01 Reproduction in Lower and Higher Plants

Syllabus

1.0 Introduction

INTEXT QUESTION

Q.1 Can you recall ?

i. **How do plants reproduce without seeds ?**

Ans :

i. Plants reproduce without seeds by the process of vegetative propogation.

ii. In vegetative propogation plants reproduce asexually through their vegetative parts leading to formation of new plants genetically identical to their parents.

ii. **How does vegetative propogation occur in nature ?**

Ans :

i. Plants reproduce without seeds by the process of vegetative propogation. In vegetative propogation plants reproduce asexually through their vegetative parts leading to formation of new plants genetically identical to their parents.

ii. Vegetative propogation occurs with the help of vegetative organs like root, stem, leaf or bud.

Q.2 What is reproduction?

Ans:

i. Reproduction is the production of young ones like plants.

ii. Reproduction is an essential process as it leads to continuation of species as well as to maintain the continuity of life.

iii. All organisms have their own particular method of reproduction.

iv. All these methods are generally of two types:
   a. Asexual reproduction
   b. Sexual reproduction.

1.1 Asexual Reproduction

Q.3 Write a short note on asexual reproduction?

Ans :

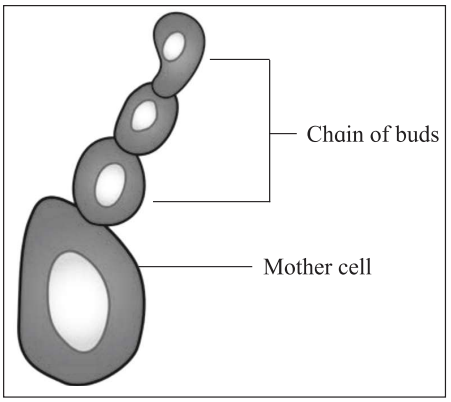
i. Asexual reproduction is the process resulting in the prodcution of genetically identical progeny from a single organism and it inherits the genes of the parent.

ii. It does not involve fusion of two gametes or sex cells.

iii. Methods of asexual reproduction are as follows:

a) **Fragmentation:** In fragmentation multicellular organisms break into fragments and each fragment can grow into a new individual. e.g. *Spirogyra.*

b) **Budding:** Budding is the most common method of asexual reproduction in unicellular organisms like Yeast. It usually takes place during favourable conditions by producing one or more outgrowths called as 'buds'. These buds on separation develop into a new individual.

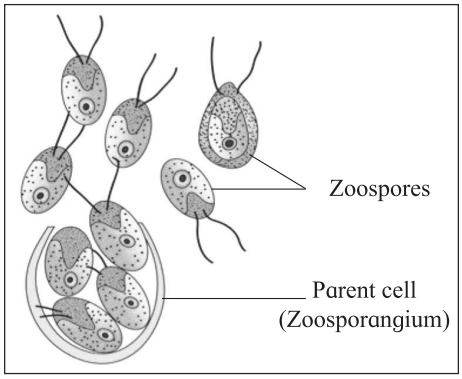


c) **Spore formation:** In spore formation flagellated, motile zoospores are formed which can grow independently into new individuals. It is observed in *Chlamydomonas.*

d) **Binary fission:** It occurs in *Amoeba*, *Paramoecium*.

e) **Conidia formation:** It is observed in *Penicilium*.

f) **Gemmules formation:** It occurs in sponges.



Q.4 Write a note on vegetative reproduction.

Ans :

i) In vegetative reproduction plants reproduce asexually through their vegetative parts leading to formation of new plants genetically identical to their parents.

ii) Agriculture and horticulture exploit vegetative reproduction in order to multiply fresh stocks of plants.

iii) Artifical methods are used to propogate desired varieties according to human requirements as there are a few methods which would not occur normally in the plants.

Q.5 What are artificial methods of vegetative propagation.

Ans : The various artificial mehtods of vegetative propogation are as follows:

i. **Cutting:**

a) The small piece of any vegetative part of a plant having one or more buds is used for propagation.

b) Common cuttings practised are: Stem cutting: eg. Rose, *Bougainvillea*; Leaf cutting: eg. *Sansevieria;* Root cutting: eg. Blackberry.

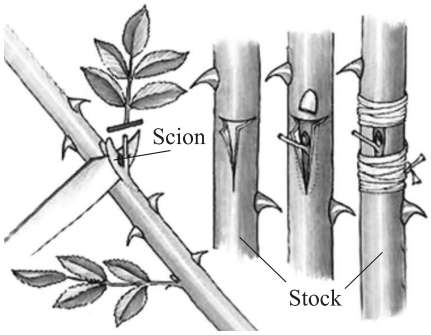
ii. **Grafting:**

a) In grafting, parts of two plants are joined in such a way that they grow as one plant.

b) A part of stem containing more than one bud **(scion)** is jointed onto a rooted plant called **stock.**

c) Budding is also called bud grafting in which only one bud is joined on the stock.

d) Grafting is practised in plants like Apple, Rose, Pear, etc.



Grafting in Rose

iii) **Tissue culture:**

a) It is a method by which a small amount of plant tissue is taken from a suitable part of parent plant and is carefully grown to give many plantlets.

b) Micropropagation method is also used now a days.

INTEXT QUESTION

Q.6 How does vegetative propogation occur in nature, discuss vegetative propogation by various plant parts.

Ans :

i. In vegetative propogation plants reproduce

asexually through their vegetative parts leading to formation of new plants genetically identical to their parents.

ii. **Vegetative propogation by roots:**
   a. It is a root modification for vegetative reproduction and storage of reserve food.
   b. Adventitious buds develop on the surface of these modified roots which later sprout into leafy shoots and adventitious roots.
   c. e.g. Sweet potato, *Asparagus, Dahlia*.

iii. **Vegetative propagation in leaf:**
   a. In some plants, adventitious buds develop on the surface of leaves which later sprouts into a plantlet.
   b. These plantlets fall of from parent plant to continue their growth in the wet soil.
   c. eg: *Bryophylum, Kalanchoe, Begonia* etc.

iv. **Vegetative propogation by stem:**
   a. Vegetative propogation in stem occurs through various stem modifications like rhizome, tubers, bulbs etc.
   b. It occurs through rhizome in turmeric and ginger, through tubers in potato, and through bulbs in onion and garlic.

INTEXT QUESTION

Q.7

i. Do you know?
Why does gardener choose to propagate plants asexually?

Ans : Gardener chooses to propogate plants asexually due to following advantages:

i. Vegetative propogation is faster, easier and a cheaper process as compared to propogation by seeds.

ii. Plants where sexual reproduction is absent, vegetative propagation is the means of reproduction.

iii. By the help of methods like grafting desired character of stock (eg. disease resistance, high yield, vigour, etc.) can be transferred to the scion.

iv. It helps in the production of clones of economically useful and rare plants.

ii. Activity:
Prepare chart for natural vegetative propagation exhibited by flowering plants indicating the vegetative parts and the different examples.

Ans :

Organ	Part	Name of the plant
Tuber	Stem	Potato
Rhizome	Stem	Ginger
Napiform root	Root	Beet
Stolon	Stem	*Mentha*
Leaf buds	Leaf	*Bryophyllum*
Bulbil	Floral buds	Agave
Runner	Stem	Lawn Grass
Bulbil	Stem	Onion

Entrance Corner (Set 1)

i. Under unfavourable condition the Amoeba withdraws it pseudopodia and secretes three-layered hard covering or cyst around itself. This phenomenon is termed as **encystation**.

ii. When favourable conditions return, the encysted Amoeba divides by miltiple fission and producers many minute amoeba or pseudo spores; the cyst wall busts out and spores are liberated in the surrounding medium to grow up into many amoeba. This phenomenon is known as **sporulation**.

iii. In binary fission and parent cell divides to produce two equal cells that gives rise to two new individuals eg. Bacteria and Amoeba.

iv. **Conidia** are non motile spores produced by Fungi e.g. *Penicillium*.

v. Internal buds found in sponges are called as **gemules**.

MULTIPLE CHOICE QUESTIONS

Entrance Corner (Set 1)

1. Which one of the following is correctly matched?
   (a) Onion-Bulb
   (b) Ginger-Sucker
   (c) Chlamydomonas-Conidia
   (d) Yeast-Zoospores

2. Which one of the following pairs is wrongly matched while the remaining three are correct?

(a) Penicillium - conidia
(b) Water hyacinth - runner
(c) Bryophyllum - leaf buds
(d) Agave - bulbils

3. Vegetative propagation in Pistia occurs by
(a) Stolon (b) offset
(c) shoot buds (d) sucker.

4. Vegetative propagation in mint occurs by
(a) offset (b) rhizome
(c) sucker (d) runner.

5. Vegetative reproduction of Agave occurs through
(a) rhizome (b) stolen
(c) bulbils (d) sucker

6. For union between stock and scion in grafting which one is the first to occur.
(a) formation of callus
(b) production of plasmodesmata
(c) differentiation of new vascular tissues.
(d) regeneration of cortex and epidermis.

7. Plants identical to mother plants can be had obtained from
(a) Seeds
(b) Stem cutting
(c) Both (a) and (b) (d) None of these

8. A clone is a group of individuals obtained through
(a) Self pollination
(b) Hybridization
(c) Vegetative propagation
(d) Cross pollination

9. Reproducing new plants by cells instead of seeds is known as
(a) Biofertilizer (b) Mutation
(c) Tissue culture (d) Antibiotics

10. Genetically identical progeny is produced when an individual
(a) Practices self-fertilization
(b) Produces identical gametes
(c) Practices reproduction
(d) Practices by breeding without meiosis

Try yourself

11. The development of gametophyte from the vegetative parts of the sporophyte without the intervention of spores is called
(a) Parthenocarpy
(b) Parthenogenesis
(c) Apogmay
(d) Apospory

12. The reason of formation of embryoid from pollen grain in a tissue culture medium is
(a) Organogenesis
(b) Double fertilization
(c) Test tube culture
(d) Cellular totipotency

13. Grafting of tissue or organ between individuals of different species is called
(a) Autograft (b) Isograft
(c) Xenograft (d) Allograft
(e) Intergraft

14. The formation of gametophyte from the sporophyte (without meiosis) is called
(a) Apospory (b) Apogamy
(c) Agametospermy (d) None of these

15. Which of the following paris is not correctly matched?

Mode of reproduction	**Example**
a. Binary fission	Sargassum
b. Conidia	Penicillium
c. Offset	Water hyacinth
d. Rhizome	Banana

16. Binary fission is a form of:
(a) asexual reproduction
(b) sexual reproduction
(c) both (a) and (b)
(d) none of these

17. Transverse binary fission occurs in:
(a) *Hydra* (b) *Euglena*
(c) *Paramecium* (d) *Amoeba*

18. Which of the following animals is having longitudinal binary fission?
(a) *Hydra* (b) *Euglena*
(c) *Planaria* (d) *Plasmodium*

19. *Hydra* reproduces by budding. This is an example of:
(a) parthenocarpy
(b) regeneration
(c) asexual reproduction
(d) sexual reproduction

1.2 Sexual Reproduciton

Q.8 Write a short note on sexual reproduction.

