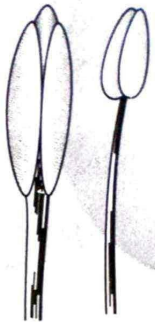
CHAPTER

1 Sexual Reproduction in Flowering Plants



1.2. Pre-Fertilisation: Structures and Events

1. Which part of the ovule stores reserve food materials?

(A) Nucellus (B) Integument

(C) Placenta (D) Funicle **[Re-NEET 2024]**

2. Pollen grains remain preserved as fossils due to the presence of:

(A) Epidermal layer (B) Tapetum

(C) Exine layer (D) Intine layer

[Re-NEET 2024]

3. Identify the set of correct statements:

(I) The flowers of *Vallisneria* are colourful and produce nectar.

(II) The flowers of waterlily are not pollinated by water.

(III) In most of water-pollinated species, the pollen grains are protected from wetting.

(IV) Pollen grains of some hydrophytes are long and ribbon like.

(V) In some hydrophytes, the pollen grains are carried passively inside water.

Choose the correct answer from the options given below:

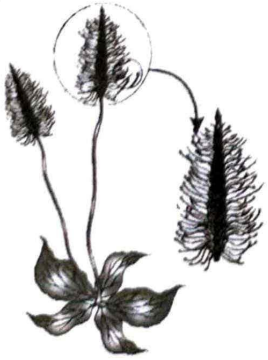
(A) (I), (II), (III) and (IV) only

(B) (I), (III), (IV) and (V) only

(C) (II), (III), (IV) and (V) only

(D) (III), (IV) and (V) only **[NEET 2024]**

4. Identify the correct description about the given figure:



(A) Water pollinated flowers showing stamens with mucilaginous covering.

(B) Cleistogamous flowers showing autogamy.

(C) Compact inflorescence showing complete autogamy.

(D) Wind pollinated plant inflorescence showing flowers with well exposed stamens. **[NEET 2024]**

5. Large, colourful, fragrant flowers with nectar are seen in:

(A) Bat pollinated plants

(B) Wind pollinated plants

(C) Insect pollinated plants

(D) Bird pollinated plants **[NEET 2023]**

6. What is the function of tassels in the corn cob?

(A) To disperse pollen grains

(B) To protect seeds

(C) To attract insects

(D) To trap pollen grains **[NEET 2023]**

7. Given below are two statements. One labelled as Assertion (A) and the other labelled as Reason (R):

Assertion (A): In gymnosperms, the pollen grains are released from the microsporangium and carried by air currents.

Reason (R): Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed.

In the light of the above statements, choose the correct answer from the options given below:

(A) (A) is true but (R) is false

(B) (A) is false but (R) is true

(C) Both (A) and (R) are true and (R) is the correct explanation of (A)

(D) Both (A) and (R) are true but (R) is NOT the correct explanation of (A) **[NEET 2023]**

8. Identify the incorrect statement related to Pollination:

(A) Pollination by wind is more common amongst abiotic pollination.

(B) Flowers produce foul odours to attract flies and beetles to get pollinated.

(C) Moths and butterflies are the most dominant pollinating agents among insects.

(D) Pollination by water is quite rare in flowering plants.

[NEET 2022]

9. Given below are two statements:

Statement I: Cleistogamous flowers are invariably autogamous.

Statement II: Cleistogamy is disadvantageous as there is no chance for cross pollination.

In the light of the given statements, choose the correct answer from the options given below:

(A) Both Statement I and Statement II are incorrect.

(B) Statement I is correct but Statement II is incorrect.

(C) Statement I is incorrect but Statement II is correct.

(D) Both Statement I and Statement II are correct.

[NEET 2022]

10. A typical angiosperm embryo sac at maturity is:

(A) 8-nucleate and 7-celled

(B) 7-nucleate and 8-celled

(C) 7-nucleate and 7-celled

(D) 8-nucleate and 8-celled **[NEET 2021]**

11. The term used for transfer of pollen grains from anthers of one plant to stigma of a different plant which during pollination, brings genetically different types of pollen grains to stigma, is:

(A) Xenogamy (B) Geitonogamy

(C) Chasmogamy (D) Cleistogamy

[NEET 2021]

12. Which of the following is incorrect for wind pollinated plants?

(A) Well exposed stamens and stigma

(B) Many ovules in each ovary

(C) Flowers are small and not brightly coloured

(D) Pollen grains are light and non-sticky

[NEET Oct. 2020]

13. In water hyacinth and water lily, pollination takes place by:

(A) water currents only (B) wind and water

(C) insects and water (D) insects or wind.

[NEET Sept. 2020]

14. The body of the ovule is fused within the funicle at:

(A) micropyle (B) nucellus

(C) chalaza (D) hilum. **[NEET Sept. 2020]**

15. Which is the most common type of embryo sac in angiosperms?

(A) Tetrasporic with one mitotic stage of divisions

(B) Monosporic with three sequential mitotic divisions

(C) Monosporic with two sequential mitotic divisions

(D) Bisporic with two sequential mitotic divisions

[NEET Odisha 2019]

16. What type of pollination takes place in *Vallisneria*?

(A) Pollination occurs in submerged condition by water.

(B) Flowers emerge above surface of water and pollination occurs by insects.

(C) Flowers emerge above water surface and pollen is carried by wind.

(D) Male flowers are carried by water currents to female flowers at the surface of water.

[NEET Odisha 2019]

17. Pollen grains can be stored for several years in liquid nitrogen having temperature of:

(A) – 196°C (B) – 80°C

(C) – 120°C (D) – 160°C. **[NEET 2018]**

18. Which of the following has proved helpful in preserving pollen as fossils?

(A) Oil content (B) Cellulosic intine

(C) Pollen kitt (D) Sporopollenin

[NEET 2018]

19. Flowers, which have single ovule in the ovary and are packed into inflorescence are usually pollinated by:

(A) water (B) bee

(C) wind (D) bat **[NEET 2017]**

20. Functional megaspore in an angiosperm develops into:

(A) ovule (B) endosperm

(C) embryo sac (D) embryo **[NEET 2017]**

21. A dioecious flowering plant prevents both:

(A) autogamy and xenogamy

(B) autogamy and geitonogamy

(C) geitonogamy and xenogamy

(D) cleistogamy and xenogamy. **[NEET 2017]**

22. Attractants and rewards are required for:

(A) anemophily (B) entomophily

(C) hydrophily (D) cleistogamy **[NEET 2017]**

23. Which one of the following statement is not true?

(A) Exine of pollen grains is made up of sporopollenin.

(B) Pollen grains of many species cause severe allergies.

(C) Stored pollen in liquid nitrogen can be used in the crop breeding programmes.

(D) Tapetum helps in the dehiscence of anther

[NEET Phase-I 2016]

24. Proximal end of the filament of stamen is attached to the:

(A) connective (B) placenta

(C) thalamus or petal (D) anther

[NEET Phase-I 2016]

25. In majority of angiosperms:

(A) egg has a filiform apparatus

(B) there are numerous antipodal cells

(C) reduction division occurs in the megaspore mother cells

(D) a small central cell is present in the embryo sac

[NEET Phase-II 2016]

26. Pollination in water hyacinth and water lily is brought about by the agency of:

(A) water (B) insects or wind

(C) birds (D) bats

[NEET Phase-II 2016]

27. The ovule of an angiosperm is technically equivalent to:

(A) megasporangium

(B) megasporophyll

(C) megaspore mother cell

(D) megaspore **[NEET Phase-II 2016]**

28. Which one of the following may require pollinators, but is genetically similar to autogamy?

(A) Geitonogamy (B) Xenogamy

(C) Apogamy (D) Cleistogamy

[AIPMT Cancelled 2015]

29. Which of the following are the important floral rewards to the animal pollinators?

(A) Colour and large size of flower

(B) Nectar and pollen grains

(C) Floral fragrance and calcium crystals

(D) Protein pellicle and stigmatic exudates

[AIPMT Cancelled 2015]

30. Filiform apparatus is characteristic feature of:

(A) generative cell (B) nucellar embryo

(C) aleurone cell (D) synergids

[AIPM Latest July 2015]

31. In angiosperms, microsporogenesis and megasporogenesis:

(A) occur in anther

(B) form gametes without further divisions

(C) involve meiosis

(D) occur in ovule **[AIPMT Latest July 2015]**

32. Function of filiform apparatus is to:

(A) recognise the suitable pollen at stigma

(B) stimulate division of generative cell

(C) produce nectar

(D) guide the entry of pollen tube. **[AIPMT 2014]**

33. Megasporangium is equivalent to:

(A) embryo sac (B) fruit

(C) nucellus (D) ovule. **[NEET 2013]**

34. Which one of the following statement is correct?

(A) Hard outer layer of pollen is called intine.

(B) Sporogenous tissue is haploid.

(C) Endothecium produces the microspores.

(D) Tapetum nourishes the developing pollen.

[NEET 2013]

35. Advantage of cleistogamy is:

(A) higher genetic variability

(B) more vigorous offspring

(C) no dependence on pollinators

(D) vivipary **[NEET 2013]**

36. Animal vectors are required for pollination in:

(A) *Vallisneria* (B) mulberry

(C) cucumber (D) maize

[NEET Karnataka 2013]

37. Megaspores are produced from the megaspore mother cells after:

(A) mitotic division (B) formation of thick wall

(C) differentiation (D) meiotic division

[NEET Karnataka 2013]

38. Which of the following statements is correct?

(A) Sporopollenin can be degraded by enzymes.

(B) Sporopollenin is made up of inorganic materials.

(C) Sporopollenin can withstand high temperatures as well as strong acids and alkalis.

