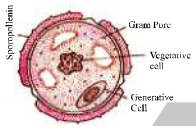


Chapter - 2 Sexual Reproduction in Flowering Plants

Autogamy : When pollen grains of a flower are transferred from anther to stigma of the same flower.

Coleorhiza : A protective sheath of radicle in monocot seed.

Coleoptile : A protective sheath of plumule in monocot seed.

Perisperm : It is diploid persistent nucellus e.g. Black, Paper, Beet.

Nucellus : Multicellular tissue in the centre of ovule in which embryo sac is present.

Viability of Seed : Ability of seed to retain the power of germination.

Micro-sporangium (Pollen sac) :

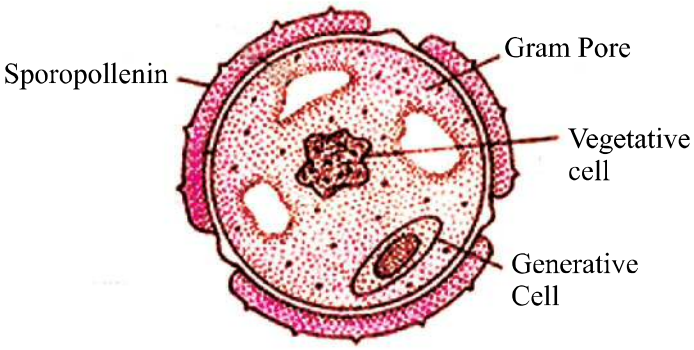
Outermost layer = Epidermis
Second layer = Endothecium
Middle layer = 2–4 layers of cells
Innermost layer = Tapetum [Nourishes the developing Pollen grains (Microspores)]

Microsporogenesis : Process of formation of micropores from a pollen mother cells.

Sporogenous tissue (2n) → MMC 2n —meiosis→ Micro spore tetrad (n)↓

4 Pollen Grains (2n) ← 4 Microspores (n)

Pollen grain (Male gametophyte) →
- outerwall (Exine) – Thick, hard, made of sporopollenin
- innerwall (Intine) – Thin, made of cellulose and Pectin
- cells – a vegetative cell (large in size) and a generative cell (small in size)



Pollen Grain (Male gametophyte)

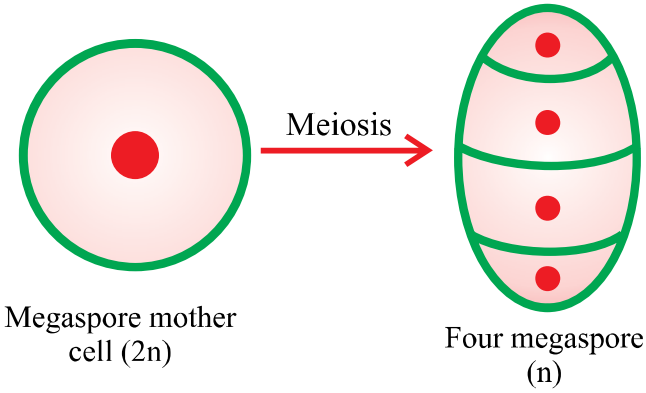
Sporopollenin is one of the most resistant organic substance. It is not affected by high temperature, strong acids or alkali. No enzyme can degrade it.

Pollen Products : Pollen grains are rich in carbohydrates, proteins and unsaturated fats. Their consumption is believed to increase performance of athlete and horses. They are used in the form of tablets and syrups.

Pollen Viability : Pollens of wheat and rice remain viable for 30 minutes. Pollens of same other plants may remain viable for several months. Pollens can be cryopreserved in liquid nitrogent (– 196°C) in pollen banks.

Pollen of carrot grass (*Parthenium*), *Chenopodium, Amaranthus* etc. may cause pollen allergy.