Ans :

i. Sexual reproduction involves fusion of two compatible gametes or sex cells.

ii. It involves two major events viz. meiosis and fusion of gametes.

iii. Sexual reproduction is characterised by fusion of the male and female gametes (fertilization) leading to zygote formation and embryogenesis (embryo formation).

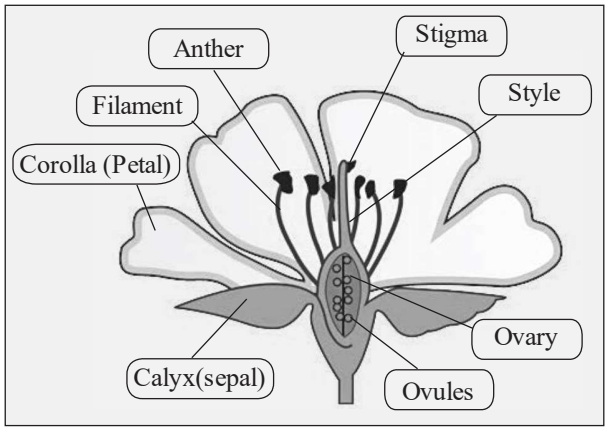
iv. Fusion of gametes leads to production of genetically dissimilar offsprings.

v. Variations are useful from the perspective of survival and the evolution of species.

vi. Sequential events that occur in sexual reproduction are grouped into three distinct stages viz. Pre-fertilization, Fertilization and the Post-fertilization.

Q.9 Define flower state structure and function of a typical flower.

Ans :



i. The flower is specialized reproductive structure of a plant in which sexual reproduction takes place.

ii. Typical flower consists of four different whorls viz. calyx, corolla, androceium and gynoceium.

iii. The male reproductive whorl of flower is called androceium and the female reproductive whorl is called gynoceium.

iv. The function of flower is to produce haploid gametes and to ensure that fertilization will takes place.

Q.10 Describe the structure of an anther.

Ans :

i. An immature stage of anther is represented by group of parenchymatous tissue surrounded by single layered epidermis.

ii. Anther is generally dithecous but can also be monothecous.

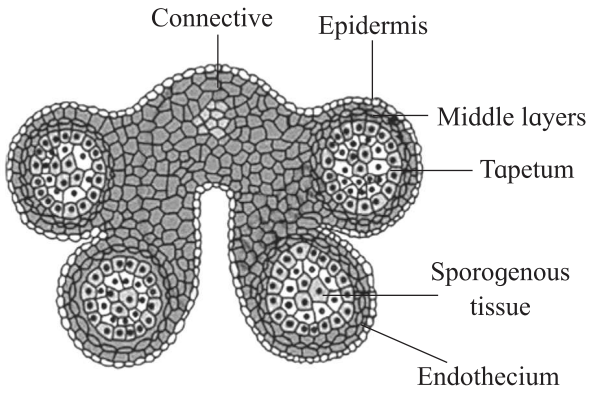
iii. Dithecous anther contain two lobes whereas monothecous anther has one lobe.

iv. In dithecous anther four pollen sacs are present, thus is tetrasporongiate.

v. Each monothecous anther contains two pollen sacs.

Q.11 Explain the T.S. of anther with the help of neat and labelled diagram.

Ans :



i. **Sporogenous tissue:**

a. The heterogenesity (differenciation) arises when some hypodermal cells get transform into archesporial cells.

b. The archeporial cell divides into an inner sporongeous cell forms sporogenous tissue.

c. Each cell of sporogenous tissue is capable of giving rise to a microspore tetrad.

ii. **Anther wall:** Parietal cell undergoes divisions to form anther wall layers. The wall of mature anther is divided into following four layers:

a. **Epidermis:** It is the outermost protective layer mode up of tabular (flattened) cells.

b. **Endothecium:** It is sub-epidermal layer made up of rodially elongated cells with fibrous thickenings.

c. **Middle layer:** Inner to endothecium is middle layer made up of thin walled cells

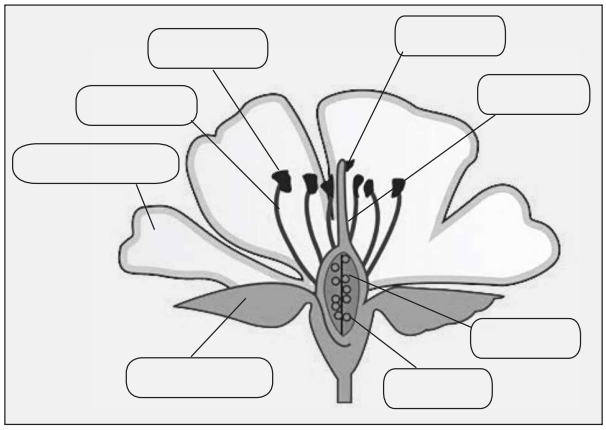
(1-2 layered), which may disintegrate in mature anther.

d. **Tapetum:** It is the inner most nutritive layer of anther wall. It immediately encloses the sporogenous tissue (microspore mother cells).

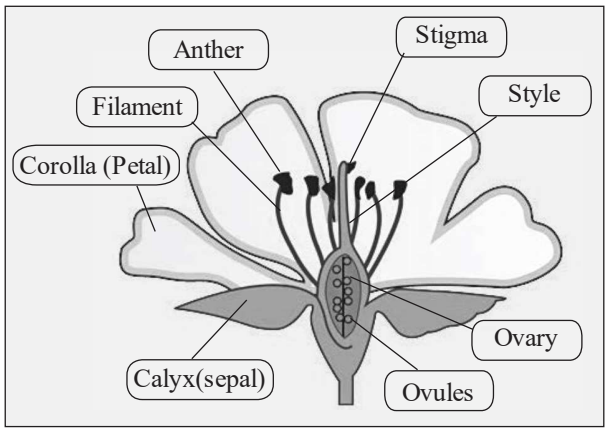
INTEXT QUESTION

Q.12 Activity:

Label the parts of flower in the given diagram.



Ans :



TEXTUAL QUESTION

★Q.13 Name the layer which supplies noursihment to the developing pollen grains.

Ans : **Tapetum** is the layer which supplies nourishment to the developing pollen grains.

Entrance Corner (Set 2)

i. All organisms have to reach a certain stage of growth and maturity in their life, before they can reproduce sexually. That period of growth is called the **juvenile phase**. It is known as **vegetative phase** in plants.

ii. A few plants exhibit unusual flowering phenomenon; some of them such as bamboo species flower only once in their life time, generally after 50-100 years, produce large number of fruits and die.

iii. Another plant, Strobilanthus kunthiana (neelakuranji), flowers once in 12 years. As many of you would know, this plant flowered during September-October 2006. Its mass flowering transformed large tracks of hilly areas in Kerala, Karnataka and Tamil Nadu into blue stretches and attracted a large number of tourists.

iv. In animals, the juvenile phase is followed by morphological and physiological changes prior to active reproductive behaviour. The reproductive phase is also of variable duration in different organisms.

MULTIPLE CHOICE QUESTIONS

Entrance Corner (Set 2)

1. Ubisch bodies are present in
   (a) Pollen tube (b) Pollen grain
   (c) Microspore (d) Tapetum
2. Ubisch bodies found in tapetal cell help in formation of
   (a) Pollen kit and pollinia
   (b) Exine
   (c) Sporopollenin
   (d) Intine and pollen kit
3. Mature male gametophyte is made up of
   (a) One cell (b) Two cells
   (c) Three cells (d) Four cells
4. In plants meiosis occurs in
   (a) Anther (b) Root tip
   (c) Cambium (d) Pollen grain

Try yourself

5. Which one of the following statements is not true ?
   (a) Pollen grains of many species cause severe allergies
   (b) Stored pollen in liquid nitrogen can be used in the crop breeding programmes
   (c) Tapetum helps in the dehiscence of anther

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

6. Proximal end of the filament of stamen is attached to the
   (a) placenta
   (b) thalamus or petal
   (c) anther
   (d) connective.

7. Which one of the following statements is correct?
   (a) Endothecium produces the microspores
   (b) Tapetum nourishes the developing pollen
   (c) Hard outer layer of pollen is called intine
   (d) Sporogenous tissue is haploid.

1.3 Microsporogenesis

Q.14 What is Microsporogenesis ?
Or
Define microsporogenesis.

Ans : The process by which each microspore mother cell divides meiotically to form tetrad of haploid microspores (pollen grains).

Q.15 Describe the structure of microspore.

Ans :

i. A typical pollen grain is a non-motile, haploid, unicellular body with single nucleus.

ii. It is surrounded by a two layered wall called sporoderm.

iii. The outer wall layer is called **exine** and the inner wall layer is called **intine.**

iv. **Exine:**
   a. Exine is thick and made up of complex, non-biodegradable, substance called **sporopollenin**.
   b. Exine may be smooth or with a sculptured pattern (characteristic of the species).
   c. It is resistant to chemicals.
   d. At some places exine is very thin showing thin areas known as **germ-pores.**
   e. Germ-pores are meant for the growth of emerging pollen tube during germination of pollen grain.

v. **Intine** consists of cellulose and pectin.

INTEXT QUESTION

Q.16 Why pollen grain can remain well preserved as fossil?

Ans :

i. Exine of a pollen grain is made up of sporopollenin substance.

ii. Pollen grain is resistant to high temperatures, strong acids and bases due to sporolleniun. Thus, pollen grain can remain well preserved in fossil.

Q.17 Write a note on pollen viability.

Ans :

i. Pollen viability is the functional ability of pollen grain to germinate to develop male gametophyte.

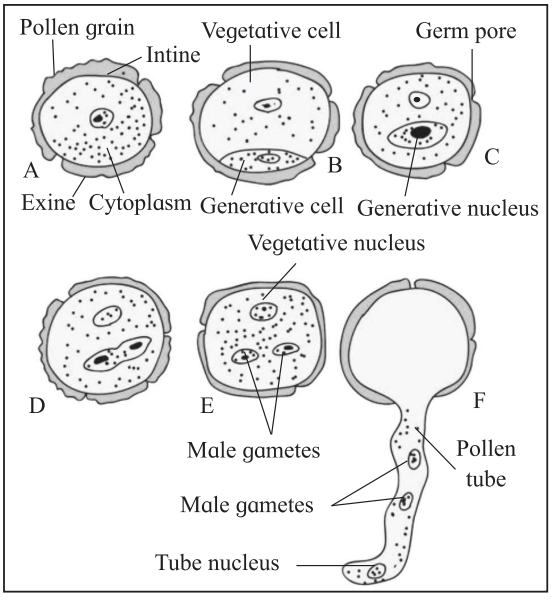
ii. Pollen viability depends upon environmental conditions of temperature and humidity.

iii. It is 30 minutes in rice and wheat whereas in some members of solanaceae, Rossaceae, Leguiminosae, the pollen grains remain viable even for months.

TEXTUAL QUESTION

★Q.18 Explain the stages involved in the maturation of microspore into male gametophyte.