(D) Sporopollenin can withstand high temperatures but not strong acids. **[NEET Karnataka 2013]**

39. Both, autogamy and geitonogamy are prevented in:

(A) papaya (B) cucumber

(C) castor (D) maize

[AIPMT Screening 2012]

40. An organic substance that can withstand environmental extremes and cannot be degraded by any enzyme is:

(A) cuticle (B) sporopollenin

(C) lignin (D) cellulose

[AIPMT Screening 2012]

41. Even in absence of pollinating agents, seed-setting is assured in:

(A) *Commelina* (B) *Zostera*

(C) *Salvia* (D) fig

[AIPMT Screening 2012]

42. What is the function of germ pore?

(A) Emergence of radicle

(B) Absorption of water for seed germination

(C) Initiation of pollen tube

(D) Release of male gametes **[AIPMT Mains 2012]**

43. Plants with ovaries having only one or a few ovules, are generally pollinated by:

(A) bees (B) butterflies

(C) birds (D) wind

[AIPMT Mains 2012]

44. Filiform apparatus is a characteristic feature of:

(A) egg (B) synergid

(C) zygote (D) suspensor

[AIPMT Screening 2011]

45. Wind pollination is common in:
(A) lilies (B) grasses
(C) orchids (D) legumes
[AIPMT Screening 2011]

46. In which one of the following, pollination is autogamous?
(A) Xenogamy (B) Chasmogamy
(C) Cleistogamy (D) Geitonogamy
[AIPMT Screening 2011]

47. In angiosperms, functional megaspore develops into:
(A) embryo sac (B) ovule
(C) endosperm (D) pollen sac
[AIPMT Mains 2011]

48. Transfer of pollen grains from the anther to the stigma of another flower of the same plant is called:
(A) xenogamy (B) geitonogamy
(C) karyogamy (D) autogamy
[AIPMT Screening 2010]

49. Wind pollinated flowers are:
(A) small, brightly coloured, producing large number of pollen grains
(B) small, producing large number of dry pollen grains
(C) large, producing abundant nectar and pollen
(D) small, producing nectar and dry pollen
[AIPMT Screening 2010]

50. Unisexuality of flowers prevents:
(A) autogamy, but not geitonogamy
(B) both geitonogamy and xenogamy
(C) geitonogamy, but not xenogamy
(D) autogamy and geitonogamy
[AIPMT Screening 2008]

51. What does the filiform apparatus do at the entrance of the ovule?
(A) It helps in the entry of pollen tube into a synergid.
(B) It prevents entry of more than one pollen tube into the embryo sac.
(C) It brings about opening of the pollen tube.
(D) It guides pollen tube from a synergid to egg
[AIPMT Screening 2008]

52. Which one of the following is surrounded by callose wall?
(A) Male gamete (B) Egg
(C) Pollen grain (D) Microspore mother cell
[AIPMT 2007]

53. Male gametes in angiosperms are formed by the division of:
(A) generative cell
(B) vegetative cell
(C) microspore mother cell
(D) microspore **[AIPMT 2007]**

54. Long filamentous threads protruding at the end of a young cob of maize are:
(A) hairs (B) anthers
(C) styles (D) ovaries **[AIPMT 2006]**

55. Which one of the following represents an ovule, where the embryo sac becomes horse-shoe shaped and the funiculus and micropyle are close to each other?
(A) Amphitropous (B) Circinotropous
(C) Atropous (D) Antropous **[AIPMT 2005]**

56. In a flowering plant, archesporium gives rise to:
(A) only the wall of the sporangium
(B) both wall and the sporogenous cells
(C) wall and the tapetum
(D) only tapetum and sporogenous cells **[AIPMT 2003]**

57. What is the direction of micropyle in anatropous ovule?
(A) Upward (B) Downward
(C) Right (D) Left **[AIPMT 2002]**

58. In angiosperm all the four microspores of tetrad are covered by a layer which is formed by:
(A) pectocellulose (B) callose
(C) cellulose (D) sporopollenin
[AIPMT 2002]

59. Anemophily type of pollination is:
(A) *Salvia* (B) bottle brush
(C) *Vallisneria* (D) coconut **[AIPMT 2001]**

60. Flowers showing ornithophily show few characteristic like:
(A) blue flower with nectaries at bases of corolla
(B) red sweet scented flower with nectaries
(C) bright red flower into thick inflorescence
(D) white flowers with fragrance **[AIPMT 1999]**

61. How many pollen grains will be formed after meiotic division in 10 microspore mother cells?
(A) 10 (B) 20
(C) 40 (D) 80 **[AIPMT 1996]**

62. In an angiosperm, how many microspore mother cells are required to produce 100 pollen grains?
(A) 25 (B) 50
(C) 75 (D) 100 **[AIPMT 1995]**

63. The Anthesis is a phenomenon, which refers to:
(A) Development of anthers
(B) Opening of flower bud
(C) Stigma receptors
(D) All of these **[AIPMT 1995]**

64. Number of meiotic divisions required to produce 200/400 seeds of pea would be:
(A) 200/400 (B) 400/800
(C) 300/600 (D) 250/500 **[AIPMT 1995]**

65. Chief pollinators of agricultural crops are:
(A) butterflies (B) bees
(C) moths (D) beetles **[AIPMT 1994]**

66. Fertilisation involving carrying of male gametes by pollen tube is:
(A) porogamy (B) siphonogamy
(C) chalazogamy (D) syngonogamy
[AIPMT 1994]

67. Meiosis is best observed in dividing:
(A) cells of apical meristem
(B) cells of lateral meristem
(C) microspores and anther wall
(D) microsporocytes **[AIPMT 1992]**

68. Point out the odd one:
(A) nucellus (B) embryo sac
(C) micropyle (D) pollen grain
[AIPMT 1991]

69. Pollination occurs in:
(A) bryophytes and angiosperms
(B) pteridophytes and angiosperms
(C) angiosperms and gymnosperms
(D) angiosperms and fungi **[AIPMT 1991]**

70. Embryo sac occurs in:
(A) embryo (B) axis part of embryo
(C) ovule (D) endosperm **[AIPMT 1991]**

71. Entry of pollen tube through micropyle is:
(A) Chalazogamy (B) Mesogamy
(C) Porogamy (D) Pseudogamy
[AIPMT 1990]

72. Generative cell was destroyed by laser but a normal pollen tube was still formed because:
(A) vegetative cell is not damaged
(B) contents of killed generative cell stimulate pollen growth.
(C) laser beam stimulates growth of pollen tube
(D) the region of emergence of pollen tube is not harmed
[AIPMT 1989]

73. Male gametophyte of angiosperms is shed as:
(A) four-celled pollen grain
(B) three-celled pollen grain
(C) microspore mother cell
(D) anther **[AIPMT 1988]**

74. Total number of meiotic divisions required for forming 100 zygotes/100 grains of wheat are:
(A) 100 (B) 75
(C) 125 (D) 50 **[AIPMT 1988]**

1.3. Double Fertilisation

75. In angiosperm, the haploid, diploid and triploid structures of a fertilized embryo sac sequentially are:
(A) Synergids, Zygote and Primary endosperm nucleus
(B) Synergids, Antipodals and Polar nuclei
(C) Synergids, Primary endosperm nucleus and Zygote
(D) Antipodals, Synergids, and Primary endosperm nucleus **[NEET 2023]**

76. What is the fate of the male gametes discharged in the synergid?
(A) All fuse with the egg.
(B) One fuses with the egg, other(s) fuse(s) with synergid nucleus.
(C) One fuses with the egg and other fuses with central cell nuclei.
(D) One fuses with the egg other(s) degenerate(s) in the synergid. **[NEET National 2019]**

77. Double fertilisation is:
(A) fusion of two male gametes with one egg
(B) fusion of one male gamete with two polar nuclei
(C) fusion of two male gametes of pollen tube with two different eggs
(D) syngamy and triple fusion **[NEET 2018]**

78. Double fertilisation is exhibited by:
(A) gymnosperms (B) algae
(C) fungi (D) angiosperms **[NEET 2017]**

79. Which one of the following statements is wrong?
(A) When pollen is shed at two-celled stage, double fertilisation does not take place.
(B) Vegetative cell is larger than generative cell.
(C) Pollen grains in some plants remain viable for months.
(D) Intine is made up of cellulose and pectin.
[AIPMT Mains 2012]

80. Which of the following is without exception in angiosperms?
(A) Presence of vessels
(B) Double fertilisation
(C) Secondary growth
(D) Autotrophic nutrition **[AIPMT 2002]**

81. In angiosperms pollen tubes liberate their male gametes into the:
(A) central cell (B) antipodal cells
(C) egg cell (D) synergids **[AIPMT 2002]**

82. Double fertilisation leading to initiation of endosperm in angiosperms require:

(A) fusion of one polar nucleus and the second male gamete only

(B) fusion of two polar nuclei and the second male gamete

(C) fusion of four or more polar nuclei and the second male gamete only

(D) all of the above kinds of fusion in different angiosperms **[AIPMT 2000]**

83. In angiosperms, triple fusion is required for the formation of:

(A) embryo (B) endosperm

(C) seed coat (D) fruit wall. **[AIPMT 1996]**

84. Double fertilisation and triple fusion were discovered by:

(A) Hofmeister (B) Nawaschin and Guignard

(C) Leeuwenhoek (D) Strasburger

[AIPMT 1993, 88]

85. Syngamy means:

(A) Fusion of gametes

(B) Fusion of cytoplasms

(C) Fusion of two similar spores

(D) Fusion of two dissimilar spores **[AIPMT 1991]**

1.4. Post-fertilisation: Structures and Events

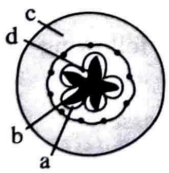
86. The part marked as '*x*' in the given figure is:

(A) Endosperm (B) Thalamus

(C) Endocarp (D) Mesocarp

[Re-NEET 2024]

87. Which part of the fruit, labelled in the given figure makes it a false fruit?



(A) b → Endocarp (B) c → Thalamus

(C) d → Seed (D) a → Mesocarp

[NEET 2022]

88. Which one of the following statements regarding post-fertilisation development in flowering plants is incorrect?

(A) Zygote develops into embryo.

