c)

41.Scutellum is

a) Cotyledon in dicots b) Cotyledon in gymnosperm

c)Monocot root d) Cotyledon in grass family

42.. Sporopollenin is chemically

a) Homopolysaccharide b) Fatty substance

c)Protein d) Heteropolysaccharide

43.Which one of the following is not a correct explanation of cross-pollination?

a) The pollen grains are transferred from one flower to another flower situated on the same plant

b) The pollen grains are transferred from one flower to another flower, of another plant the same species

c)The pollen grains of male flower are transferred to the stigma of the female flower

d)The pollen grains of the flower are transferred to the stigma of the same flower

44.. How many cells are found in female gametophyte?

a)6 b)8 c)7 d)5

45.Identify the wrong statements regarding post-fertilization development.

a)The ovary wall develops into pericarp

b)The outer integument of ovule develops into tegmen

c)The fusion nucleus (triple nucleus) develops into endosperm

d)The ovule develops into seed

46.Thalamus contributes in the fruit formation in

a) Apple b) Strawberry c) Cashew d) All of these

47.Most oldest viable seed is of

a) Lupine b)ficus c)Date palm d)Phoenix

48.Which one of the following was observed for the first time by Trenb?

a) Entry of the pollen tube into the ovule through the micropyle in ottetia

b)Entry of the pollen tube into the ovule through the chalaza in casuarina

c)Entry of the pollen tube into the ovule through the integuments

d)Formation of many pollen tube into the ovule through the grain in hibiscus

49.If male plant has genotypes and female plant have genotypes. Then the result would be

a) All of the pollen will germinate

b) All pollen will die

c)Fertilization doesn't occur

d)Half pollen die and half will germinates on stigma

50.Self incompatibility is

a)For incouraging self-fertilisation pollination

b) Genetic method for preventniig self-pollination

c)Both (a) and (d)

d)Found in unisexual flower

Answers

1. b) Fertilization. Pollination is the transfer of pollen from the male reproductive organ to the female reproductive organ, while fertilization is the process of fusion of male and female gametes.

2. a) Stamen. The stamen is the male reproductive organ in angiosperms, consisting of an anther and a filament.

3. c) Pistil. The pistil is the female reproductive organ in angiosperms, consisting of a stigma, style, and ovary.

4. a) Pollination. Pollination is the transfer of pollen from the anther to the stigma of a flower.

5. c) Pollen grain. The pollen grain in flowering plants contains the male gamete

6. b) Egg cell. The egg cell is the female gamete in flowering plants.

7. c) One sperm cell with the egg and the other with the polar nuclei. Double fertilization in angiosperms involves the fusion of one sperm cell with the egg cell to form the zygote, and the other sperm cell with the polar nuclei to form the endosperm.

8. a) Embryo. The fusion of the sperm cell with the egg cell during fertilization results in the formation of the embryo.

9. d) All of the above. Embryo development in flowering plants involves the formation of root and shoot meristems, cotyledons, epicotyl, and hypocotyl.

10.b) Fruit. The ovary in flowering plants develops into a fruit after fertilization.

11. b) Pollination. Pollination is the process of transfer of pollen from the male reproductive organ (anther) to the female reproductive organ (stigma) in flowering plants.

12. a) Anemophily. Anemophily is the pollination of flowers by wind.

13. b) Entomophily. Entomophily is the pollination of flowers by insects.

14. a) Anther. The anther is the structure in flowers that produces pollen.

15. b) Brightly colored and scented. Insect-pollinated flowers are typically brightly colored and have a strong scent to attract pollinators.

16. a) Endosperm nucleus. In double fertilization, one sperm fertilizes the egg cell to form the zygote, while the other sperm fertilizes the polar nuclei to form the endosperm.

17. c) Ovary. Double fertilization occurs in the ovary of the flower, where the ovules are located.

18. b) A different plant of the same species. In artificial hybridization, the pollen from one plant is transferred to the stigma of a different plant of the same species.

19. c) Cross-pollination. Cross-pollination is a method of artificial hybridization where pollen from one plant is transferred to the stigma of another plant.

20. d) All of the above. Artificial hybridization can be used to create new plant varieties, improve plant traits, and produce disease-resistant plants.

21. a) It results in plants with improved traits. Artificial hybridization can result in plants with improved traits, such as disease resistance or higher yields.

22. b) To remove the anthers from the plant. Emasculation is the process of removing the anthers from the flower to prevent self-pollination and allow for cross-pollination.

23. a) It can result in plants with reduced genetic diversity. Artificial hybridization can result in plants with reduced genetic diversity, which can make them more susceptible to disease or environmental changes.

24. d) All of the above. Many plants, including bananas, carrots, and tomatoes, have been created through artificial hybridization.

25. c) It produces offspring that are genetically identical to the parent.

Explanation: Apomixis is a type of asexual reproduction in which seeds are produced without fertilization, and the offspring are genetically identical to the parent. This means that there is no fusion of gametes, and the resulting offspring have the same genetic makeup as the parent plant.

26. d) It allows for the production of offspring without the need for pollinators.

Explanation: One of the main advantages of apomixis is that it allows for the production of offspring without the need for pollinators or other agents of fertilization. This can be particularly advantageous in environments where pollinators are scarce or where there is a risk of cross-pollination with other plant species.

27. b) Vegetative propagation in strawberries.

Explanation: Vegetative propagation is a type of apomixis in which new plants are produced from vegetative structures such as stems, roots, or leaves. This can occur naturally or through human intervention, as in the case of vegetative propagation of strawberries.