Ans :



i. Pollen grain marks the beginning of male gametophyte.

ii. It undergoes first mitotic division to produce

bigger, naked **vegetative cell** and small, thin walled **generative cell**.

iii. The vegetative cell is rich in food and having irregular shaped nucleus.

iv. The generative cell floots in the cytoplasm of vegetative cell.

v. The second mitotic division is concerned with generative cell only and gives rise to two non-motile male gametes.

vi. The motitic division of generative cell takes place either in pollen grain or in the pollen tube.

vii. The pollen grains are shed from the anther, at this two-celled stage in most of the angiosperms.

Entrance Corner (Set 3)

i. Pollen grains of many species cause severe allergies and bronchial afflictions in some people often leading to chronic respiratory disorders– asthma, bronchitis, etc. It may be mentioned that Parthenium or carrot grass that came into India as a contaminant with imported wheat, has become ubiquitous in occurrence and causes pollen allergy.

ii. Pollen grains are rich in nutrients. It has become a fashion in recent years to use pollen tablets as food supplements. In western countries, a large number of pollen products in the form of tablets and syrups are available in the market. Pollen consumption has been claimed to increase the performance of athletes and race horses.

iii. You may have heard of storing semen/sperms of many animals including humans for artificial insemination. It is possible to store pollen grains of a large number of species for years in liquid nitrogen (-1960C). Such stored pollen can be used as pollen banks, similar to seed banks, in crop breeding programmes.

MULTIPLE CHOICE QUESTIONS

Entrance Corner (Set 3)

1. The type of fossil pollen grains present in the area may be helpful in the exploration of
   (a) Coal
   (b) Petroleum
   (c) Fossil pteriodophytes
   (d) All the above
2. The pollen grain is
   (a) An immature male gametophyte
   (b) A mature male gametophyte
   (c) Partially developed male gametophyte
   (d) Last stage of male gametophyte
3. Exine of pollen grains is composed of
   (a) Pectocellulose (b) Lignocellulose
   (c) Sporopollenine (d) Pollen kit
4. In angiosperm, all 4 microspores of tetrad are covered by a layer which is formed by
   (a) Callose (b) Cellulose
   (c) Sporopollenin (d) Pectocellulose
5. Pollen grain are formed in
   (a) Anther (b) Stigma
   (c) Filament (d) Pollen sac
6. Germpore is the region where the exine is
   (a) Thick (b) Uniform
   (c) Thick and uniform (d) Absent
7. How many pollen grains are formed from 10 microspore mother cells by meiosis
   (a) 80 (b) 40
   (c) 20 (d) 10
8. Meiosis can be observed in
   (a) Spore mother cells (b) Microspores
   (c) Megaspores (d) Tapetal cells
9. Microsporogenesis is a synonym for
   (a) Spermatogenesis
   (b) Development of pollen
   (c) Development of male gametophyte
   (d) Development of female gametophyte
10. Which is the most common type of embryo sac in angiosperm?
   (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

Try yourself

11. Which of the following has proved helpful in preserving pollen as fossils?
(a) Pollenkitt (b) Cellulosic intine
(c) Oil content (d) Sporopollenin

12. Male gametophyte in angiosperms produces
(a) single sperm and two vegetative cells
(b) three sperms
(c) two sperms and a vegetative cell
(d) single sperm and a vegetative cell.

13. 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 temperature as well as strong acids and alkalis.
(d) Sporopollenin can withstand high temperatures but not strong acids.

14. An organic substance that can withstand environmental extremes and cannot be degraded by any enzyme is
(a) cuticle (b) sporopollenin
(c) lignin (d) cellulose.

15. The microscopic structure in flower that contains polar nuclei is
(a) Only gametophyte
(b) Pollen tube
(c) Embryo sac
(d) None of the above

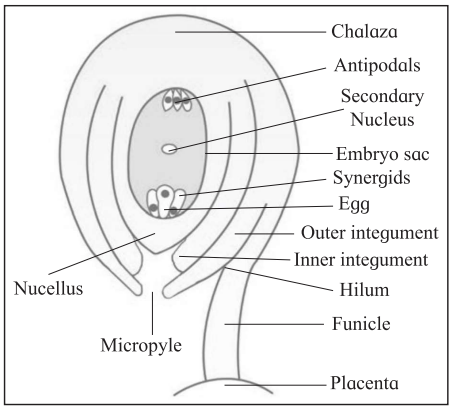
16. Mature embryo sac contains or A normal angiosperm embryo sac at the final stage of development has
(a) 4 cells (b) 3 cells
(c) 7 cells (d) 8 cells

17. In an embryo sac of a typical angiosperm, there are
(a) Egg, synergids and antipodals
(b) Egg, synergids, polar nuclei and antipodals
(c) Egg, synergids, central cell and polar nuclei
(d) Egg, synergids and secondary cell

1.4 Structure of Anatropus Ovule

Q.19 Explain the structure of an anatropous ovule with the help of a neat and labelled diagram.

Ans :



i. Anatropous ovule is the most common type of ovule present in angiosperms.

ii. Each ovule develops inside the ovary and is attached to the **placenta** by a small stalk called **funiculus.**

iii. **Hilum** is the point of attachment of funciculus with the main body of ovule.

iv. The ovule consists of central parenchymatous tissue known as the **nucellus.**

v. Nucellus is usually surrounded by two protective coverings called **integuments** viz. Outer and inner integument.

vi. **Micropyle** is a narrow opening at the apex of the ovule, it is directed downwards and is present adjacent to the funiculus(funicle)in an anatropous ovule.

vii. **Chalaza** is the base of ovule directly opposite to micropyle.

viii. **Embryo sac** (female gametophyte) is oval multicellular structure embedded in the nucellus.

Q.20 Name the following.

i. Female reproductive whorl of flower.

Ans : Gynoceium (Pistil).

ii. Individual member of gynoecium.

Ans : Carpel (megasporophyll).

iii. A flower with many free carpels.

Ans : Apocarpous (eg. *Michelia*).

iv. A flower with many, fused carpels.

Ans : Syncarpous (eg. Brinjal).

MULTIPLE CHOICE QUESTIONS

Entrance Corner (Set 4)

1. Which one of the following represents an ovule, where the embryo sac becomes horse-shore shaped and the funiculus and micropyle are close to each other?
   (a) Amphitropous (b) Circinotropous
   (c) Atropous (d) Anatropous
2. What is the direction of micropyle in anatropous ovule?
   (a) Upward (b) Downward
   (c) Right (d) Left
3. Embryo sac represents
   (a) megaspore
   (b) megagametophyte
   (c) megasporophyll
   (d) megagamete.
4. Point out the odd one.
   (a) Nucellus (b) Embryo sac
   (c) Micropyle (d) Pollen grain
5. Which of the following pair have haploid structures?
   (a) Nucellus and antipodal cells
   (b) Antipodal cells and egg cell
   (c) Antipodal cells and megaspore mother cell
   (d) Nucellus and primary endosperm nucleus
6. Embryo sac occurs in
   (a) embryo
   (b) axis part of embryo
   (c) ovule (d) endosperm.
7. Female gametophyte of angiosperms is represented by
   (a) ovule
   (b) megaspore mother cell
   (c) embryo sac (d) nucellus.
8. The stalk of the ovule is called
   (a) Pedicel (b) Petiole
   (c) Funicle (d) Hilum
9. Tegmen develops from
   (a) Outer integument
   (b) Inner integument
   (c) Chalaza (d) Funicle
10. In anatropous ovule, the micropyle is
    (a) In straight line with funicle
    (b) At right angle with funicle
    (c) At 45o with funicle
    (d) Side by side with funicle
11. Which of the following is not functionally analogous with others in the group
    (a) Archegonium (b) Oogonium
    (c) Antheridium (d) Ovule

Try yourself

12. The microscopic structure in flower that contains polar nuclei is
    (a) Only gametophyte
    (b) Pollen tube
    (c) Embryo sac
    (d) None of the abov
13. Mature embryo sac contains or A normal angiosperm embryo sac at the final stage of development has
    (a) 4 cells (b) 3 cells
    (c) 7 cells (d) 8 cells
14. In an embryo sac of a typical angiosperm, there are
    (a) Egg, synergids and antipodals
    (b) Egg, synergids, polar nuclei and antipodals
    (c) Egg, synergids, central cell and polar nuclei
    (d) Egg, synergids and secondary cell
15. Female gametophyte of angiospermic plants is represented by [MP PMT 1994, 2000]
    (a) Oospore (b) Egg
    (c) Carpel (d) Pollen grain
16. If diploid chromosome number in a flowering plant is 12, then which one of the following will have only 6 chromosomes
    (a) Endosperm (b) Leaf cells
    (c) Cotyledons (d) Synergids
17. Egg apparatus of angiosperm consists of
    (a) One egg cell and two synergids
    (b) One egg cell 2 synergids 3 antiodals
    (c) 3 antipodals only
    (d) Secondary nucleus and egg cell
18. The point of attachment of funicle with chalazal end is called
    (a) Placenta (b) Integument
    (c) Nucellus (d) Hilum

19. What is the direction of micropyle in anatropous ovule
    (a) Left (b) Right
    (c) Upward (d) Inverted
20. In angiosperms embryosac is developed from
    (a) Megaspore mother cell
    (b) Secondary nucleus
    (c) Endothecium
    (d) Microspore mother cell
21. Ovule with funiculus lying close to micropyle is known as
    (a) Anatropous (b) Campylotropous
    (c) Atropous (d) Cytokinin

1.5 Mega-sporogenesis

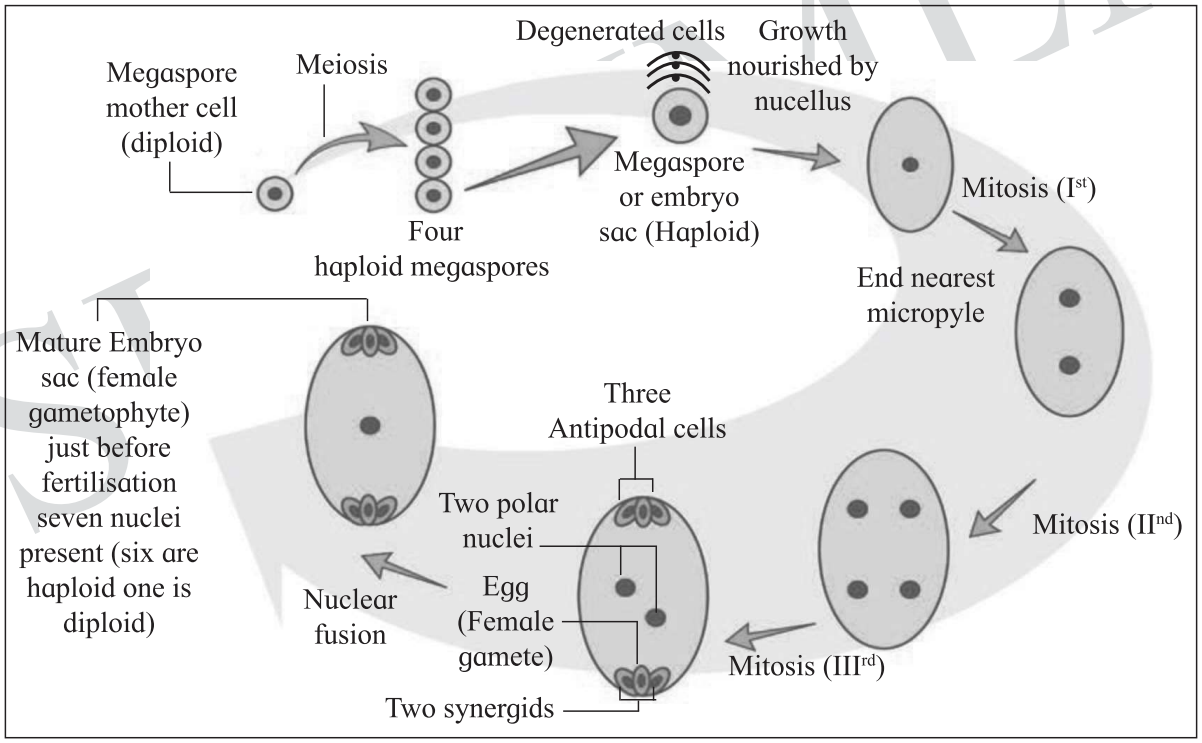
TEXTUAL QUESTION

Q.21 Define megasporogenesis.