(B) Central cell develops into endosperm.

(C) Ovules develop into embryo sac.

(D) Ovary develops into fruit. **[NEET National 2019]**

89. The morphological nature of the edible part of coconut is:

(A) perisperm (B) cotyledon

(C) endosperm (D) pericarp.

[NEET 2017, AIPMT Screening 2012]

90. The coconut water from tender coconut represents:

(A) fleshy mesocarp

(B) free-nuclear proembryo

(C) free-nuclear endosperm

(D) endocarp. **[NEET Phase-I 2016, AIPMT Latest July 2015]**

91. Endosperm is consumed by developing embryo in the seed of:

(A) coconut (B) castor

(C) pea (D) maize.

[AIPMT Screening 2008]

92. The embryo in sunflower has:

(a) two cotyledons (b) many cotyledons

(c) no cotyledon (d) one cotyledon

[AIPMT 1998]

93. Study of formation, growth and development of new individual from an egg is:

(A) apomixis (B) embryology

(C) embryogeny (D) cytology **[AIPMT 1993]**

94. Tegmen develops from:

(A) Funiculus (B) Chalaza

(C) Inner integument (D) Outer integument.

[AIPMT 1990]

95. Perisperm is:

(A) remnant of endosperm

(B) persistent nucellus

(C) peripheral part of endosperm

(D) disintegrated secondary nucleus **[AIPMT 1989, 88]**

1.5. Apomixis and Polyembryony

96. Seed formation without fertilisation in flowering plants involves the process of:

(A) budding (B) somatic hybridization

(C) apomixis (D) sporulation.

[NEET Phase-I 2016, AIPMT Latest July 2015]

97. Nucellar polyembryony is reported in species of:

(A) *Gossypium* (B) *Triticum*

(C) *Brassica* (D) *Citrus*.

[AIPMT Screening 2011]

98. Apomictic embryos in *Citrus* arise from:
(A) synergids
(B) maternal sporophytic tissue in ovule
(C) antipodal cells
(D) diploid egg. **[AIPMT Screening 2010]**

99. In a type of apomixis known as adventive embryony, embryos develop directly from the:
(a) Nucellus or integuments
(b) Zygote
(c) Synergids or antipodals in an embryo sac
(d) Accessory embryo sacs in an ovule **[AIPMT 2005]**

100. The polyembryony commonly occurs in:
(A) Tomato (B) Potato
(C) *Citrus* (D) Turmeric **[AIPMT 1995]**

SOLUTIONS

1. (A) Nucellus of the ovule take part in the storage of reserve food materials.

The covering of ovule refers to the integument. Placenta is the part of the ovule where the funiculus is present. Funicle is the stalk of the ovule.

2. (C) Pollen grains have a eminent double-layered wall. The outer layer is hard called the exine which is made up of sporopollenin. It is one of the most impenetrable organic material known and this substance help them remain as preserved as fossils.

3. (C) The flowers of Vallisneria are not colorful and do not produce nectar. They are adapted for underwater pollination and are typically small and white.

Related Theory

- *The flowers of waterlily are pollinated by insects.*
- *In most water-pollinated species, such as Vallisneria, the pollen grains are protected from wetting by mucilaginous covering.*
- *The pollen grains of some hydrophytes like sea grasses are long and ribbon-like, which facilitates their dispersal in water.*
- *In some hydrophytes, pollen grains are carried passively inside water, which is a characteristic of hydrophilous (water pollination) adaptation.*

4. (D) The given figure shows a wind-pollinated plant showing inflorescence with well exposed stamens. Stamens are exposed, so complete autogamy does not occur.

5. (C) Plants that are pollinated by insects have large, vibrant, fragrant blooms that contain nectar. This is so that insects such as bees, butterflies, moths, and flies, can be drawn to flowers that offer nectar, a sugary liquid, and pollen. The brilliant colors and aroma of flowers attract insects. After that, when the insects go from flower to flower in quest of nectar, they brush against the stamens and gather up pollen, which they then transfer to other flowers. This facilitates the movement of pollen from the flower's anther to stigma, facilitating pollination and fertilisation, and ultimately the development of seeds.

6. (D) Tassels represent the female reproductive part like style and stigma in corn. These tassels are used by the plant to trap the pollen grain which are dispersed in the air. This is the modification by the plant for wind pollination.

7. (A) In gymnosperms, the male gametes are discharged from the pollen grain itself, not from the mouth of the archegonia. After the pollen grain lands on the ovule, the male gametes are released from the pollen grain and fertilise the egg cell within the ovule, without the formation of a pollen tube.

8. (C) Pollination is the transfer of pollen grains from the anther to the stigma of a pistil. Bees, not moths or butterflies, are the principal pollination agents among insects. To attract these insects, the flowers produce foul odour. Wind pollinating is more common in abiotic pollinations. Pollen grains that are light and non-sticky help in the wind pollination. It aids pollen transportation in wind currents. They frequently have exposed stamens, allowing pollen to be easily dispersed via wind currents. Water pollination is uncommon in flowering plants, occurring in only around 30 taxa, the majority of which are monocotyledons.

Related Theory

- *Most insect-pollinated flowers are large, colorful, aromatic, and nectar-rich. The bulk of flowering plants rely on a variety of animals to pollinate them. Common pollinators include bees, butterflies, flies, beetles, wasps, ants, moths, birds (sunbirds and hummingbirds), and bats.*

9. (D) The anther and stigma are cleistogamous, which means they are very near to one other within the same flower. As the anthers and stigma are so close together, these flowers are bisexual. Self-pollination happens in these flowers because the flowers remain closed long after they have matured. They are generally autogamous forms of flowers because they remain closed, and there is no chance of cross-pollen landing on the stigma. *Viola* (common pansy), *Oxalis*, and *Commelina* are a few examples.

Related Theory

Even in the absence of pollinators, cleistogamous flowers produce assured seed-set. This is due to the proximity of the anther and stigma. Pollination occurs when pollen is discharged and comes into contact with the stigma. As a result, pollinators aren't needed to pollinate cleistogamous flowers.

Caution

Students often get confused between two terms autogamous and allogamous. They should remember that autogamous species are those whose ovules are (predominantly) fertilised by pollen from the same flower, whereas allogamous species are those whose ovules are fertilised by pollen from another flower, typically from a different plant.

10. (A) The embryo sac of angiosperms consists of seven cells. A typical angiospermic embryo at maturity is 7-celled 8-nucleate. The cells are arranged in three sets *i.e.*, three cells are grouped together at the micropylar end and constitute the egg apparatus. The egg apparatus, in turn, consists of two synergids and one egg cell. Three cells are at the chalazal end and are called the antipodals. In the centre, there are two polar nuclei which are a part of the large central cell.

11. (A) Xenogamy is the transfer of pollen grains from the anther to the stigma of a different plant. This is the only type of pollination during which pollination brings genetically different types of pollen grains to the stigma. On the other hand, geitonogamy is the transfer of pollen from the anther of one flower to the stigma of another flower on the same plant. Although geitonogamy is cross-pollination involving a pollinating agent, genetically it is identical to autogamy because the pollen grains come from the same plant. Chasmogamous flowers are open and showy, exposing their reproductive structures to the outside, whereas cleistogamous flowers remain closed and hidden so that anthers and stigmas are never exposed. These both flowers shows autogamy (pollination is achieved within the same flower).

Related Theory

Pollination is essential for fertilisation and production of seeds and fruits which are necessary for continuity of plant life. Cross-pollination, results in production of plants with a combination of characters from two plants. Pollination is significant in production of hybrid seeds.

12. (B) Wind pollinated flowers are characterised by single ovule in each ovary, small and inconspicuous, colourless and nectar-less flowers, light and sticky pollen grains, well exposed stamens and sticky stigma. All these factors contribute to the high probability of pollination and thus, results in fertilisation of flowers.

Related Theory

In Anemophily, a large number of pollen grains are produced as the number of pollen grains are wasted or lost during the directionless pollination.

Mnemonics

The number of ovules in an ovary may be one to many. So to remember their examples, follow the given trick.
For single ovule, examples can be learned as:

Man Watch a Picture

Man – ***Mango***

Watch – ***Wheat***

Picture – ***Paddy***

For many ovules, examples can be learned as:

Papa Won Orchids

Papa – ***Papaya***

Won – ***Watermelon***

Orchids – ***Orchids***

13. (D) In water hyacinth and water lily, the flowers emerge above the level of water and are thus pollinated by insects or wind. The flowers of water lily are brightly coloured and have pleasant smell, while the pollen grains are large, sticky and spiny. Thus, it mainly exhibit entomophily (pollination by insects). The flowers of water hyacinth are colourless and do not have smell, while the pollen grains are small and light in weight. Thus, they generally exhibit anemophily (pollination by wind). Flowers of water hyacinth and water lily cannot be pollinated by water currents (hydrophily) as the flowers are not submerged in water and do not release pollen grains in water.

Related Theory

Pollination in Vallisneria is epihydrophily. It is a type of hydrophily which occurs on the surface of water. The female flower have a very long pedicel, therefore it reaches the surface of water. Male flowers after breakage floats on the surface of water. Pollen grains are released on to the surface of water. They are carried passively by water currents, some of them eventually reach the female flowers and the stigma.