28. b) It involves the production of multiple embryos from a single fertilization event.

Explanation: Polyembryony is a phenomenon in which multiple embryos are produced from a single fertilization event. This can occur naturally or through human intervention, and the resulting embryos may or may not be genetically identical to each other or to the parent

29. c) Suture of anther.

The suture of the anther is a longitudinal line on the anther that separates the two lobes of the anther (called the theca) and allows for the dehiscence (opening) of the anther.

30. b) 2

Explanation: An angiospermic anther typically has two microsporangia, each of which contains numerous microspore mother cells that undergo meiosis to produce microspores (pollen grains).

31. d) Pollen sac

Explanation: The microsporangium is the structure that contains the microspore mother cells that develop into pollen grains. The microsporangium is often referred to as the pollen sac because it is where the pollen grains are produced.

32. b) Endothecium

Explanation: The endothecium is the innermost layer of the microsporangium, and it provides structural support for the developing microspores. It also plays a role in the dehiscence (opening) of the anther.

33. a) Sporogenous tissue

Explanation: The center of each microsporangium is occupied by sporogenous tissue, which contains the microspore mother cells that undergo meiosis to produce the microspores (pollen grains).

34. d) Epidermis

Explanation: The epidermis is the outermost layer of the microsporangium in an anther, and it provides protection for the developing microspores.

35. b) Pollen mother cell

Explanation: Microsporogenesis is the process of producing microspores (pollen grains) from the microspore mother cells. The microspore mother cells undergo meiosis to produce four haploid microspores, each of which develops into a pollen grain.

36. b) Meiotic cell division

Explanation: The microspore mother cell undergoes meiosis to produce four haploid microspores, each of which develops into a pollen grain.

37. c) It is located opposite to the nucellus.

Explanation: The chalazal pole is the end of the embryo sac that is opposite to the micropyle. It is located near the base of the ovule, opposite to the nucellus.

38. b) embryo

Explanation: The mass of cells enclosed by the integuments is the developing embryo, which is the future plant that will grow from the seed.

39. c) female gametophyte

Explanation: The embryo sac is a multicellular structure that develops from the megaspore and contains the female gametes, including the egg and two synergids. It is also known as the female gametophyte.

40. c) formation of megaspores

Explanation: Megasporogenesis is the process of the formation of megaspores, which are the precursors of the female gametophyte. The female gametophyte then develops within the megaspore and contains the egg cell and other cells that aid in reproduction. The formation of fruits is the result of fertilization, while the formation of seeds is the result of the development of the fertilized ovule.

41.Scutellum is:

Answer: D) Cotyledon in grass family

Explanation: Scutellum is a specialized cotyledon found in the seeds of grass family plants. It is a modified structure that is used to transfer nutrients from the endosperm to the developing embryo.

42.Sporopollenin is chemically:

Answer: D) Heteropolysaccharide

Explanation: Sporopollenin is a complex, chemically inert, and highly resistant substance that forms the outer layer of pollen and spores. It is a polymer made up of a variety of monomers, including phenolic compounds, carotenoids, and fatty acids. Hence, it is a heteropolysaccharide.

43. A) The pollen grains are transferred from one flower to another flower situated on the same plant.

Explanation: Cross-pollination is a process in which pollen from one flower is transferred to another flower, either on the same plant or on a different plant of the same species. Option A) is incorrect because cross-pollination cannot occur between two flowers situated on the same plant.

44. B) 8

Explanation: The female gametophyte (embryo sac) is the structure that produces the egg cell in plants. It is formed by the mitotic division of the megaspore mother cell. In most angiosperms, the female gametophyte consists of eight haploid cells, arranged in three groups: the egg cell, two synergids, and three antipodal cells.

45. B) The outer integument of ovule develops into tegmen.

Explanation: After fertilization, the ovule develops into a seed, and the ovary wall develops into a fruit. The endosperm develops from the fusion nucleus (triple fusion) formed during double fertilization.

46.Thalamus contributes in the fruit formation in:

d) All of these.

Thalamus is the receptacle of the flower that supports the reproductive structures of the flower such as sepals, petals, stamens, and carpels. In certain plants, such as apple, strawberry, and cashew nut, the thalamus also contributes to the development of the fruit.

47.The most oldest viable seed is of:

c) Date palm.

The oldest viable seed is the one that can germinate and grow into a plant. The oldest viable seed to date is the Judean date palm, which is believed to be approximately 2,000 years old. The seed was discovered during excavations at the Masada fortress in Israel.

48.Which one of the following was observed for the first time by Trenb?

c) Entry of the pollen tube into the ovule through the integuments.

Trenb observed the entry of the pollen tube into the ovule through the integuments, which are the outer layers of the ovule. This process is known as double fertilization and is unique to flowering plants.

49.If male plant has genotypes and female plant have genotypes. Then the result would be:

d) Half pollen die and half will germinate on stigma.

If the male plant has the genotype AA and the female plant has the genotype aa, then all the F1 generation will be Aa. Therefore, half of the pollen carrying the A allele will germinate on the stigma of the female plant and half carrying a allele will not, resulting in a 1:1 segregation of the F1 generation.

50.Self-incompatibility is:

b) Genetic method for preventing self-pollination.

Self-incompatibility is a genetic mechanism that prevents self-pollination and promotes cross-pollination. In plants with self-incompatibility, the pollen from a flower cannot fertilize the ovules of the same flower or another flower from the same plant due to genetic recognition mechanisms. This promotes genetic diversity in the offspring, which can lead to better adaptation and survival.