Ans : Megasporogenesis is the process of formation of haploid megaspores from diploid **megaspore** mother cell **(MMC).**

Q.22 Explain development of female gametophyte with the help of neat and labelled diagram.

Ans :



i. Megaspore mother cell undergoes meiosis to form linear tetrad of haploid cells i.e. megaspore.
ii. Upper three megaspores abort (degenerate) and lowest one towards centre of nuclleus remains functional. It acts as first cell of female gametophyte
iii. The functional megaspore undergoes three successive, free nuclear **mitotic** divisions.
iv. Thus total eight nuclei are formed, four of which are located at each pole.
v. One nucleus from each pole migrates towards the centre and are called **polar nuclei.**
vi. Three nuclei towards micropylar end constitute egg apparatus.

vii. It consists of large central, haploid egg cell and two supporting haploid synergid cells.

viii. Synergid shows hair like projections called **fillform apparatus,** which guide the pollen tube towards the egg.

ix. Antipodal cells are group of three cells present at the chalazal end.

x. The two haploid polar nuclei of large central cell fuse to form diploid secondary nucleus or definitive nucleus, just prior to fertilization.

xi. The two haploid polar nuclei of large central cell fuse to form diploid **secondary nucleus or definitive nucleus,** just prior to fertilization.

xii. This seven celled and eight nucleated structure is called an embryo sac.

xiii. This method of **embryo sac** development from a single megaspore is described as **monosporic development.**

ix. In angiosperms, the development of female gametophyte is endosporous i.e. within the megaspore.

x. Female gametophyte is colourless, endosporic and is concealed in the ovule enclosed by ovary.

TEXTUAL QUESTION

★Q.23 How many haploid cells are present in a mature embryo sac?

Ans : Total 6 haploid cells are present in a mature embryo sac viz. antipodal cells(3), Synergids(2) and egg cell(1).

★Q.24 What is the function of filliform apparatus.

Ans : The function of filliform apparatus is to guide the entry of pollen tube towards the egg.

MULTIPLE CHOICE QUESTIONS

Entrance Corner (Set 5)

1. In angiosperms, megaspores formed after meiosis of megaspore mother cell are arranged in _____
   (a) Isobilateral tetrad
   (b) Linear tetrad
   (c) Tetrahedral tetrad
   (d) T-shaped tetrad

2. Which is the most common type of embryo sac in angisoperms?
   (a) Bisporic with two sequential mitotic divisions
   (b) Tetrasporic with one mitotic stage of divisions
   (c) Monosporic with three sequential mitotic divisions
   (d) Monosporic with two sequential mitotic divisions

3. A typical embryo sac at maturity is
   (a) 7 nucleated, 8 celled
   (b) 8 nucleated, 7 celled
   (c) 8 nucleated, 8 celled
   (d) 7 nucleated, 7 celled

4. What is the fate of the male gametes discharged in the synergid?
   (a) One fuses with the egg and other fuses with central cell nuclei.
   (b) One fuses with the egg, other(s) degenerates in the synergid.
   (c) All fuses with the egg, other(s) fuse(s) with synergid nucleus.

5. Functional megaspore in an angiosperm develops into an
   (a) endosperm (b) embryo sac
   (c) embryo (d) ovule.

6. Filiform apparatus is characteristic feature of
   (a) aleurone cell (b) synergids
   (c) generative cell (d) nucellar embryo

7. In angiosperms, microsporogenesis and megasporogenesis
   (a) involve meiosis
   (b) occur in ovule
   (c) occur in anther
   (d) form gametes without further divisions.

8. Function of filiform apparatus is to
   (a) recognize the sutiable pollen at stigma
   (b) stimulate division of generative cell
   (c) produce nectar
   (d) guide the entry of pollen tube.

Try yourself

9. Meiosis takes place in
   (a) gemmule (b) megaspore
   (c) meiocyte (d) conidia

10. Megasporangium is equivalent to
(a) nucellus (b) ovule
(b) embryo sac (d) fruit.

11. Megaspores are produced rom the megaspore mother cells after
(a) mitotic division
(b) formation of thick wall
(c) differentation
(d) meiotic division

12. In angiosperms, functional megaspore develops into
(a) embryo sac (b) ovule
(c) endosperm (d) pollen sac

13. What does the filiform apparatus do at the entrance into ovule?
(a) It brings about opening of the pollen tube.
(b) It guides pollen tube from a synergid to egg.
(c) It helps in the entry of more than one pollen tube into the embryo sac.

14. In angiosperm pollen tube liberate their male gametes into the
(a) central cell (b) antipodal cells
(c) egg cell (d) synergids.

15. Eight nucleated embryo sac is
(a) only monosporic (b) only bisporic
(c) only tetrasporic (d) any of these

1.6 Pollination

Q.25 Define Pollination

Ans : Pollination is the transfer of pollen grains from anther to the stigma of the flower.

Q.26 State the importance of agents of pollination to angiosperms.

Ans :

i. Pollen grains being non motile, angiosperms have evolved the strategy to use abiotic agents (wind, water) and biotic agents/birds, insects, snails).

ii. By feeding the visitors (biotic agents) and exploiting their mobility for pollination and also seed dispersal.

iii. Pollen grains are non-motile and they are usually carried from flower to flower by means of external agents.

iv. Most of the food crops grown throughout the world depend upon pollinators for reproduction.

Q.27 What are two main types of pollination?

Ans : The two main types of pollination are as follows:

i. **Self pollination:**
a. Self pollination is a type of pollination which occurs in a single flower or two flowers on a single plant.
b. It results in inbreeding or selfing

ii. **Cross pollination:**
a. Cross pollination is the transfer of pollen grains from the another of one flower to the stigma of another flower of different plants of same species.

Q.28 Explain the types of pollination on the basis of source of pollination.

Ans : Three types of pollination on the basis of source of pollination are as follows :

i. **Autogamy** (Self pollination) :
a. It is a type of pollination in which bisexual flower is pollinated by its own pollen grains.
b. Offsprings are genetically identical to their parents eg. pea

ii. **Geitonogamy:**
a. It is the transfer of pollen grain to a stigma of a different flower produced on the same plant.
b. It is functionally similar to cross pollination as it involves pollinating agents, but it cannot bring about genetic variation and is only of ecological significance e.g. *Cucurbita maxima*.
c. It is similar to antogamy as pollen grains come from same plant

iii. ***Xenogames (Cross polination/out breeding)***
a. It is a type of cross pollination when pollen grain of one flower is deposited on the stigma of a flower of different plant belonging to same species, with the help of pollinating agency.
b. It generates genetically varied offsprings.

Q.29 Explain the following terms:
i) Chasmogamy ii) Homogamy

iii) Cleistogamy

Ans :

i. **Chasmogamy** is the condition in which flower opens to expose its sex organs.

ii. When another and stigma of a flower become mature at the same time, called **homogamy**.

iii. Some flowers are self pollinated even before the opening of flower such condition is called cleistogamy.

Q.30 Write a note on anemophily and adaptations in anemophilous flowers.

Ans :

i. Pollination by wind is called as anemophily. Most of the important crop plants are wind pollinated.

ii. These includes wheat, rice, corn, rye, barley, plan and oats.

iii. **Adaptations in anemophilous flowers**

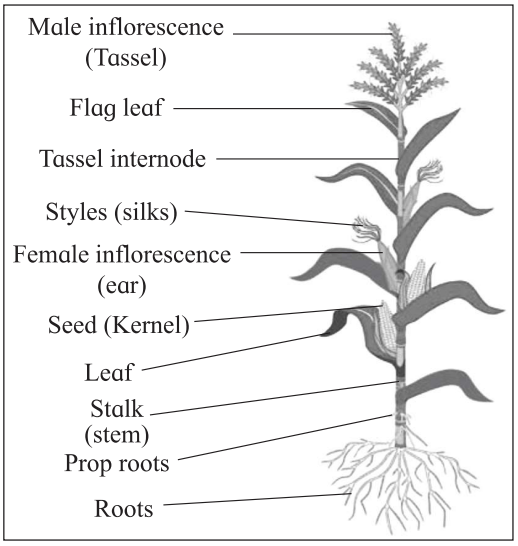
a. The flowers are small, inconspicuous, colourless, without nectar and fragrance (odour).

b. The pollen grains are light in weight, dry and produced in large numbers to increase chances of pollination considering wastage of pollengrains.

c. Stigma is feathery to trap pollens carried by wind currents.

d. Stamens are exserted with long filaments and versatile anthers.

e. Stamens and stigmas are exposed to air currents.



Q.31 What is hydrophily? Enlist adaptations in hydrophilous flowers.

Ans :

i. Pollination by water is called hydrophily.

ii. It is found in some 30 genera of aquatic monocots. e.g. ***Vallisneria, Zostera, Ceratophyllum*** etc.

iii. Adaptations in hydrophilious flowers :

a. Flowers are small and inconspicuous.

b. Perianth and other floral parts are unwettable.

c. Pollen grains are long and unwettable due to presence of mucilage.

d. Nectar and fragrance are lacking in flowers.

Q.32 Write a note on two types of hydrophily.

Ans : The two types of hydrophily are hypolydrophily and epihydrophily.

i. **Hypolydrophily:**

a. This pollination occurs below the surface of water.

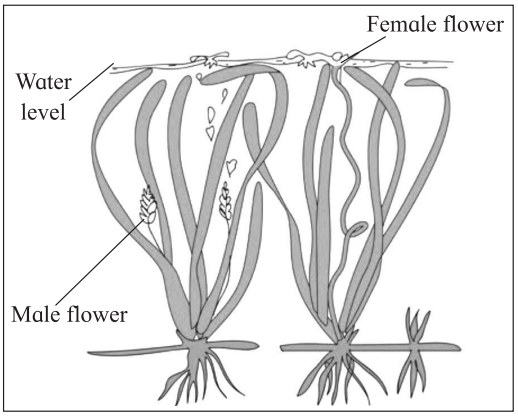
b. Here the pollen grains are heavier than water thus sink down and get caught by stigmas of female flowers, e.g. In *Zostera* (sea grass) the pollen grains are long, ribbon like and without exine.

ii. **Epihydrophily:**

a. In this the pollen grain float on the water surface and reach the stigma of female flower.

b. For e.g. *Vallisneria* is a submerged dioecious, fresh water aquatic plant in which female flowers reach the water surface temporarily to ensure pollination and male flowers float on the surface of water.

c. This pollen grains have specific gravity equal to that of water, thus they can float on the surface of water.