14. (D) The point of attachment of funicle and body of ovule is known as hilum. It is the point where ovule attaches to the base and is present as the eye or scar on the seed. Micropyle is a minute opening in the integument of an ovule of a seed plant. The nucellus is the largest part of the ovule. It houses the embryo sac as well as nutritive tissue and actually remains present in some flowering plants after fertilization as a source of nutrients for the Embryo. Chalaza is located opposite the micropyle opening of the

integuments. It is the tissue where the integuments and nucellus are joined. Nutrients from the plant travel through vascular tissue in the funiculus and outer integument through the chalaza into the nucellus.

Caution

In anatropus ovule, synergid cells and egg cell is present at micropylar end and antipodal cells are present at chalazal end.

15. (B) The most common type of female gametophyte (embryo sac) in angiosperm is the monosporic embryo sac in which the embryo sac develops from a single functional megaspore (n) while the other three megaspores degenerate. The functional megaspore undergoes three sequential mitotic divisions and gives rise to 8-nucleate and 7-celled mature embryo sac.

Related Theory

An embryo sac is said to form when the haploid megaspore nucleus divides. It possesses two haploid nuclei and six haploid cells which have cell walls. The embryo sac formation occurs in two stages: In the first stage, megasporogenesis occurs, where the haploid megaspore tetrad forms due to the meiosis of a single diploid mother cell; the second stage is the megagametogenesis, where the embryo sac is formed due to mitosis of the functional haploid megaspore to produce 8-nucleate, 7-celled gametophyte.

Caution

The female gametophyte called the embryo sac, produces the female gametes and usually is obscured within the maternal, sporophytic ovule. Fusion of male and female gametes occurs during double fertilisation, after the sperm cells are delivered to the embryo sac by the pollen tube.

16. (D) *Vallisneria* is a water pollinated plant. The female flowers reach the surface of water by the long stalk and the male flowers or pollen grains are released onto the surface of water. They are carried passively by water currents to female flowers at surface of water.

Related Theory

Vallisneria (eelgrass, tape grass) is a submerged plant that spreads by runners and sometimes forms tall underwater meadows. Leaves arise in clusters from their roots. The leaves have rounded tips, and definite raised veins. Single white female flowers grow to the water surface on very long stalks. Male flowers grow on short stalks, become detached, and float to the surface. The fruit is a banana-like capsule having many tiny seeds.

17. (A) The temperature of liquid nitrogen is –196°C. Seeds and pollen grains are preserved in low temperature, which can be later used in plant breeding techniques.

Related Theory

Cryopreservation is a process of preserving or storing cells, tissues, organs or any other biological materials from any potential damage by maintaining the materials at very low temperature. It maintains biological samples in a state of suspended animation for any considerable period and is used to preserve the fine structure of cells. The liquid nitrogen is used for storing viable samples at –196° C, maintaining the energy efficiency and providing an environmental friendly approach to cryopreservation. This method ensures that cells remain viable, and indefinite storage is possible.

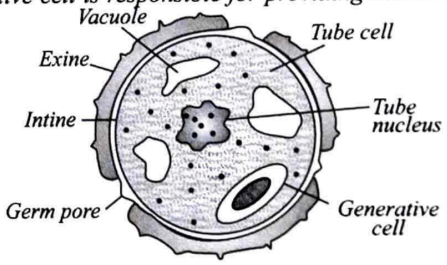
Caution

Students make mistake as they are unaware of the temperature of liquid nitrogen.

18. (D) Sporopollenin forms the outer covering of the exine and the most resistant organic material on the Earth. It protects the pollen grains from external damages such as rain and high temperature. Intine covers the pollen grains, inner to exine, and composed of pectin and cellulose. Oil content in pollen grain act as a reserve material for living cells. Pollen kitt is a yellowish, viscous, sticky and oily layer that covers exine of insect pollinated flowers.

Related Theory

The pollen grain is the male gametophyte which contains the male gametes. The pollen grain is surrounded by two layers as exine, the outer layer and intine, the inner layer. The intine layer comes out of the germ pore to form the pollen tube. The generative cell divides to form the two male gametes. The vegetative cell is responsible for providing nutrition.



Pollen Grain

19. (C) The flowers with packed inflorescence and single ovary, produce large number of pollen grains, which are light weighted and sometimes are winged. They are pollinated by wind (anemophily). Flower pollinated by water (hydrophily) are small and inconspicuous, floral parts are unwettable, Pollen grains are light and have mucilage cover. Stigma is long, sticky but unwettable. Flower pollinated by bee (entomophily) are brightly coloured, scented, and secrete nectar, pollen grains are larger, sticky, and spiny and low in number. The stigma of flowers is small and deep within the corolla. Flower pollinated by bat (chiropterophily) are large and showy, white or light coloured, open at night and have strong musty odours. They are often large balls of stamens.

Related Theory

Malacophily refers to when pollination of plants occurs through snails. Pollination by the agency of ants is called myrmecophily. Ornithophily is the pollination by birds.

20. (C) In angiosperm, a functional megaspore develops into an embryo sac. The functional megaspore is the first cell of female gametophyte. The ovule of an angiosperm is referred to as the megasporangium. Embryo is the part of a seed or bud that contains the earliest forms of a plant's roots, stem and leaves. Endosperm is formed after double fertilisation.

21. (B) Dioecious plants contain unisexual flowers on different plants. Hence, it does not favour self-fertilisation/ self-pollination. Autogamy is the pollination of a flower by its own pollens, whereas geitonogamy is the pollination of a flower by pollen grains of another flower present on the same plant. Xenogamy is the transfer of pollen grains from anther of one flower to stigma of another flower of a different plant. It is a type of cross-pollination. Cleistogamous flowers are monoecious flowers which do not open at all and only autogamy occurs.

Related Theory

Advantages of Cross Pollination:

(1) Cross-pollination brings about genetic recombination resulting into the origin of new varieties.

(2) The offspring produced through cross-pollination are healthy and stronger due to hybrid vigour.

(3) Numerous crop plants (such as sunflower, mustard, clover, etc.) give higher yields if only cross-pollination is allowed to occur in them.

(4) Variations are produced due to cross-pollination resulting into the origin of disease resistant plants.

22. (B) Entomophily refers to pollination by insects. Flowers produce fragrance odor to attract insects and produce nectar as a reward for effective pollination. Anemophily is pollination by wind. Hydrophily is pollination by water currents. Cleistogamy is pollination in cleistogamous (closed) flowers.

Related Theory

Entomophilous flowers generally have the following characteristic features:

(1) They are large, brightly colored and often scented.

(2) The flowers produce nectar as a source of food for insects which imbibe sugary nectar from the nectarines and collect the pollen.

(3) Nectaries, anthers and stigmas are situated in a special relationship to one another, so that the anthers and stigmas must be disturbed if the nectar or pollen is to be reached by the insect.

(4) The pollen grains are usually thick-walled, sticky and spiny to enhance adhesion to bodies of insects.

23. (D) Tapetum forms the inner layer of anther and provides nourishment to the developing pollen grains. Pollen grains consist of two layers, outer exine (made of sporopollenin) and inner intine (made of pectin). Pollen grains are common agents that cause allergies. Pollen grains of threatened plants are cryopreserved in –196°C for future use.

24. (C) Stamen is the male reproductive part of flowers. It consists of filaments, attached to the base of a flower *i.e.*, thalamus or sometimes with petal. Distal end of stamen consists of free anthers, containing pollen grains. Connective tissue is found in anther, while placenta is the part of female reproductive organ.

Related Theory

Microsporogenesis comprises the events leading to the formation of the haploid unicellular microspores. During microsporogenesis, the diploid sporogenous cells differentiate as microsporocytes (pollen mother cells or meiocytes) which divide by meiosis to form four haploid microspores. Each diploid meiocyte gives rise to a tetrad of four haploid microspores or pollen grains.

Caution

Students usually get confused between the terms proximal and distal end. To simplify, proximal is toward the point of origin of a part while distal is away from the point or origin of the part.

Mnemonics

The names of male reproductive system can be memorized by the given simple and easy trick.

Fir Aayi Subah, Aazaadi Ki!

Fir	–	***Filament***
Aayi	–	***Anther***
Subah	–	***Stamen***
Aazaadi ki	–	***Androecium***

*Remember: **Distal** as **D**istance from the origin.*

25. (C) In angiosperms, megaspore mother cell are diploid and they undergoes meiotic division to form haploid egg cell. Egg does not have filiform apparatus, but embryo sac consisting of two synergids and one egg cell at the micropylar end. These synergids have special cellular thickenings called filiform apparatus, which play an important role in guiding the pollen tubes into the synergid. There are three antipodal cells at the chalazal end. A large central cell is present in the embryo sac.

26. (B) Water hyacinth and water lily despite being hydrophytes, shows pollination by insects or wind, not by water. This is because the flowers are not submerged in water. They are above the water level.

27. (A) Ovule is equivalent to megasporangium. Megasporophyll is equivalent to the carpel of the angiosperms. The megaspore is produced inside the nucellus of the ovule. During megasporogenesis, a diploid precursor cell, the megaspore mother cell, undergoes meiosis to produce initially four haploid megaspores.

28. (A) Geitonogamy is the type of self-pollination, which involves the transfer of pollen from the anther of one flower to the stigma of another flower on the same plant. It requires pollinating agents to facilitates

the pollination and result in genetically similar progenies. Xenogamy is a type of cross fertilisation, which results in genetically different progenies. Cleistogamy is the condition in which flower does not open and hence facilitates self-pollination, without any agents. Apogamy is the development of sporophytes without gametes and syngamy from vegetative cells of the gametophyte. It is usually seen in ferns.