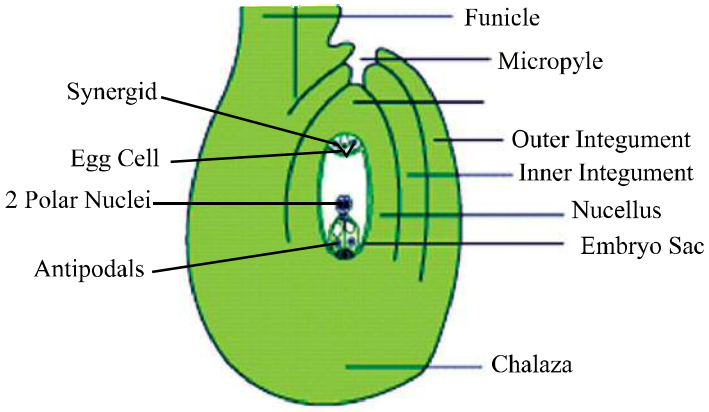
Megasporogensis : Process of formation of haploid megaspores from megaspore mother cells



Megasporangium (Ovule) :

- The ovule is a small structure attached to the placenta by means of a stalk called funicle.

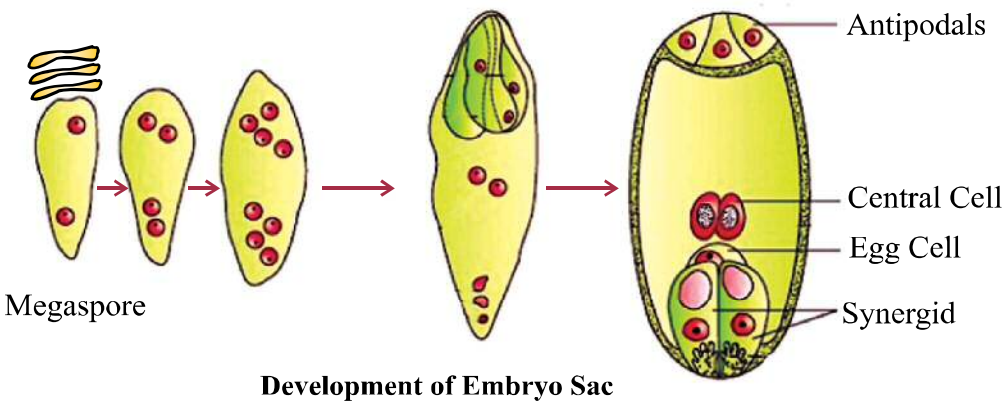
- The point of attachment of the body of the ovule to the funicle is known as hilum. The main body of the ovule is composed of paranchymatous cells known as nucellus.
- Each ovule has one or two protective integument, which encircle the ovule except at the tip having small opening called micropyle.
- Opposite to micropylar end is chalazal end
  Generally a single embryosac or female gametophyte located in nucellus.
- Cells of nucellus have abundant reserve food material and provide nourishment to the developing embryo.



6. Female gametophyte (embryo sac) : In a majority of flowering plant one of the megaspore is functional while other three degenerate, (monosporic development)

- The functional megaspore develops in embryo sac.
- The nucleus of the functional megaspore (n) undergoes three successive mitotic cell division which result the formation of eight nucleate stage of embryo sac (free nuclear division).
- The cell wall formation starts at eight nuclear stages. Three cells are grouped together at micropylar end to form the egg apparatus (2 synergids + 1 egg cell).
- Three cells are grouped at chalazal end, called antipodal cells.
- The remaining 2 nuclei are polar move to the centre of embryo sac, called central cell.

Thus, typical agniospermic embryo sac at maturity is 8 nucleate and 7 celled.



Development of Embryo Sac

Kind of Pollination : Autogamy, Geitonogamy and Zenogamy

Agents of Pollination : (a) Biotic Agents— Bees, flies, butterflies, waspa, moths, ant, birds, beetles, rodents, reptiles and some primates, etc.

(b) Abiotic Agents—Wind and water.

In some plants like *oxalis, viola* e.t.c. have two types of flowers :

1. Chasmogamous Flower

Flower remain open after maturity self pollination and cross pollination both can take place.

2. Cleistogamous Flower

Flower remain closed throughout their life. So only self pollination occurs.

Outbreeding Devices : (i) Non synchronisation of pollen release and stigma receptivity. (ii) Self-incompatibility (iii) Monoecius or dioecious plants (iv) Position of anthers and stigma in such a way that pollen cannot come in contact of stigma of same flower.

Pollen—pistil interaction :

- This pistil has the ability to recognize the pollen, whether it is right type (Compatible) or of the wrong type (incompatible).
- If it is compatible then the pistil accepts the pollen.
- The pollen grains germinate on stigma to produce pollen tubes. The contents of the generative cell (or the two male gametes in those species whose pollen is liberated in the three celled stage), move into the pollen tube.