Q.33 Give examples of the following.
i. Anemophilous aquatic plants
ii. Entomophilous aquatic plants

Ans :

i. Potamogeton, Halogaris are some examples of Anemophilous plants.

ii. Lotus, water hyacinth, waterlily are some example of Anemophilous plants.

Q.34 What ie Entomophily? Enlist adaptations in entomophilous flowers.

Ans :

i. Pollination by insects is called as Entomophily.

ii. It occurs in Rose, Jasmine, Cestrum, etc.

iii. **Adaptations in entomophilous flowers :**
a. They are large, showy and often brightly coloured.
b. The flowers produce sweet odour (small) and have nectar glands.
c. The stigma is rought due to presence of hair or is sticky due to mucilaginous secretion.
d. The pollen grains are spiny and surrounded by a yellow sticky substance called pollen-kit.
e. Some plants have special adaptations for the insect visitor to help in cross pollination, e.g. lever mechanism or turnpipe mechanism in Salvia.

Q.35 What is pollination syndrome

Ans :

i. In biotic pollination, plants are adapted to encourage the specific pollinators they need.

ii. They are said to have developed pollination contrivance.

iii. Plants and pollinators have co-evolved physical characteristics that make them to interact successfully. Such characteristics are considered pollination syndromes.

Q.36 What is Ornithophily? Enlist adaptations in ornithophilous flowers.

Ans :

i. Pollination by birds is called as Ornithophily

ii. Only a few types of birds specialised for pollination these birds usually have a long beaks and are small in size e.g. Sunbirds and humming birds.

iii. For e.g. *Bombax, Callisfemon* (Bootle Bush), *Butea*, etc.

iv. Adaptations in ornithophilous flowers:
a. Flowers are usually brightly coloured, large and showy.
b. They secrete profuse, dilute nectar.
c. Pollen grains are sticky and spiny.
d. Flowers are generally without fragrance, as birds have poor sense of smell.

Q.37 Define Chiropterophily and enslist the adaptations in chiropterophilous flowers.

Ans :

i. Pollination by bats is known as Chiropterophily

ii. Bats can transport pollens over long distance, some times several kilometers.

iii. Adaptations in Chiropterophilous flowers:
a. Flowers are dull coloured with strong fragrance.
b. They secrete abundant nectar.
c. Flowers produce large amount of edible pollen grains, e.g. *Anthocephalous* (kadamb tree), *Adansonia* (Baobab tree), *Kigelie* (Sausage tree).

TEXTUAL QUESTION

Q.38 What is hydrophily?

Ans : Pollination carried out by water is called as hydrophily.

INTEXT QUESTION

Q.39 Why do some plants have both chasmogamous and cllistogamous flowers?

Ans :

i. Some plants produce both chasmogamous and clictogamous flowers eg. *Viola*, *Commelina*.
ii. Chasmogamous flowers have open or exposed reproductive whorls they facilitate cross pollination.
iii. Clistogamous flowers do not open, thus facilitating autogamy.
iv. Thus to ensure pollination and seed formation, some plants have both chasmogamous and claistogamous flowers.

Entrance Corner (Set 6)

i. In some species floral rewards are in providing safe places to lay eggs; an example is that of the tallest flower of Amorphophallus (the flower itself is about 6 feet in height).
ii. A similar relationship exists between a species of moth and the plant Yucca where both species – moth and the plant – cannot complete their life cycles without each other. The moth deposits its eggs in the locule of the ovary and the flower, in turn, gets pollinated by the moth. The larvae of the moth come out of the eggs as the seeds start developing.
iii. Many insects may consume pollen or the nectar without bringing about pollination. Such floral visitors are referred to as pollen/ nectar robbers.

MULTIPLE CHOICE QUESTIONS

Entrance Corner (Set 6)

1. Animal vectors are required for pollination in
   (a) Vallisneria (b) mulberry
   (c) cucumber (d) maize.
2. Which one of the following statements is correct?
   (a) Cleistogamous flowers are always autogamous.
   (b) Xenogamy occurs only by wind pollination.
   (c) Chasmogamous flowers do not open at all.
   (d) Geitonogamy involves the pollen and stigma of flowers of different plants.
3. Both, autogamy and geitonogamy are prevented in
   (a) papaya (b) cucumber
   (c) castor (d) maize
4. Even in absence of pollinating agents seed-setting is assured in
   (a) Commelina (b) Zostera
   (c) Salvia (d) fig.
5. Anemophily type of pollination is found in
   (a) Salvia (b) bottle brush
   (c) Vallisneria (d) coconut
6. An interesting modification of flower shape for insect pollination occurs in some orchids in which male insect mistakes the pattern on the orchids flower for the female species and tries to copulate with it, thereby pollinating the flower. This phenomenon is called
   (a) pseudopollination
   (b) pseudoparthenocarpy
   (c) mimicry
   (d) pseudocopulation
7. When pollen of a flower is transferred to the stigma of another flower of the same plant, the pollination is referred to as
   (a) autogamy (b) geitonogamy
   (c) xenogamy (d) allogamy.
8. Pollination occurs in
   (a) bryophytes and angiosperms
   (b) pteridophytes and angiosperms
   (c) angiosperms and gymnosperms
   (d) angiosperms and fungi.
9. Pollination occurs when a pollen grain
   (a) Matures and has three nuclei
   (b) Lands on a stigma
   (c) Releases its sperm nuclei
   (d) Releases its pollen tube nucleus
10. In which type of flowers, stigma is rough and sticky
    (a) Insect pollinated (b) Wind pollinated
    (c) Water pollinated (d) All the above

Try yourself

11. Pollination by wind is called
    (a) Geitnogamy
    (b) Anemophily
    (c) Autogamy
    (d) None of the above

12. When pollen grains of a flower pollinate the stigma of another flower of the same plant, it is called
(a) Dichogamy (b) Herkogamy
(c) Geitnogamy (d) Autogamy

13. Correct definition of pollination is
(a) Transfer of pollen grain from anther to stigma
(b) Germination of pollen grain
(c) Growth of pollen tube in ovule
(d) Visits of insects in flower

14. Self pollination means
(a) Occurrence of male and female sex organs in the same flower
(b) Germination of pollens within the anther
(c) Transference of pollens from anther to the stigma within the same flower
(d) Transference of pollens from one flower to another on the same plant

15. Fig is pollinated by
(a) Wind (b) Self
(c) Water
(d) Insects (Blastophaga grossorum)

16. The insect Blastophaga grossorum is associated with the pollination of
(a) Mango (b) Paddy
(c) Beans (d) Ficus

17. Pollination by water is seen in
(a) Nelumbium (b) Vallisneria
(c) Eichornia (d) Nymphaea

18. In which of the following pollination takes place by lever mechanism
(a) Salvia (b) Ficus
(c) Antirhinum (d) Ocimum

19. In sausage tree (Kigelia africana) the pollination takes place by
(a) Birds (b) Bats
(c) Wind (d) Insects

1.7 Outbreeding Devices (contrinuances)

TEXTUAL QUESTION

Q.40 Describe threee devices by which cross pollination is encouraged in angiosperms by avoiding self-pollination (write any three)

Ans :

i. Genetic diversity is an essential factor for evolution by natural selection. Continued self pollination results in the inbreeding depression.

ii. Thus plants have developed many devices to encourage cross pollination. The examples of outbreeding devices are as follows:

iii. **Unisexuality:**
a. In this case, the plant bears either male or female flowers. It is also called as dioecism.
b. As flowers are unisexual, self pollination is not possible. Plants may be monoecious, e.g. Maize or dioecious, e.g. Mulberry, Papaya.

iv. **Dichogamy:**
In this device, anthers and stigmas mature at different times in a bisexual flower so as to prevent self pollination. It can be further divided into two types:
a. **Protandry:** In this type, androecium matures earlier than the gynoecium, e.g. in the disc florest of sunflower.
b. **Protogyny:** In this type, gynoecium matures earlier than the androecium, e.g. Gloriosa.

v. **Prepotency:**
Pollen grains of other flowers germinate rapidly over the stigma than the pollen grains from the same flower, e.g. Apple.

vi. **Heterostyly (heteromorphy):**
a. In some plants like Primula (Primrose, there are two or three types of flowers in which stigmas and anthers are placed at different levels (heterostyly and heteroanthy).
b. This prevents the pollens from reaching the stigma and pollinating it.
c. In heteromorphic flowers, pollen grains produced from anther pollinate stigmas produced at the same level.

vii. **Herkogamy:**
a. It is a mechanical device to prevent self pollination in a bisexual flower.
b. In plants, natural physical barrier is present between two sex organs and avoid

contact of pollen with stigma of same flower, e.g. Calotropis-pentangular stigma is positioned above the level of anthers (pollinia).

viii. **Self incompatibility (self sterility):** This is a genetic mechanism due to which the germination of pollen on stigma of the same flower is inhibited, e.g. Tobacco, Thea.

MULTIPLE CHOICE QUESTIONS

Entrance Corner (Set 7)

1. Which prevents self pollination
   (a) Self sterility (b) Herkogamy
   (c) Dichogamy (d) All of the above
2. In plants, in nature, autogamy is avoided since the seeds produced
   (a) Are fewer in number
   (b) Do not germinate successfully
   (c) Do not produce healthy plants
   (d) All the above
3. The allogamy is best favoured by
   (a) Homogamy (b) Cleistogamy
   (c) Dicliny (d) All of the above

Try yourself

4. Progeny produced as a result of cross pollination
   (a) Shows high degree of variability and is evolutionary important
   (b) Is sterile
   (c) Has recessive characters
   (d) Is homozygous with phenotypic uniformity
5. Flowers preventing self-pollination is called
   (a) Dichogamy (b) Protanary
   (c) Herkogamy (d) Protogyny

1.8 Pollen-Pistil Interaction

Q.41 Write a details note on Pollen-Pistil interaction.

Ans :

i. It is the interaction of pollen grains with sporophytic tissue (stigma).

ii. It begins with pollination and ends with fertilization.

iii. All the events from the deposition of pollen grain on stigma to the entry of pollen tube in the ovule (synergid) are referred as pollen-pistil interaction.

iv. Pollination does not guarantee the transfer of right type of pollen, often wrong type also land on stigma.

v. The pistil has the ability to recognise and accept the right or compatible pollen of the same species. Thus wrong rtype of pollen is discarded by pistil.

vi. Compatibility and incompatibility of the pollen-pistil is determined by special protein.

vii. The stigmatic surface of flower refuse other wrong type or incompatible pollen grains. A physiologial mechanism operates to ensure that only intraspecific pollen germinate successfully.

viii. the compatible pollen absorbs water and nutrients from the surface of stigma, germinates and produces pollen tube. Its growth through the style is determined by specific chemicals.

ix. The stigmatic surface provides the essential prerequisites for a successful germination, which are absent in the pollen.

x. The pollen tube is finally pushed through the ovule and reaches the embryo sae.

xi. The tip of the pollen tube enters in one of the synergids and the ruptures to release the contents.

xii. Due to pollen pistil interaction, intense competition develops even in the compatible pollen grains (gametes).