Caution

➥ *Students should remember that genetically similar plants occurs in case of self-pollination. It can be either autogamy or geitonogamy.*

29. (B) Floral reward includes any part of the flower which attracts the pollinating agents like insects, birds, *etc.*, and ensures that they visit the flowers regularly which will increase the chances of pollination. For example, nectar and pollen grains.

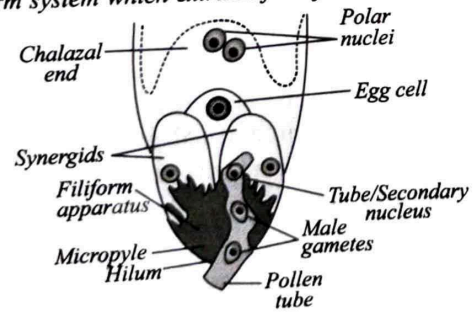
Related Theory

➥ *Nectar robbers are organisms that feed upon nectar via holes bitten in flowers, often without providing pollination service. Almost all flowering plants whose flowers are tubular or that have nectar spurs experience nectar robbing it, especially by birds, who can damage the reproductive parts of a flower and thus diminish the fitness of a plant.*

30. (D) The synergid cell wall forms a structure at the micropylar end is called the filiform apparatus which bears several finger-like projections into the structure of synergid cytoplasm.

Related Theory

➥ *Filiform apparatus assists in entering a pollen tube into synergids. It is a finger-like projection consisting of an enclosed core of microfibrils in a sheath. It resembles the transfer cells meaning the movement of metabolites at short distances. The filiform system which extracts food from the nucleus.*



Embryo sac

31. (C) Microsporogenesis and megasporogenesis is the process of formation of gametes in angiosperms. Microsporogenesis occur in anthers which results in the formation of pollen grains, while megasporogenesis occur in ovule and forms egg by the meiotic divisions in their respective mother cells.

Related Theory

➥ *Difference between megasporogenesis and microsporogenesis*

S. No.	Microsporogenesis	Megasporogenesis
(1)	Formation of microspores from microspore mother cell.	Formation of megaspores from megaspore mother cell.
(2)	All four microspores are functional.	Only one megaspore is functional.
(3)	The process occurs in microsporangium.	The process occurs in megasporangium.
(4)	Large number of microspore mother cells undergo microsporogenesis.	Generally a single megaspore mother cell undergoes megasporogenesis.

32. (D) The pollen tube carries male gametes towards the ovary through stigma and style and enters the ovule through the micropylar end into the synergid cell. The filiform apparatus guides the entry of the pollen tube into synergids. The stigma recognise the suitable pollen for the growth of pollen tube. The division of the generative cell occurs in pollen tube. Nectar is produced by glands called nectaries present in flowers.

Related Theory

➥ *On the stigma, the germination of pollen grains begins by absorption of water and nutrients and the pollen grain produces a tiny pollen tube through the style to the ovary. The tube cell enlarges and comes out of the pollen grain through one of the germ pores to form a pollen tube. The tube nucleus descends to the tip of the pollen tube. The generative cell also passes into it. It soon divides into two male gametes.*

33. (D) Megasporangium is equivalent to ovule. The nucellus is part of the inner structure of the ovule, forming a layer of diploid sporophytic cells immediately inside the integuments. The embryo sac develops within an ovule, which is contained within the ovary of a flower.

Related Theory

➥ *An ovule generally has a single embryo sac formed from a megaspore through reduction division. It is a small structure attached to the placenta by means of a stalk called funicle.*

34. (D) Tapetum is the innermost layer of microsporangium. It nourishes the pollen grains. The inner wall of pollen grain is called intine. However, the hard outer layer of pollen is called as exine. Endothecium is the wall around the microsporangium, which provide protection and help in dehiscence of anther to release the pollen. Sporogenous tissue is diploid and undergoes meiotic division to form microspore tetrad.

Related Theory

A microsporangium contains sporogenous cells which divide mitotically and increases their number before they function as microspore mother cell (diploid). Each microspore mother cell divides meiotically and consequently, four microspores are formed from each microspore mother cell. All the four microspores remain enclosed in a common wall. These four celled organisations is called tetrad.

35. (C) Cleistogamous flowers are the one which do not open at all, and hence shows self-fertilisation only. Hence, the flowers produced does not required pollinators. Due to self-fertilisation, the progeny produced shows inbreeding due to least genetic variability and are have least vigorous offsprings.

Related Theory

Sometimes bisexual flowers remain closed and never open; such flowers are called cleistogamous. In such flowers, the anthers and stigma lie close to each other. When anthers dehisce, the pollen grains come in contact with stigma and pollination takes place. Such a type of pollination occurring in closed flowers is referred as cleistogamy, e.g., Arachis hypogea (Groundnut).

36. (C) In *Vallisneria*, water pollination occurs, while mulberry and maize undergo wind pollination. In cucumber, animal pollination occurs by Bumblebees and honeybees.

Related Theory

In Yucca, the flowers are fully expanded and emit perfume during night. They are then visited by the moth-Pronuba yuccasella. The female moth has a long ovipositor and collects much pollen from a flower. She then visits another flower pierces the wall of the ovary with the ovipositor and deposits the eggs below the ovules. Then the moth climbs the top and pushes the pollen into the stigma-opening bringing about pollination.

37. (D) A hypodermal cell of the nucellus enlarges to form an archesporial cell which transformed into a megaspore mother cell. Each diploid megaspore mother cell undergoes meiosis to form linear tetrad of megaspores. Three megaspores degenerate and remaining functional one enlarges at the chalazal end.

Related Theory

The functional megaspore undergoes three subsequent mitotic divisions and forms the eight nuclei. The eight nuclei arrange themselves into three groups. Three nuclei migrate at the micropylar end and forms the egg apparatus, consisting of two synergids and a round egg cell. The other three nuclei arrange themselves at the chalazal end and form the antipodal cells. The remaining two nuclei come together as polar nuclei in the centre of the embryo sac. All the cells of the embryo sac are haploid.

38. (C) Sporopollenin forms the outer covering of the exine and it is the most resistant organic material on the Earth ever known. It is the most resistant biological material that can not be degraded by enzymes. It helps in fossilization of pollen grains. It protects pollen grains from external factors such as temperature, acid, alkali, enzyme, *etc.*

Related Theory

The tapetal cells secrete ubisch granules that provides sporopollenin and other materials for exine formation.

39. (A) Papaya is a dioecious plant, hence only prefers xenogamy (cross-pollination). Autogamy and geitonogamy are the modes of self–pollination. Cucumber, maize and castor are monoecious plants.

Related Theory

Differences between Autogamy, Geitonogamy and Xenogamy

Autogamy	Geitonogamy	Xenogamy
Autogamy is the fertilisation of a flower by pollen from the same flower.	*Gietonogamy is the fertilisation of a flower by pollen from another flower on the same plant.*	*Xenogamy is the fertilisation of a flower by the pollen of a flower from a different plant.*
Self-pollination method.	*Functionally a cross-pollination method.*	*Cross-pollination method.*
Produces a genetically identical offspring.	*Produces a genetically identical offspring.*	*Produces an offspring with genetic variations.*
Flowers can shed pollen grains directly onto the stigma and pollinate before its opening.	*Several flowers are located on the same stem.*	*Herkogamy, dichogamy, self-incompatibility, male sterility and heterostyly are adaptations used.*
Examples include sunflowers, orchids, peas and tridax.	*Corn is the most common example.*	*Examples include squash, onions, broccoli, spinach, and grasses.*

40. (B) Sporopollenin is an organic compound that is resistant to environmental extremes and cannot be broken down by an enzyme. It is found in outer coating of pollen grains. Due to its presence, fossils of pollen grains can be found.

41. (A) *Commelina benghalensis* or Kankaeoa is a cleistogamous flower which never opens. The pollen from anther lobe fall on the stigma of the same flower and thus, pollination is not dependent on any external agency *i.e.*, pollinators. Thus even in the absence of pollinators, seed-setting is assured in this plant. *Salvia* is pollinated by insects. Fig is pollinated by a wasp. The wasp lays egg in the fig fruits and in turn fig is pollinated. *Zostera* is a marine grass which is pollinated inside water.

Related Theory

	Chasmogamous flowers	*Cleistogamous flowers*
(1)	*The flowers open, exposing anthers and stigmas.*	*The flowers remain closed so that anthers and stigmas are never exposed.*
(2)	*The flowers may undergo self pollination or cross pollination.*	*The flowers undergoes only self–pollination.*
(3)	*A pollinating agency is often required.*	*No external pollinating agency is required.*
(4)	*The flowers are often prominent.*	*The flowers are not much distinguishable.*

42. (C) 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 fertilisation. Absorption of water for seed germination occurs by seed coat. Release of male gametes occurs in ovary, at micropyler end, via pollen tube. Emergence of radicle from a seed occurs through the micropyle.

Related Theory

In flowering plants, however, the ovules are contained within a hollow organ called the pistil, and the pollen is deposited on the pistil's receptive surface, the stigma. On the stigma, the germination of pollen grains begins by absorption of water and nutrients and the pollen grain produces a tiny pollen tube through the style to the ovary. The tube cell enlarges and comes out of the pollen grain through one of the germ pores to form a pollen tube. The tube nucleus descends to the tip of the pollen tube. The generative cell also passes into it. It soon divides into two male gametes.

43. (D) Anemophily is a mode of pollination accomplished through wind, while entomophily is the mode of pollination accomplished by insects like moth, butterflies, wasps, bees, *etc*. The plants with ovaries having only one or a few ovules are generally pollinated by wind but sometimes by insects.

Related Theory

Wind-pollinated flowers are typically:

(1) Have no bright colours, special odours, or nectar.
(2) Small.
(3) Stamens and stigmas exposed to air currents.
(4) Produce large amount of pollen.
(5) Pollen smooth, light, easily airborne.
(6) Stigma feathery to catch pollen from wind.