- Pollen tube grows through the tissue of stigma and style by secreting enzyme and enters the ovule, through micropyle via one of the synergid. Filiform apparatus guides the entry of Pollen tube.

Double Fetilisation : The pollen tube releases to male gamete into the cytoplasm of synergid. One male gamete move towards eggcell and other male gamete towards the central cell.

- Syngamy : One male gamete + Egg cell → Zygote (2n)
- Triple Fusion : Second male gamete + 2 polar nuclei → PEN (3n)
- Since two types of fusion takes place in embryo sac, hence it is called as double fertilisation.

Post Fertilisation Events :

(i) Endosperm and embryo development

(ii) Maturation of ovule & ovary

Fate of Floral Parts

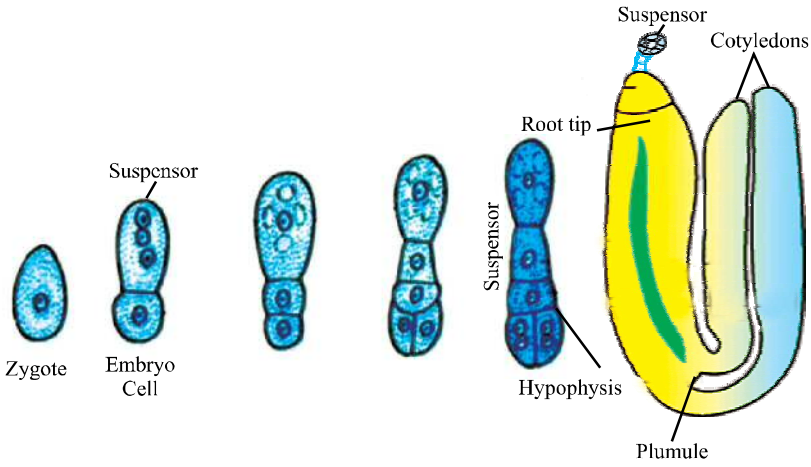
Ovary (2n)	→	Fruit
Ovary Wall (2n)	→	Pericarp
Ovule (2n)	→	Seed
Outer Integument (2n)	→	Testa
Inner integument (2n)	→	Tegmen
Zygote (2n)	→	Embryo
Primary Endosperm Cell (3n)	→	Endosperm
Sepals	→	Fall down
Petals	→	Fall down
Stamens	→	Wither away
Stigma, style	→	Wither away
Nucellus	→	Consumed/may be present as Perisperm
Synergids	→	Degenerate
Antipodal Cells	→	Degenerate

Development of Endosperm : The primary endosperm cell (PEC) in embryo sac devide again and again, and form triploid endosperm. The cells of endosperm are filled with reserve food material which is used for nourishment of the embryo during its development and also for the yound seedling at the time of germination.

PEN —nuclear division→ Free Nuclear endosperm —Cell wall formation→ Cellular endosperm

Development of Embryo : Embryo formation start after certain amount of endosperm is formed. Following are the stages in development of a dicotyledon embryo.

Zygote → Pro-embryo → Globular embryo → Heart Shaped embryo → Mature embryo



Development of Dicot Embryo

13. Dicot Embryo : A typical dicot embryo consist of an embryonal axis and two cotyledons. The portion of embryonal axis above the level of cotyledons is the epicotyl and the portion below the level of cotyledons is hypocotyl.

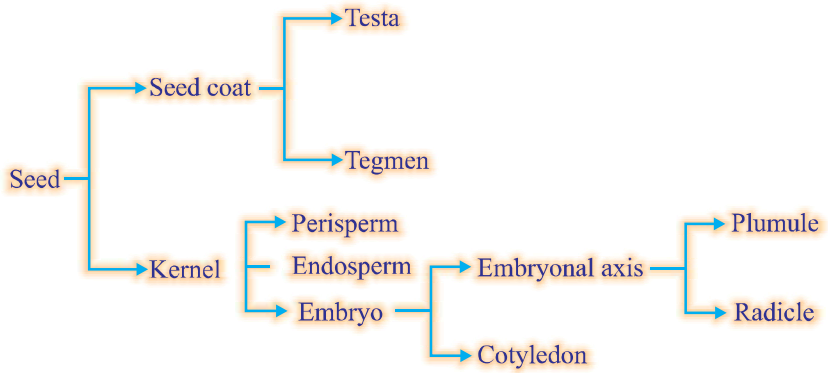
Monocot Embryo : Monocot (Rice, Maize etc.) has one cotyledon called Scutellum. The embryonal axis has the radicle and root cap enclosed by a sheath called Coleorrhiza.