Q.42 Name the part of gynoceium that determines the compatible nature of pollen grain.

Ans : The compatible nature of pollen grain is determined by pistil.

Q.43 How pollen grains can be induced to germinate artificially.

Ans :

i. Pollen grain can also be induced to germinate in a synthetic medium.

ii. Sucrose induces pollen germination and ttube growth *in vitro*.

iii. Addition of boric acid facilitates and accelerates pollen germination.

Q.44 Explain Artificial hybridization?

Ans :

i. In artificial hybridization, only the desired pollen grains are hand pollinated and used for fertilization.

ii. It is one of the major approaches used in the crop improvement.

iii. This is accomplished through emasculation and bagging procedure.

TEXTUAL QUESTION

Q.45 Incompatibility is a natural barrier in the fusion of gametes. How will you explain this statement?

Ans :

i. Inhibition refers to inability of gametes of two plants even of the same species to fuse with each other.

ii. In the pollen pistil interaction the pollen tube is only formed when the pollen grain is recognised by the stigma.

iii. In some cases the chemical substance released by the style act as barrier.

iv. Incompatibility acts as the most prevalent and effective device to avoid inbreeding and outbreeding.

v. The pollen which are not recognised do not initiate the pollen tube formation and thus are discarded. Thus, incompatibility is a natural barrier in the fusion of gametes.

MULTIPLE CHOICE QUESTIONS

Entrance Corner (Set 7 & 8)

1. Fill up the blanks with suitable words.
The ability of the pistil to recognize pollen is dependent on _____ components and _____ guide the entry of pollen tube. This study leads to help _____ in getting _____ even in _____.
p. Chemicals
q. Plant breeders
r. Hybrids
s. Incompatible pollination
t. Synergids
(a) p, q, r, s, t (b) p, t, q, r, s
(c) t, p, s, r, q (d) p, r, q, s, t

2. Which of the following statements is not correct?
(a) Pollen germination and pollen tube growth are regulated by chemical components of pollen interacting with those of the pistil.
(b) Some reptiles have also been reported as pollinators in some plant species.
(c) Pollen grains of many species can germinate on the stigma of a flower, but only one pollen tube of the same species grows into the style.
(d) Insects that consume p-ollen or nectar whithout bringing about pollination are called pollen/nectar robbers.

3. Transmission tissue is characteristic feature of
(a) dry stigma (b) wet stigma
(c) hollow style (d) solid style

4. Pollen tube at the time of entering embryo sac has
(a) Four gametes
(b) Three male gametes
(c) Two male gametes
(d) One gametic nucleus

5. Which prevents self pollination
(a) Self sterility (b) Herkogamy
(c) Dichogamy (d) All of the above

Try yourself

6. In plants, in nature, autogamy is avoided since the seeds produced
(a) Are fewer in number
(b) Do not germinate successfully
(c) Do not produce healthy plants
(d) All the above

7. The allogamy is best favoured by
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8. Progeny produced as a result of cross pollination
(a) Shows high degree of variability and is evolutionary important
(b) Is sterile

(c) Has recessive characters
(d) Is homozygous with phenotypic uniformity

9. Flowers preventing self-pollination is called
(a) Dichogamy (b) Protanary
(c) Herkogamy (d) Protogyny

1.9 Double fertilization

TEXTUAL

Q.46 Describe the process of double fertilization.

Ans :

i. Double fertilization is a complex fertilized on mechanism in angiospermic plants.
ii. It was discovered by Nawaschin in the liliaceous plants like ***Lilium*** and ***Fritillaria***.
iii. Pollen grain germinates after reaching the surface of the stigma and forms a pollen tube.
iv. Pollen tube penetrates the stigma, style, ovary chamber and then enters ovule.
v. The growth of pollen tube is guided by the chemical secreted by the synergids.
vi. It usually enters the ovule through the micropyle which is termed as **porogamy**. But in some cases, it is found to enter through chalaza, known as **chalazogamy** and in some plants by piercing the integuments, called **mesogamy**.
vii. The pollen tube penetrates embryo sac of ovule through its micropylar end.
viii. The pollen tube carrying male gametes penetrates in one of the synergids.
ix. Watery contents of synergid are absorbed by pollen tube which then ruplures and releases the contents, including the two non-motile male gametes.
x. As non motile male gametes are carried through hollow pollen tube, it is known as **siphonogamy** that ensures fertilization to take place.
xi. **Syngamy** and **triple fusion** are two events of sexual reproduction in angiospermic flowering plants.
xii. Syngamy is the fusion of haploid ale gamete with haploid female gamele (egg) to produce a diploid zygote the zygote develops into an embryo.
xiii. In triple fusion, second haploid male gamete fuses with diploid secondary nucleus producing **primary endosperm nucleus** (PEN) that develops into **triploid endosperm**.
xiv. Syngamy is a type of generatine fertilization whereas triple fusion is a type of negetatine fertilization.
xvi. Here, both the male gametes participate in the process and therefore it is described as or called **double fertilization**.

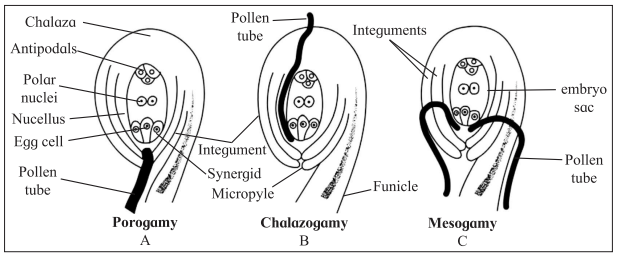
Q.47 State the significance of double fertilization

Ans :

i. It is a unique feature of angiosperms.
ii. It ensures that the parent plant invests a seed with a food store, only if the egg is fertilized.
iii. The diploid zygote develops into an embryo which consequently develops into a new plant.
iv. The triploid PEN develops into nutritive endosperm tissue.
v. It restores the diploid condition by fusion of haploid male gamete with haploid female gamete (i.e. through syngamy).
vi. It also helps to avoid polyembryony.

Q.48 Draw neat labelled diagram on various ways of entry of pollen tube into the ovule.

Ans :



TEXTUAL

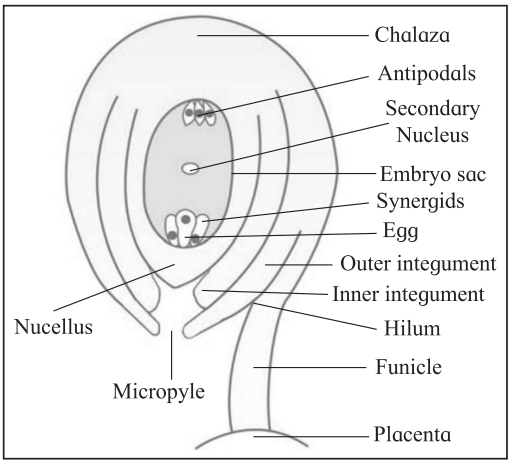
Q.49 Even though each pollen grain has 2 male games, why atleast 20 pollen grains are required to fertilize 20 ovules in a particular carpel?

Ans :

i. In doubel fertilization, one male gamete of pollen grain fuses with the eggcell whereas the other fuses with secondary nuclueses.
ii. Both the male gametes in a pollen grain fertilize only one ovule. Thus to fertilize 20 ovules in a particular carpet, 20 pollen grains are required.

Q.50 Draw a labelled diagram of the L.S. of anatropous ovule and list the components of embryo sac and mention their fate after fertilization.

Ans :



Components of embryo sorc	Fate after fertilization
Egg	Forms embryo
Nucleus	Forms perisperm
Ovule	Forms seed
Secondary Nucleus	Forms Endosperm
Synergies	Degenerate after fertilization
Antipodal cells	Degenerate after fertilization
Micropyle	Forms a opening to the seed
Outer integument	Forms outer seed coat i.e. Testa
Inner integument	Forms inner seed coat i.e. Tegmen

MULTIPLE CHOICE QUESTIONS

Entrance Corner (Set 9)

1. Endosperm of gymnosperm is
   (a) two polar nuclei and one male gamete
   (b) one polar nuclei and one male gamete
   (c) ovum and male gamete
   (d) two polar nuclei and two male gametes.
2. The role of double fertilization in angiosperms is to produce
   (a) cotyledons (b) endocarp
   (c) no cotyledon (d) integuments
3. Double fertilization is characteristic of
   (a) angiosperms (b) anatropous
   (c) gymnosperms (d) bryophytes
4. Entry of pollen tube through micropyle is
   (a) chalazogamy (b) mesogamy
   (c) porogamy (d) pseudogamy
5. Double fertilization and triple fusionwere discovered by
   (a) Hofmeister
   (b) Nawaschin and Guignard
   (c) Leeuwenhock
   (d) Strasburger
6. When the pollen tube enters through the micropyle, it is termed as
   (a) Chalazogamy
   (b) Mesogamy
   (c) Porogamy
   (d) None of the above
7. Syngamy means
   (a) Fusion of similar spores
   (b) Fusion of dissimilar spores
   (c) Fusion of cytoplasm
   (d) Fusion of gametes
8. Double fertilization was discovered by
   (a) Karl Schnarf (b) P. Maheshwari
   (c) S.G. Nawaschin (d) B.G.L. Swamy
9. When pollen tube enters by integuments, then the process is called
   (a) Mesogamy (b) Porogamy
   (c) Chalazogamy (d) Pseudogamy
10. Double fertilization is a characteristic of
    (a) Gymnosperms (b) Bryophytes
    (c) Angiosperms (d) Pteridophytes

Try yourself

11. Fertilization of egg takes place inside
    (a) Anther (b) Stigma
    (c) Pollen tube (d) Embryo sac
12. Number of nuclei taking part in double fertilization is
    (a) 2 (b) 3
    (c) 4 (d) 5
13. Fusion of two dissimilar gametes is called
    (a) Fertilization (b) Pollination
    (c) Self pollination (d) Self fertilization
14. By double fertilization is formed
    (a) Endosperm (b) Megaspore
    (c) Seed (d) Fruit
15. The process of fusion between male nucleus and egg nucleus is called as
    (a) Syngamy (b) Triple fusion
    (c) Double fertilization (d) Conjugation

16. The phenomenon of syngamy (fertilization) in angiosperms was discovered by
(a) Svedberg
(b) Strasburger
(c) Nawaschin
(d) Coulter and Chamberlin

17. In angiosperm, triple fusion is necessary for the formation of
(a) Seed coat (b) Fruit wall
(c) Embryo (d) Endosperm

18. In an angiospermic plant, endosperm is formed due to fertilization of secondary nucleus but it is absent in some of the seeds viz. pea, bean, phaseolus (moong) etc. It is due to lack of
(a) Certain enzymes
(b) Dicotyledonous hormone
(c) Growth hormone
(d) None of the above

1.10 Development of Endosperms

Q.51 What is endosperm?