44. (B) Filiform apparatus is finger-like projection of the cell membrane of synergids or help cells at the micropylar end of the ovule. Filiform apparatus is rich in polysaccharides and a chemotropic gradient directs pollen tube towards micropyle.

Related Theory

After pollination the intine of pollen grain forms pollen tube through germ pore. The pollen tube with two male gametes and tube nucleus runs through the style and finally enters into the ovule. There may be three possible modes of entry of pollen tube into the ovule.

45. (B) Wind pollinations (Anemophily) is most common in family poaceae (*e.g.*, grasses). On the other hand, lilies are pollinated by insects like bees and butterflies. Orchids are pollinated by bees, wasps, flies, *etc*. Legumes are pollinated by honeybees mainly.

46. (C) Bisexual flowers which remain always closed are called cleistogamous and such condition of flowers is called cleistogamy. In such flowers, the anthers and stigma lie close to each other. When anthers dehisces in the flower buds, pollen grains come in contact with stigma to effect pollination. Thus, cleistogamous flowers are invariably autogamous.

Geitonogamy is technically a cross pollination, even though it is considered as self-pollinated, wherein pollens from one plant are transferred to stigma of flower borne on same plant. Xenogamy is also a cross pollination.

Caution

Students choose option geitonogamy instead, as it is a type of self–pollination. However, out of options cleistogamy and geitonogamy, cleistogamy is much closer to autogamy (self-pollination than geitonogamy).

47. (A) From the remaining functional megaspore, the megagametophyte (also known as female gametophyte or embryo sac) develops by three mitotic divisions, at the mature stage consisting of 8 nuclei and 7 cells (one egg cell, two synergids, one central cell and three antipodals).

Related Theory

Any of the cells of the nucellus of ovule towards the micropylar end get differentiated from other cells. These are called archesporial cells. The archesporial cell undergo division to form sporogenous cell. The sporogenous cell behaves as Megaspore mother cell (MMC). The MMC is diploid (2n) in nature. It undergoes meiosis and forms a linear tetrad of four haploid megaspores. In majority of angiosperms, one of the four megaspore (towards the chalazal end) remains functional while the other three degenerates. The functional megaspore develops into female gametophyte, i.e., embryo sac.

48. (B) Geitonogamy is the pollination taking place between the two flowers of the same plant or genetically similar plants. Fertilisation of a flower by the pollen grains from the same flower is autogamy. The transfer of pollen grains from one flower to another flower of a different plant in a same population is called xenogamy. Karyogamy is the fusion of nuclei or nuclear material that occurs during sexual reproduction.

49. (B) Wind pollinated flowers, also known as anemophilous flowers, are small, not brightly colored. They produce large amounts of light weight or dry pollen grains that can be easily carried by the wind without nectar or fragrance.

50. (A) Dioecious plants contains unisexual flowers on different plants. Hence, it does not favour self-fertilisation or self-pollination. Autogamy is the pollination of a flower by its own pollen grains, whereas geitonogamy is the pollination of a flower by pollen grains of another flower present on the same plant. Thus in geitonogamy, pollination can occur between two unisexual male and female flowers of the same plant.

51. (A) In most cases, the mature embryo sac contains 7-cells and 8 nuclei. The cells are arranged in egg apparatus (two synergid cells and one egg cell), a central cell with two nuclei and antipodal cells (3 in number). The synergid cells occur laterally to the egg cell. These cells are characterised by finger-like projections called filiform apparatus towards the micropylar end. Filiform apparatus is formed due to invaginations of cell wall into the protoplasm and is made up of pecto cellulosic fibres evolved in non-cellulosic sheath. Secretion of chemotactic substances for the attraction of pollen tube during fertilisation is the function of synergids. One of the synergid degenerate during pollen entry into the embryo sac and thus, provides a way/passage for the entry of pollen tube into the embryo sac.

Related Theory

➥ *Synergids have following functions:*

(1) Absorption of nourishment from nucellus.

(2) Act as shock absorber for ingrowing pollen tube.

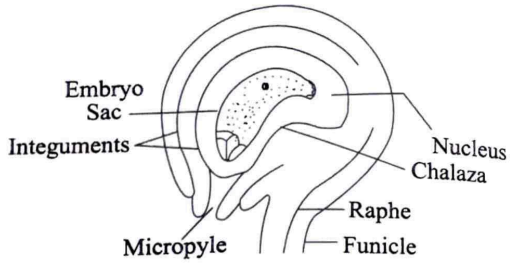
(3) Forms seat for pollen tube discharge.

52. (D) Microspore mother cell is surrounded by a callose wall (β-1, 3-glucan). Egg cell and male gamete are devoid of cell wall. Pollen grain is covered by sporopollenin.

53. (A) Make gametes (Pollen grains) in angiosperms are released at the 2-celled stage generative cell and vegetative cell. The generative cell divides to form two male gametes.

54. (C) In a cob of maize, each ovary has a long silky (hair) style, called corn silk. Collectively, these styles protrude at the end of a young cob. The grains are formed on the cob which remains covered by leafy bracts.

55. (A) In an amphitropous ovule, the embryo sac becomes horse-shoe shaped and the funiculus and micropyle are close to each other. This type of ovule is found in Alismaceae, Butomaceae families.



Amphitropous ovule

Mnemonics

➥ *The names of the families that have amphitropous ovule can be memorized by the given simple and easy trick.*

Ali Baba

Ali – ***Alismaceae***

Baba – ***Butomaceae***

56. (B) Archesporium is a cell or cell structure in a sporophyte from which spores may later develop during the alternate generation. Archesporium cell divides into the primary parietal cell which later forms the anther wall and primary sporogenous cells which form the microspore mother cell. Primary parietal wall after few more periclinal divisions forms anther wall and sporogenous cells give rise to sporogenous tissue.

Related Theory

➥ *The pollen grain grows into the male gametophyte on germination which is initiated before pollination takes place. Inside the microsporangium, Pollen Mother Cell (PMC) undergoes meiosis and results in four microspores which eventually mature into pollen grains.*

57. (B) Anatropous ovule is the most common type of ovule found in angiosperms. Here, the ovule is inverted so that micropyle and hilum are present in the same line and the micropyle is directed downwards.

Related Theory

➥ *Micropyle is used for the various functions and processes of the egg or the seed plant. It is located at top of the seed or egg. It helps in absorbing the water at the time of germination of the seed. Through micropyle the root emerges out at the time of germination of the seed.*

58. (B) Callose wall surrounds the sporocytes during the meiotic stage. It provides an isolation barrier sealing off one meiotic cell (microspore mother cell) from another.

Related Theory

➥ *Tetrad is a group of four haploid and immature pollen grains in tetrahedral fashion produced by meiotic microsporogenesis. The tetrads are of five types namely tetrahedral (most common), isobilateral, T-shaped, decussate and linear. In dicots, the most common type of pollen tetrad is tetrahedral.*

Caution

➥ *Students should remember the trick to calculate no. of pollen grains from microspore mother cell after meiosis is:*
Total no. of pollen grains = 4 × No. of microspore mother cell.

59. (D) Anemophily is wind pollination. Anemophilous plants have small flowers, a great number of pollens that are small, dry, and light in weight, a reduced number of ovules in the ovary, and a feathery or brushy stigma to receive the pollen. Coconut flower demonstrates all of these characteristics.

Hydrophily, or pollination through water, occurs in *Vallisneria*. Birds fertilise *Callistemon* (bottle brush), which is an example of ornithophily. *Salvia* is an example of entomophily since it is pollinated by insects.

60. (B) Bird pollination of flowering plants is known as ornithophily. Birds are frequently drawn to flowers that are brightly coloured and have plenty of nectar, which helps in pollination. Plants are designed to be pollinated by birds. The majority of bird pollinated flowers are red, have a lot of nectar, and are sweetly scented.

61. (C) One meiotic division in a pollen mother cell produces four microspores, which grow into four pollen grains; hence, 10 meiotic divisions in a microspore mother cell produces 40 pollen grains.

62. (A) Pollen grains or microspores are formed inside anther, which is the fertile portion of stamen or microsporophyll. The formation of microspores or pollens is called microsporogenesis. The primary sporogenous tissues (group of compactly arranged homogenous cells) give rise to microspore mother cells or pollen mother cells. Each microspore mother cell on reduction division gives rise to 4 microspores or pollens. So for the formation of 100 pollen grains, 25 MMC are required, *i.e.*, $\frac{100}{4} = 25$ MMC (or PMC). It involves karyokinesis followed by cytokinesis.

63. (B) Anthesis is the period during which the flower bud opens. As a result, the flower becomes functional. The style of a flower is extended far beyond the upper perianth during anthesis. It helps in the pollination. Anthesis is classified into two types: diurnal anthesis, which occurs in brightly coloured flowers that attract insects and the other, is nocturnal anthesis, which occurs in white or pale-colored flowers and attracts a variety of moth species.

64. (D) The meiotic division is involved in the formation of the two types of gametes in an organism, one male gamete, and the other female gamete. The formation of the male gamete requires only one meiotic division which results in four male gametes while the formation of four female gametes requires four meiotic divisions. So, for 100 seeds, 100 meiotic divisions for eggs and 25 meiotic divisions for pollen grains (totaling 125) are required. For 200 seeds, 250 (200+50) meiotic divisions and for 400 seeds 500 (400+100) meiotic divisions are required. Thus, 250/500 is meiotic division required.