The upper end (epicotyle) has plumule which is covered by hollow foliar structure called the coleoptile.

Polyembryony : Occurrence of more than one embryo is a seed, is knowan as polyembryony e.g. Orange, lemon, onion, mango, groud nut. It may be due to presence of more than one egg cell in the embryo sac or more than one embryo sac in the ovule.

Reasons of polyembryony : It is due to fertilisation of more than one egg cell in an ovule. The condition develop when an embryo sac contains more than one egg cell or ovule contain more than one embryo sac.

Seed : After fertilisation ovule mature into seed.



Non albuminous seed : Those seeds in which no residual endosperm is found because it is completely consumed during development of the embryo.
eg. pea, gram, ground nut.

Albuminous Seed : Those seeds, which retain a part of the endosperm because endosperm is not completely consumed by developing embryo.
eg. maize, wheat, sunflower, castor

Seed Dispersal : Seeds are dispersed to new habitat through agent like water, wind and animals.

Apomixis : Apomixis is a form of asexual repduction that mimics sexual reproduction where seeds are formed without fertilisation.

Advantages of Apomictic Seed :

- No segregation of characters in hybrid progeny
- These seeds can be used to grow crop year after year
- These are economical as hybrid seed are not used to grow crops year after year.

Parthenocarpic fruits : The fruits which are formed (developed) without fertilisation are known as parthenocarpic fruit. Such fruits are seedless eg. Banana.

This phenomenon of development of fruit without fertilisation is known as parthenocarpy.

Questions

VSA **1 Mark**

1. Give the scientific name of a plant with came to India as a contaminant with imported wheat and causes pollen allergy.

2. Which characteristic of water pollinated species of pollen grains protect them from water.

3. Why are pollen grains produced in enormous quantity in maize ?

4. In some species of Asteraceae and grasses, seed are formed without fusion of gametes. Mention the scientific term for such of reproduction.

5. If the diploid number of chromosomes in an angiospermic plant is 16. Mention number of chromosomes in the endosperm and antipodal cell.

SA-I **2 Marks**

6. Fruits generally develops from ovary, but in few species thalamus contributes to fruit formation.

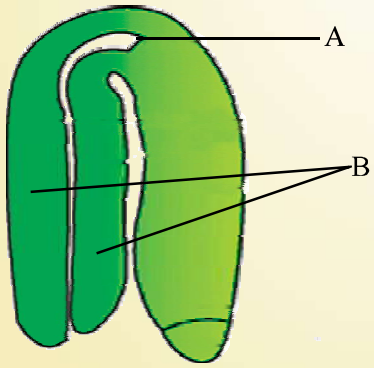
   (a) Name the two categoris of fruits.

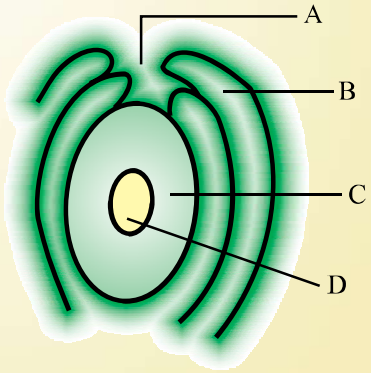
   (b) Give one example of each.

7. Among the animals, insects particularly bees are the domiant pollinating agents. List any four characteristic features of the insect pollinated flower.