Ans : The triploid primary endosperm nucleus repeatedly divides, mitotically to form nutritine tissue called endosperm.

Q.52 Explain three thypes of endosperm on the basis of 'modes of development' in detail.

Ans : The three types of endosperms on the basis of mode of development are :

i. **Nuclear type:**
a. It is the most common type found in 161 angiospermic families.
b. Here, the primary endosperm nucleus repeatedly.
c. A big central vacuole appears in the centre of cell pushing the nuclei towards the periphery.
d. Later, walls develop between the nuclei, hence multicellular endosperm is formed.
e. But in several cases cell wall formation remains incomplete. e.g. wheat, sunflower and coconut.
f. Coconut has multicellular endosperm in the outer part and free nuclear as well as vacuolated endosperm in the centre.

ii. **Cellular type:**
a. In some plants, division of triploid primary endospermic nucleus is immediately followed by wall formation.
b. So that the endosperm is cellular right from the beginning.
c. It is mostly observed in 72 families of dicots as in members - Balsam, Petunia, Adoxa, etc.

iii. **Helobial type:**
a. It occurs in the order Helobiales of monocotyledons.
b. In this case, first division of primary endosperm nucleus is followed by a transverse wall, which divides the cell unequally.
c. The smaller cell is called chalazal cell and larger cell in the micropylar cell.
d. Then the nuclei in each cell divide by free nuclear divisions and then walls develop between nuclei in micropylar chamber.
e. It is intermediate between cellular and nuclear type endosperm e.g. *Asphodelus*.

Q.53 What is mosaic endosperm?

Ans :

i. Endosperm containing tissues of two different types is called mosaic endosperm.

ii. In plants like corn the endosperm contains patches of two different colours.

iii. It forms a sort of mosaic pattern

INTEXT

Q.54 What do you call kernal that you eat in tender coconut?

Ans : In tender coconut, the kernel that we eat is a cellular endosperm.

1.11 Development of Embryo

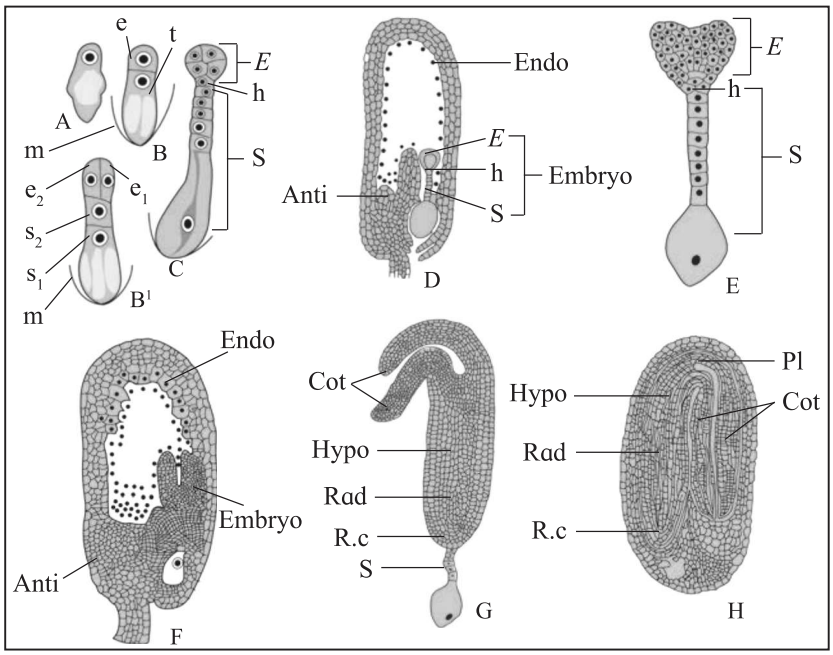
Q.55 What is embryogenesis?

Ans : The process of development of zygote into an embryo is called **embryogenesis**.

TEXTUAL

Q.56 Explain the development of dicot embryo

Ans :

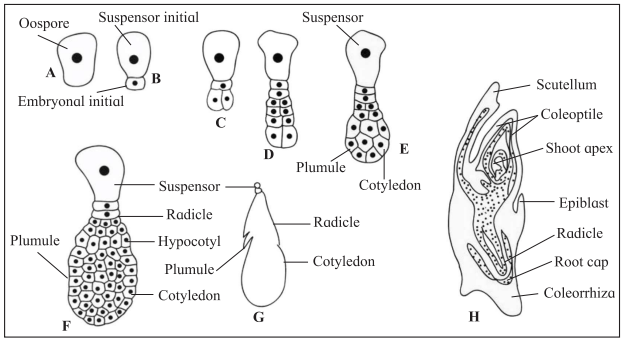


A: Oospore.
B: Two celled proembryo.
e: embryonal initial;
t: suspensor initial;
m: Embryo sac membrane.
B¹: 4-celled I-shaped proembryo;
e_1, e_2: embryonal initial;
s_1, s_2: suspensor initial.
C: Further development of embryo.
S: Suspensor, **h:** Hypophysis;
E: Embryonal mass.
D: L. S. of ovule
Endo: Endosperm in free nuclear stage.
Anti: Antipodal tissue.
Embryo: Developing embryo
E: Embryo showing further development of embryonic octants and hypophysis.
F: L. S. of ovule. Endosperm becoming cellular.
G: Embryo; **Cot:** Cotyledons;
Hypo: Hypocotyl; **Rad:** Radicle;
R.c.: Root-cap **H:** Mature seed.
Pl: Plumule. Endosperm has been consumed almost completely.

i. The zygote divides to form two-celled proembryo.
ii. The larger cell towards the micropyle is called basal or suspensor initial cell and smaller cell towards chalaza is called terminal or embryonal intial cell.
iii. The suspensor cell divides transversely in one plane to produce filamentous suspensor of 6-10 cells.
iv. The first cell of the suspensor towards the micropylar end becomes swollen and function as a haustorium.
v. The lowermost cell of suspensor is known as hypophysis.
vi. The suspensor helps in pushing the embryo in the endosperm.
vii. The embryonal initial undergoes three successive mitotic divisions to form octant.
viii. The planes of division are at right angles to each other.
ix. The lower tier of four cells of octant give rise to hypocotyl and radicle whereas four cells of upper tier form the plumule and the one or two cotyledons.
x. The hypophysis by further division gives rise to the part of radicle and root cap.
xi. Subsequently, the cells in the upper tier of octant divide in several planes so as to become heart shaped which then forms two lateral cotyledons and a terminal plumule.
xii. Further enlargement of hypocotyl and cotyledons result in a curvature of embryo and it appears horse-shoe shaped.

Q.57 Explain the development of Monocot Embryo

Ans :



i. The embryo development is similar in both dicots and monocots up to the octant stage.

ii. In monocot embryo, single cotyledon, occupies terminal position and plumule is lateral.

iii. The single shield shaped cotyledon is called as **scutellum**.

iv. The protective sheath of plumule is called **caleoptile** and that of radicle is **coleorhiza**.

TEXTUAL

Q.58 Name the parts of pistil which develop into fruits and seeds.

Ans : Quary and ovule of pistil develop into fruit and seeds respectively after fertilization.

MULTIPLE CHOICE QUESTIONS

Entrance Corner (Set 10 & 11)

1. Ruminate endosperm is commonly found in seeds of
   (a) Cruciferae
   (b) Compositae
   (c) Euphorbiaceae
   (d) Anonaceae (Areca nut)
2. If the number of chromosomes in endosperm of a dicot plant is 36, the root cells will contain
   (a) 72 chromosomes
   (b) 28 chromosomes
   (c) 24 chromosomes
   (d) 48 chromosomes
3. The endosperm of Brassica is
   (a) Haploid (b) Diploid
   (c) Triploid (d) Tetraploid
4. In angiosperms endosperm is formed by
   (a) Free nuclear divisions of megaspore
   (b) Division of fused polar nuclei
   (c) Division of fused polar nuclei and male gamete
   (d) Division of fused synergids and male gamete
5. Milky water of green coconut is
   (a) Liquid nucellus
   (b) Liquid of female gametophyte
   (c) Liquid endosperm
   (d) Liquid embryo
   (e) Liquid gametes
6. Fusion product of polar nuclei and male gamete is
   (a) Triple fusion
   (b) Primary endosperm nucleus
   (c) Zygote
   (d) Secondary nucleus
7. The embryo in sunflower has
   (a) No cotyledon
   (b) One cotyledon
   (c) Two cotyledons
   (d) Many cotyledons
8. In agamospermy, the embryo sac is diploid because it is formed without meiosis. Such embryo sac may develop from
   (a) Megaspore mother cell
   (b) Microspore mother cell
   (c) Megaspores
   (d) Microspores

Try yourself

9. Endosperm in Angiosperm is
   (a) Haploid (b) Diploid
   (c) Triploid (d) Polyploid
10. If an angiospermic male plant is diploid and female plant tetraploid, the ploidy level of endosperm will be
    (a) Haploid (b) Triploid
    (c) Tetraploid (d) Pentaploid
11. Endosperm of angiosperms results after fertilization from
    (a) Antipodal cells
    (b) Zygote
    (c) Synergids
    (d) Secondary nucleus
12. The endosperm in angiosperms develops from
    (a) Micropylar polar nucleus
    (b) Chalazal polar nucleus

(c) Secondary nucleus
(d) Zygote

13. When vegetative cell of zygote form embryo, it is called
(a) Apospory
(b) Apomixis
(c) Diploid polyembryony
(d) Adventive polyembryony

14. Fat is present in large quantities in the tissues of which of the following
(a) Cotton fibre (b) Tuber of potato
(c) Coconut endosperm (d) Embryo of pea

15. Presence of many embryos (Polyembryony) is a characteristic feature of
(a) Citrus (b) Mango
(c) Banana (d) None of these

1.12 Seed and Fruit Development

TEXTUAL

★Q.59 Pollination and seeds formation are very crucial for the fruit formation. Justify the statement.

Ans :

i. Pollination is a very important part of the life cycle in angiosperms as it is essential for fertilization.

ii. Due to pollination male and female gametes come together during fertilization resulting in development of fruits and seeds from ovary and ovules respectively.

iii. Seed on germination give rise to new plant which leads to growth of fruits and seeds. Thus pollination and seed formation are required to create offspring for the next generation.

Q.60 Explain the following terms
i. Testa ii. Tegmen
iii. Perisperm

Ans :

i. The typical outer seed coat is known as testa.

ii. The innerthin membranous covering is known as tegmen.

iii. The nuclleus in the ovule may persist in some genera like black pepper and beet as a thin, papery layer, the perisperm

Q.61 Write a note on endospermic and non-endospermic seeds

Ans :

i. In some seeds, the food reserves in the endosperm are partially used up in the development of an embryo.

ii. In such seeds the endosperm remains conspicuous and fills a greater part of the seed.

iii. Thus, the resultant seed is endospermic or albuminous e.g. Castor, Coconut, Maize, etc.

iv. In other seeds, embryo absorbs food reserve from the endosperm completely during its developmental stages.

v. Thus, endosperm disappears (disorganizes) in mature seeds.

vi. The resultant seed is **non-endospermic or ex-albuminous** e.g. Pea, bean, etc.

vii. The cotyledons in some non-endospermic seeds act as a food storage and in others they are the first photosynthetic organs.