Related Theory

➥ *Meiosis was initially described and discovered in the case of sea urchin eggs in 1876. Oscar Hertwig, a German biologist, discovered it. Edouard Van Beneden, a Belgian naturalist, discovered it again in the eggs of Ascaris(roundworms) in 1883. J. B. Farmer and J. E. S. Moore coined the term meiosis from the Greek word meiosis, which means "lessening," in 1905.*

65. (B) Bees are the most common pollinator among insects. They are very effective pollinators as they spend most of their lifetime in collecting pollen. About 30%, of 1,500 crop plant species depend on pollination by bees.

Related Theory

➥ *Pollen grains are the male gametophyte of the flowering plants. Pollination occurs when pollen grains are transferred to the stigma, a female part of the flowering plant from the anther that helps in fertilisation.*

66. (B) Siphonogamy is the process of fertilisation accomplished by means of pollen tube in which the transfer of male gametes to the female gametes takes place. On the other hand, porogamy is the process of fertilisation of a seed plant involving the passage of the pollen tube into the ovule by the micropyle. Chalazogamy is the process of fertilisation in which the pollen tube penetrates to the embryo sac through the tissue of the chalaza. Syngonogamy is a reproductive process in which male gamete is motile and no pollen tube is formed.

67. (D) Microsporocytes are the diploid cells which divide by meiosis to form haploid gametes or microspores. These microspores are haploid cells, thus, they cannot divide further by meiosis. Thus, meiosis is best observed in dividing microsporocytes. On the other hand, cells of apical and lateral meristem and also the cells of anther wall divide by mitosis.

Caution

➥ *Students must know that the microsporocyte is the other name of microspore mother cell or pollen mother cells.*

68. (D) Nucellus, embryo sac and micropyle, all are found inside of ovule but pollen grain found in male gametophytic structure. Therefore it is the odd one.

69. (C) Kolreuter reported first that only gymnosperms and angiosperms pollinate among plants. Pollination in gymnosperms is direct, with pollen carried straight

to the ovule's micropyle by wind. Pollination in angiosperms is indirect because ovules are enclosed in the ovary. Pollen first reaches the stigma, then the ovule by various pollinating agencies.

Caution

Students should remember that besides the several advantages of cross pollination, few disadvantages are also there. These are:

(1) Cross pollination is always influenced by chance.

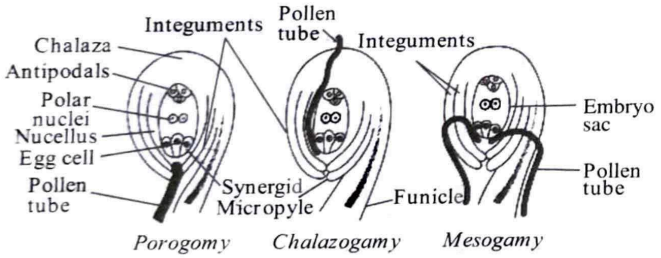
(2) It is less cost effective.

(3) Unwanted characters may influence the race.

(4) The race's extremely good characters are likely to be spoilt.

70. (C) The embryo sac develops within the ovule, which is surrounded by the nucellus, which is encircled by the integuments. Meiosis occurs in one nucellus cell, resulting in the formation of four megaspores. One megaspore survives and proceeds through three rounds of free nuclear division before cellularization to form an embryo sac with eight nuclei in seven cells.

71. (C) Porogamy is the phenomenon of the entry of pollen tube into the ovule through micropyle. It is common for most of the angiosperms. Chalazogamy is the phenomenon of the entry of pollen tube into the ovule through chalaza, *e.g.*, *Casuarina*, Mesogamy is the phenomenon of the entry of pollen tube into the ovule through integuments, *e.g.*, *Cucurbita*.



Related Theory

In botany, pseudogamy means any reproductive process that requires pollination but does not involve male inheritance. In zoology it means a type of parthenogenesis in which the sperm stimulates the egg cell to develop into an embryo, but no genes from the male are inherited.

72. (A,D)Mitotic division of a pollen grain or microspore results in the formation of a larger tube or vegetative cell and a small generative cell. As the vegetative cell gives rise to the pollen tube and the generative cell divides to form two male gametes, if a generative cell is destroyed by laser, a normal pollen tube will still form through the unaffected vegetative cell.

73. (B) When a pollen grain matures, it comprises two cells: a vegetative cell and a generative cell. The vegetative cell is larger, contains a larger irregularly shaped nucleus, and a larger food reserve. The generative cell is small and floats in the vegetative cell's cytoplasm. It has a spindle shape, dense cytoplasm, and a nucleus. Pollen grains are shed at this 2-celled stage by more than 60% of angiosperms. In the remaining species, the generative cell divides mitotically to give rise to the two male gametes before pollen grains are shed (3-celled stage).

74. (C) 100 male and female gametes are required for the development of 100 zygotes.

One cycle of meiosis produces four microspores during microsporogenesis (the formation of microspores that eventually develop into pollen grains). So, 100/4 = 25 cycles of meiosis are required for the production of 100 microspores.

One functional megaspore is produced during one cycle of meiosis during megasporogenesis (the development of megaspores, from which one functional megaspore finally develops into an embryo sac). Thus, 100 cycles of meiosis are required for the generation of 100 functional megaspores.

As a result, the total number of meiotic divisions necessary for the production of 100 zygotes is 25 + 100 = 125.

75. (A) The haploid, diploid, and triploid structures of a fertilized embryo sac in angiosperms are: synergids, zygote and primary endosperm nucleus respectively.

After double fertilisation in angiosperms, two types of nuclei are formed: the diploid zygote and the triploid primary endosperm nucleus. The zygote develops into the embryo, and the primary endosperm nucleus develops into the endosperm, which provides nutrition to the developing embryo.

Related Theory

Before fertilisation, the haploid embryo sac of angiosperms contains three antipodal cells, two polar nuclei, and two synergids. During fertilisation, one of the two sperm cells fuses with the egg cell to form the diploid zygote, and the other sperm cell fuses with the two polar nuclei to form the triploid primary endosperm nucleus. The synergids degenerate after fertilisation.

Caution

Students generally write incorrect answer as they do not know the terms haploid, diploid and triploid. They should remember that:

(1) A haploid cell has only one set of chromosomes (n).

(2) As the name suggests, a diploid has two sets of chromosomes (2n).

(3) The existence of three complete sets of chromosomes (3n) is referred to as triploidy. In this, the extra pair of chromosomes may be derived from the father (diandric) or the mother (digynic).

76. (C) Of the two male gametes, one fertilises the egg cell, forming a diploid zygote; while the other fuses with the two polar nuclei (central cell nuclei), forming a triploid cell that develops into the endosperm. Together, these two fertilisation events in angiosperms are known as double fertilisation.

Related Theory

Synergids have following functions:

(1) Absorption of nourishment from nucellus.

(2) Secretion of chemotaxically active substances from its filiform apparatus for guiding pollen tube.

(3) Act as shock absorber for ingrowing pollen tube.

(4) Forms seat for pollen tube discharge.

77. (D) Double fertilisation is the fusion of male gametes to two different cells of gametophyte. It consists of two events:

(1) Syngamy: Fusion of egg nucleus with male gamete, resulting in the formation of zygote.

(2) Triple fusion: Fusion of another male gamete with two polar nuclei, resulting in the formation of Primary Endosperm Nucleus (PEN).

Related Theory

After pollen is deposited on the stigma, it germinate through the style to reach the ovule. The pollen contain two cells: the pollen tube cell and the generative cell. The pollen tube cell grows into a pollen tube through which the generative cell travels. During this process, the generative cell divides to form two sperm cells. The pollen tube enters the ovule sac through the micropylar end.

78. (D) Double fertilisation is a characteristic feature of angiosperms. In this, one male gamete fuses with female gamete to form zygote (amphimixis). While other male gamete fuses with diploid secondary nucleus of central cell to form primary endosperm nucleus.

Related Theory

In double fertilisation, zygote develops to form embryo and thus future plants. While endosperm provides nutrition to the embryo.

79. (A) Before pollination, the protoplast of pollen grain divides into two unequal cells, small generative cell and large tube or vegetative cell. In some species the generative cell divides into two male gametes prior to dehiscence of pollen grain. Therefore, at the time of pollination the pollen grain is either 2-celled or 3-celled.

Mnemonics

The period for which pollen grains remain viable is highly variable and to some extent depends on the prevailing temperature and humidity. In some cereals such as rice and wheat, pollen grains lose viability within 30 minutes of their release, and in some members of Rosaceae, Leguminoseae and Solanaceae, they maintain viability for months. These given examples can be learned by this super easy trick.

Plants viable for several months:

***S**orry **R**ose for **L**ate*

***S**orry* – ***S**olanaceae*

***R**ose* – ***R**osaceae*

***L**ate* – ***L**eguminoseae*

80. (B) Only angiosperms have double fertilisation, in which the secondary nucleus forms a triploid cell to produce endosperm and the egg transforms into a diploid zygote to form embryo.

81. (D) The male gametes in the pollen tube are discharged into the synergid cells from where the first male gamete is transferred to the egg cell of the embryo sac. The other male gamete is transferred to the central cell through the cytoplasmic current.

Related Theory

Towards the micropylar end, a mature ovule consists of embryo sac which has an egg apparatus (an egg cell and two synergids), centrally placed 2 polar nuclei and 3 antipodal cells at the chalazal end.

82. (B) Two male gametes cells are involved in double fertilisation; one fertilises the egg cell to form the zygote, while the other fuses with the two polar nuclei that form the endosperm.

Following fertilisation, the fertilised ovule forms the seed, while the ovarian tissues form the fruit.

During the initial stage of embryonic development, the zygote divides into two cells, one of which develops into a suspensor and the other into a pro-embryo.

Due to the existence of cotyledons in the second stage of embryonic development, the developing embryo has a heart shape.

The embryo begins to bend as it fills the seed as it grows; at this time, the seed is ready for dispersal.