8. Differentiate between geitonogamy and xenogamy.

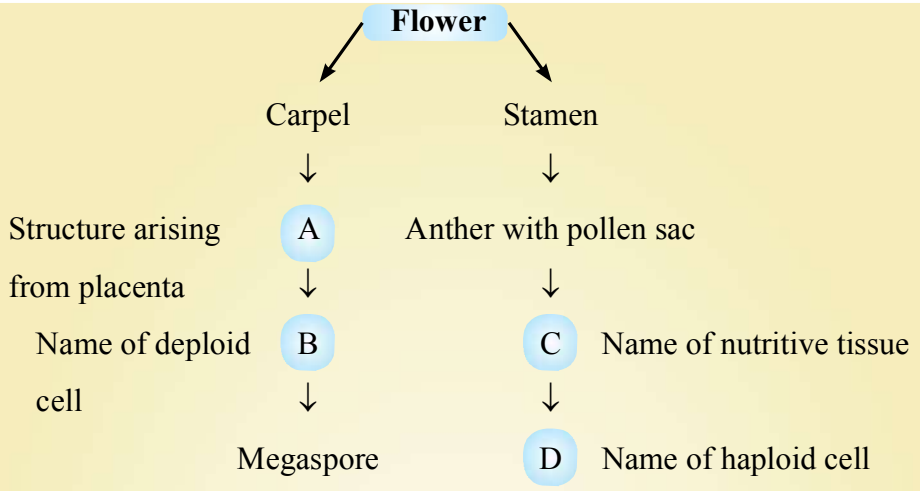
9. In the given figure 1 of a dicot embryo, label the parts (A) and (B) and give their function.





10. Name the pars A, B, C and D of the anatropous ovule (Figure 2) given above.

11. Given below is an incomplete flow chart showing formation of gamete in angiospermic plant. Observe the flow chart carefully and fill in the blank A, B, C and D.



12. Even though each pollen grain has two male gametes. Why are at least 10 pollen grains and not 5 pollen grains required to fertilise 10 ovules present in a particular carpel ?

SA-II **(3 Marks)**

13. Continued self pollination lead to inbreeding depression. List three devices, which flowering plant have developed to discourage self pollination ?

14. Differentiate between microsporogenesis and megasporogenesis. What type of cell division occurs during these events ? Name the structure formed at the end of these two events.

LA **(5 Marks)**

15. (a) Draw the embryo sac of a flowering plant and label the parts :
    (i) Which guides the entry of pollen tube ?
    (ii) Which develops into endosperm ?
    (iii) Which fuses with male gamete to form zygote ?
    (b) What will be the fate of antipodal cells atfer fertilisation ?
    (c) Name the cell that develops into embryo Sac. How many embryo sacs are formed from one megaspore mother cell.

Answers

VSA (1 Mark)

1. *Parthenium hysterophorus* (carrot grass)
2. Presence of mucilagenous covering
3. To ensure pollination because Maize is pollinated by wind.
4. Apomixis
5. Chromosomes in endosperm and 8 chromosomes in antipodal cells.

SA-I (2 Marks)

6. Two categories of fruits are :
   (i) True fruits *e.g.*, Mango
   (ii) False fruit *e.g.*, Apple
7. (i) Flowers are large
   (ii) Colourful petals of flowers
   (iii) Presence of fragnance
   (iv) Rich in nectar
8.

Geitonogamy	Xenogamy
1. Transfer of pollen grains from the anther to stigma of another flower of the same plant.	Transfer of Pollen grains from anther to Stigma of different plant.
2. Does not provide opportunity for genetic recombination.	Provide opportunity for genetic recombinations

9. A = Plumule – To form shoot system
   B = Cotyledons – Storage of food
10. A = Micropyle, B = Outer integument, C = Nucellus, D = Embryo sac
11. A = Ovule/megasporangium, C = Tapetum
    B = Megaspore mother cell, D = Pollen grains
12. Because only one male gamete is involved is syngamy, *i.e.*, fusion of male gamete with egg cell.

SA-II **(3 Marks)**

13. (a) Release of pollen and stigma receptivity is not synchronised in some species

(b) Anther and stigma are at different position/heights in some plants

(c) Self-incompatibility (a genetic mechanism).

14. • Microsporogenesis—Process of formation of microspore from a Pollen mother cell.

• Megasporogenesis—Process of formation of megaspore from megaspore mother cell.

• Meiotic division in both.

Microsporogenesis results in the formation of pollen grain while megasporogenesis results in the formation of megaspore.

15. (a) Refer to figure 2.8(c) page 26 NCERT book.

(i) Filliform apparatus (ii) Central cell (iii) Egg cell

(b) They degenerate after fertilization.

(c) Functional megaspore, one megaspore develops to form one embryo sac.

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