Double fertilisation results in the formation of endosperm in angiosperms require fusion of two polar nuclei and second male gamete only.

83. (B) During double fertilisation, one male gamete fuses with female gamete to form a diploid zygote, while the other male gamete combine with the two haploid polar nuclei of the large central cell of the megagametophyte to form a triploid nucleus. Further it develops into the endosperm which provides nourishment to the developing embryo.

84. (B) Nawaschin demonstrated the fusion of one male gamete with the egg (syngamy) and the other male gamete with polar nuclei (triple fusion) while working on *Lilium* and *Fritillaria*. As a result, he discovered double fertilisation and coined the term "triple fusion." Guignard independently confirmed Nawaschin's discovery of double fertilisation. Hofmeister, on the other hand, demonstrated embryo sac organisation as well as microspore tetrad production. Leeuwenhoek was the first to use a microscope to study microbes. Strasburger discovered syngamy while working on *Monotropa* and observed the actual fusing of the male gamete with the female gamete (*i.e.*, egg).

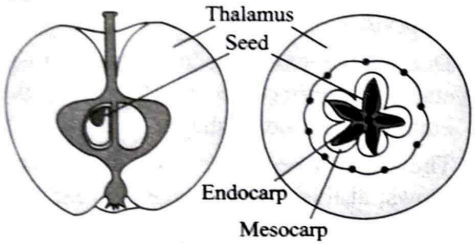
85. (A) Syngamy or fertilisation is the process of fusion between the haploid male nucleus and the egg nucleus, which results in the development of a diploid zygote. It results in character recombination, which generates variation. It is a sexual reproduction method.

Related Theory

- *The process of plasmogamy involves the fusing of cytoplasm. The cytoplasm of two parent cells merges without nuclei fusion, bringing two haploid nuclei close together in the same cell.*
- *Isogamy refers to the process of fusing of two similar spores or gametes.*
- *Anisogamy is the process by which two different spores or gametes fuse.*

86. (B) The given figure is of strawberry, which is categorised under false fruit. The part marked as 'x' in the figure is thalamus.

87. (B) Other floral parts degenerate and fall off in most plants by the time the fruit develops from the ovary. However, in a few species, such as apple, strawberry, and cashew, the thalamus also plays a role in fruit formation. Such fruits are known as false fruits. The illustration given in the question depicts false fruit of apple.



Apple (False Fruit)

Related Theory

- *Fruit is a mature or ripened ovary that develops following fertilisation. The fruit is made up of a wall, or pericarp, and seeds. When the pericarp becomes thick and fleshy, it is divided into three parts the outer epicarp, the middle mesocarp, and the inside endocarp.*

Mnemonics

- *Examples of false fruits can be easily remembered by using this mnemonic:*

Can Apple See?

Can	–	***Cashew***
Apple	–	***Apple***
See	–	***Strawberry***

88. (C) During post fertilisation, ovules develops into seed. Embryo sac is a multicellular structure developed from the megaspore.

Related Theory

- *After fertilisation the petals, stamens, style and stigma degenerates. Calyx sometimes degenerates or remains intact in dried form. Ovary becomes fruit and ovules become seeds. Ovary wall becomes pericarp of the fruit. Placenta of the ovules become stalk of the seeds. The outer integument of the ovary becomes the testa and the inner integument becomes the tegmen of the seed coat. The secondary nucleus become the endosperm, the egg cell and synergids become the embryo, and the antipodal cells degenerates.*

89. (C) The edible part of coconut is endosperm. Coconut consists of free nuclear endosperm (coconut water) and cellular endosperm (white kernel).

Nucellus remains can occasionally be found in seeds such as black pepper and beet. The perisperm is the residual, persistent nucellus.

The embryonic leaf of seed-bearing plants, one or more of which are the first to develop from a germinating seed, is defined as a cotyledon.

The ovary wall develops into the fruit wall known as the pericarp.

Related Theory

- *Endosperm accumulates the food reserves and functions as the nutritive tissue for the developing embryo. It develops from the triploid primary endospermal cell by repeated cell divisions. Its development starts shortly before the development of the embryo. It is formed by three methods:*
  - *(1) **Nuclear type:** The nuclear division is not accompanied by the cell wall formation. E.g., wheat, rice, maize and sunflower.*
  - *(2) **Cellular type:** In this, the repeated mitotic division of primary endosperm nucleus is followed by cytogenesis around each nucleus. E.g., Datura and Petunia.*
  - *(3) **Helobial type:** In this, the first mitotic division of primary endosperm nucleus is followed by incomplete cytokinesis and the endosperm is formed both by cellular and nuclear type. E.g., Eremurus.*

90. (C) In coconut, water is the free nuclear endosperm, while the white kernel is cellular endosperm. The exocarp is the outer layer of the pericarp of a fruit and it is composed of thin layer, mesocarp is a thick, fibrous middle layer forming husk, and the endocarp is hard and stony.

91. (C) Endospermic seeds or albuminous seeds are the seeds which have endosperm retained in them. *E.g.*, maize, wheat, castor bean, coconut, barley, and rubber. Non-endospermic seeds or exalbuminous seeds are the seeds in which endosperm is used up completely during the development of embryo. *E.g.*, Pea, Jack fruit, Mustard, and Sunflower.

Caution

- *Mostly monocots have endospermic or albuminous seed and dicots have both types. But one of the exceptions is Alisma seed which is a monocot plant but with non-endospermic seed.*

Mnemonics

- *Check these mnemonics for the various examples of albuminous and exalbuminous seeds.*

Albuminous seeds:

My Big Cousin Went to Railway Station

My	–	***Maize***
Big	–	***Barley***

Cousin – *Coconut*
Went – *Wheat*
Railway – *Rice*
Exalbuminous seeds:
Big GAPS
Big – *Beans*
GAPS – *Groundnut, Almond, Peas, Sunflower*

92. (A) Sunflowers (*Helianthus annuus*) are dicots, which mean they have two cotyledons when their seed germinates. An embryonal axis and two cotyledons make up a normal dicotyledonous embryo. The epicotyl is the portion of the embryonal axis above the level of the cotyledons that ends with the plumule or stem tip. The hypocotyl is the cylindrical section beneath the cotyledons that finishes at its lower end in the radicle or root tip. A root cap protects the root tip. Monocots, on the other hand, have only one cotyledon when they develop. Grasses are an excellent example of a monocot.

93. (B) Embryology is a branch of biology that deals with the pre-natal development of the foetus. In apomixis, we study about reproduction without fertilisation and this is the asexual reproduction by seeds. Embryogeny also called as embryogenesis, it is the formation and development of an embryo. Cytology is the study of cells.

94. (C) The seed is the last outcome of sexual reproduction in angiosperms. It is frequently referred to as a fertilised ovule. Seeds are formed inside fruits. Ovule integuments develop into thick protective seed coatings. The outer integument hardens into a hard and leathery testa, or outer seed coat, which assures seed survival. If the inner integuments remain, they create the tegmen. The stalk-like structure that connects the ovule to the placenta is known as the funiculus. Chalaza is the origin of the integuments or the enlarged basal region of the nucellus.

95. (B) Nucellus remains can occasionally be found in seeds such as black pepper and beet. The perisperm is the residual, persistent nucellus. It provides the nutrition to the developing embryo. It is formed at the micropylar end. It appears as a reddish papery structure.

96. (C) Apomixis is a type of asexual reproduction in which seeds are produced without fertilisation. Apomictic parthenogenesis is a one of a type and is commonly seen in citrus fruits. Budding is another type of asexual reproduction, seen in yeast. Somatic hybridisation is a technique which involves the manipulation of cellular genomes by protoplast fusion. Sporulation involves the production of specialized reproductive cells, called spores, produce new plants.

Related Theory

The formation of fruits without fertilisation is called parthenocarpy. E.g., Banana, Grapes. There fruits produced are seedless. While parthenogenesis is the development of a new individual from a single gamete without fertilisation.

Caution

Students mix the terms apomixis and amphimixis. Apomixis is an asexual reproduction developing or producing a new plant without fertilisation. This differs from amphimixis in which reproduction occurs through the sexual process involving egg fertilisation with sperm.

97. (D) In nucellar polyembryony, some of the nucellar cells surrounding the embryo sac start dividing. Then it protrudes into the embryo sac and develop into the embryos. It is found in many of the *Citrus* and mango varieties.

Related Theory

In nucellar embryony, embryos are formed asexually from the nucellus tissue. The nucellar embryos generally end up outcompeting the zygotic embryo, rending the zygotic embryo dormant. The polyembryonic seed is then formed by the many adventitious embryos within the ovule.

Mnemonics

You can easily learn the examples of polyembryony by this mnemonic.
Olivia Let's Go to Market
Olivia – *Orange*
Let's – *Lemon*
Go to – *Groundnut*
Market – *Mango*

98. (B) Apomixis is found in *Citrus*, in which there is the formation of extra embryos due to sporophytic budding. One or more diploid sporophytic cells, either nucellus or integuments undergo stages of embryogeny and eventually develop into mature embryos.

99. (A) Adventive embryony is an asexual reproduction in plants that produces a maternal clone without fertilisation. The embryo is not formed from reproductive cells or gametes. Instead, the embryo is formed from the ovule's diploid nucellus or integuments. The nucellus divides and grows into the embryo sac, producing a large number of diploid embryos.

100. (C) Polyembryony refers to the presence of more than one embryo within the seed. It occurs more frequently in gymnosperms than in angiosperms. It is often found as a unique trait in angiosperms, such as *Citrus* and mango. Many embryos in *Citrus* are produced by structures outside the embryo (like nucellus). This is known as adventive polyembryony. *Citrus* produces up to ten nucellar embryos.