Q.62 Write a note on micropyle and its function.

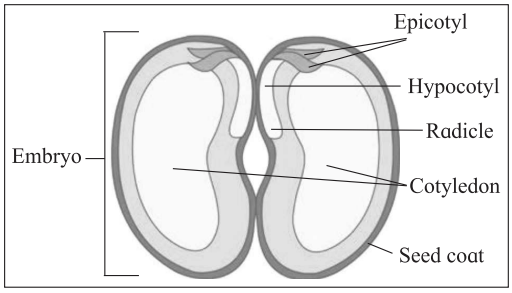
Ans :

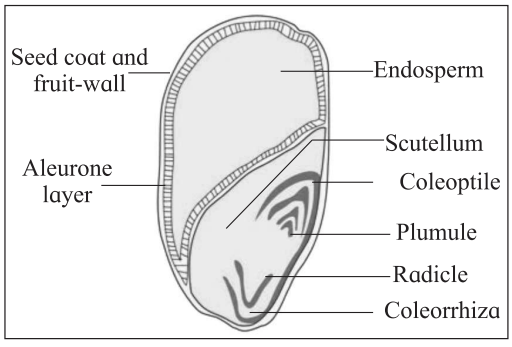
i. Micropyle persist as a small pore in the seed coat

ii. It allows the entry of water and oxygen during soaking.

Q.63 Draw a neat labelled diagram of monocot and dicot seed.

Ans :

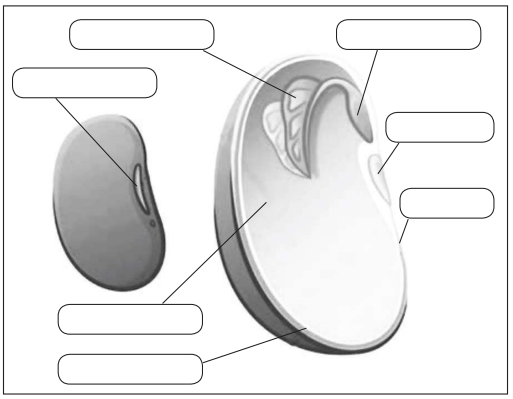


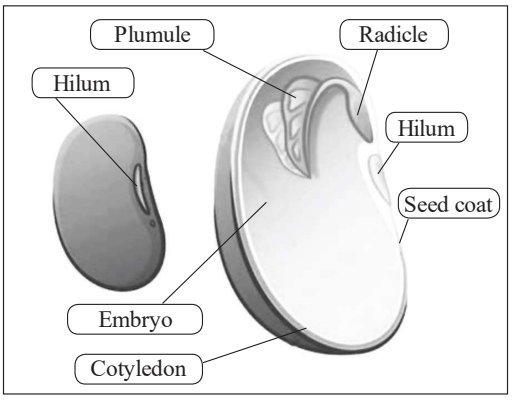


TEXTUAL

★Q.64 Label the parts of seeds.

Ans :





Q.65 State the significance of seed and fruit formation

Ans :

i. Fruits provide nourishment to the developing seeds.

ii. Fruits protect the seeds in immature condition.

iii. Seeds serve as important propagating organs (units) of plant.

iv. Seeds and fruits develop special devices for their dispersal and thus help in the distribution of the species.

Q.66 Explain dormancy with respect to seeds.

Ans :

i. Dormancy is a state of metabolic arrest that facillitates the survival of organisms during adverse environmental conditions.

ii. Structural or physiological adaptive mechanism for survival is called dormancy.

iii. Mature and viable seeds will not germinate even in the presence of favourable conditions and they are dispersed at different places during dormancy.

iv. Viable seeds germinate only after completion of dormancy period.

INTEXT

Q.67 What are the parts of the fruit?

Ans :

i. The parts of the fruit are **Pericarp** which consists of three layers epicarp, mesocarp, endocarp and **seeds**.

Q.68 What is the difference between true fruit and false fruit?

Ans :

i. A fruit which develops from a single ovary of a single flower is called as a true fruit. eg. Mango.

ii. A fruit in which other floral parts like thalamus take part in the formation of the fruit is called as false fruit. eg. apple, strawberry, cashew.

Q.69 How long seeds stay viable/healthy?

Ans : Viability of seeds differ from plant to plant, generally seeds can stay viable up to 1-2 years bt some are found to be viable after thousands of years as well. eg. *Lupinus arcticus* - 10,000 years. *Phoenix dactylifera* - 2000 years.

Q.70 Can old seeds still grow?

Ans : Yes, old seeds can grow if they are providied with suitable conditions for germination although it also depends on the viability period of the seeds.

Q.71 Write a note on apomixis

Ans :

i. Apomixis is phenomenon of formation of embryo(s) through asexual method of reproduction without formation of gametes and the act of fertilization.

ii. Alternatively, it is unusual sexual reproduction where there is no meiosis and syngamy.

iii. Embryo develops in the ovule and ovule developes to form seed.

Q.72 What is apogamy and apospoxy?

Ans :

i. In apomixis, when a gametophyle organ or cell produces embryo like structure without fertilization, it is termed as apogamy.

ii. Similarly, when diploid sporophyte cell

produces a diploid gametiophyte without undergoing meiosis is called apospory, e.g. *Orange, Mango*.

TEXTUAL

Q.73 Are pollination and fertilization necessary in apomixis?

Ans : No, as embryo is formed without fertilization or formation of gametes in apomixis it does not require pollination or fertilization.

Q.74 Write a detailed note on categories of apomixis

Ans : The main categories of apomix are as follows:

i. **Recurrent apomixis:**
   a. In this type, the embryo sac generally rise either from an archesporial cell or from some other part of the nucelius.
   b. In **diplospory**, the unreduced embryo sac is derived from the diploid megaspore mother cell e.g. *Taraxacum*.
   c. In apospory, the nucellar cells give rise to apomictic embryo sac.

ii. **Non-recurrent apomixis:**
   a. In this type, megaspore mother cell undergoes usual meotic division and a haploid embryo sac is formed.
   b. Here, the embryo arises either from the egg by parthenogenesis or from some other haploid cells of gametophyte through apogamy.
   c. Plants produced by this method are generally sterile and do not reproduce sexually, e.g. *Nicotiana*.

iii. **Adventive Embryony:**
   a. In this type, embryos may develop from somatic nucellus or integuments along with normal **zygotic embryo**.
   b. It is common in Mango, Orange, Lemon, etc. It gives rise to a condition called **polyembryony**.

iv. Genetically identical plants can be produced effectively and rapidly by apomixis.

Q.75 Collect information about seed mother Rahibai's story.

Ans : Rahibai Soma Popere is an Indian farmer and is known for Conservation of indigenous plant varieties.

Scientist Raghunath Mashelkar gaver her the epithet "Seed Mother".

She has received many awards like Padma Shri, Nari Shakti Puraskar for her efforts to save indigenous seeds and promoting traditional farming.

She believes that native seeds have several advantages when compared to hybrid seeds, thus she developed seed bank of natuve plant varieties.

Besides conserving seeds, she spreads awareness about the importance of conserving indigenous seeds, organic farming, agro-biodiversity and wild food resources.

Rahibai now trains farmers and students on seed selection, techniques to improve soil fertility, etc. She also supplies farmers with seedlings of native crops.

Entrance Corner (Set 12 & 13)

Significance of fruit formation:

i. The fruits protect the seeds from unfavourable climatic conditions. Both fleshy and dry fruits help in the dispersal of seeds to distant places.

ii. Fruits are a source of sugars, protein, oil, organic acids, vitamins and minerals. Some fruits also provide nutrition to tthe developing seedlings.

iii. Generally hard seeds are surrounded by soft fleshy fruit pericap (e.g. guava) and soft seeds by a hard fruit shell (e.g. almond). The fleshy, edible parts of the fruit become the source of food and energy for the animals which often act as dispersal agents.

Significance of seeds:

i. Seeds have better adaptive strategies for dispersal to new habitats and help the species to colonise in other areas.

ii. As they have sufficient food reserves, young seedlings are nourished until they are capable of photosynthesis on their own. The hard seed coat provides protection to the young embryo. Being products of sexual reproduction, they generate new genetic combinations leading to variations.

iii. Seed is the basis of our agriculture. Dehydration and dormancy of mature seeds are crucial for storage of seeds which can be used as food throughout the year and also to raise crop in the next season.

MULTIPLE CHOICE QUESTIONS

Entrance Corner (Set 12 & 13)

1. Seed coat is not thin, membranous in
   (a) groundnut (b) gram
   (c) maize (d) coconut
2. Albuminous seeds store their reserve food mainly in
   (a) endosperm (b) cotyledons
   (c) hypocotyl (d) perisperm.
3. Perisperm is
   (a) remnant of endosperm
   (b) persistent nucellus
   (c) peripheral part of endosperm
   (d) disintegrated secondary nucleus.
4. Parthenogenesis is
   (a) development of embryo without fertilization
   (b) development of fruit without fertilization
   (c) development of fruit without hormones
   (d) development of embryo from egg without fertilization.
5. Formation of gametophyte directly from sporophyte without meiosis is
   (a) apospory (b) apogamy
   (c) parthenogenesis (d) amphimixis.

1.14 Parthenocarpy

Q.76 Write a short note on Parthenocarpy

Ans :

i. The term Parthenocarpy was coined by Noll (1902).

ii. It is the condition in which fruit is developed without the process of fertilization.

iii. It occurs naturally in some varieties of Pineapple, Banana, Papaya, etc.

iv. In these plants, it seems that the placental tissue in the unfertilized ovary produces auxin IAA (Indore-3 Acetic Acid) which is responsible for enlargement of ovary into fruit.

v. The fruit resembles the normally produced fruit but it is seedless.

Q.77 Define Parthenocarpy

Ans : It is the condition in which fruit is developed without the process of fertilization.

Q.78 What do bananas and figs house in comman.

Ans : They both are examples of parthenocarpy fruits as they are developed withold fertilization. They do not produce any viable seeds.

1.15 Polyembrony

Q.79 Explain polyembryony in details

Ans :

i. It is development of more than one embryos, inside the seed and the condition is described as polyembryony.

ii. It was first noticed by Leeuwenhoek (1719) in the seeds of Citrus genus.

iii. It is the occurrence of more than one embryo in a seed which consequently results in the emergence of multiple seedlings.

iv. The additional embryos result from the differentiation and development of various maternal and zygotic tissues associated with the ovule of seed.

v. Polyembryony may be true or false depending upon whether many embryos arise in the same embryo sac or in different embryo sacs in the same ovule.

vi. In adventive polyembryony, an embryo develop directly from the diploid cell of nucellus and integuments as in Citrus.

vii. In cleavage polyembryony, zygote proembryo sometimes divides (cleaves) into many parts or units. Each unit then developes into an embryo.

Q.80 How polyembryony can be commercially exploited.

Ans :

i. Polyembryony is the development of more than one embryos, inside the seed.

ii. It increases the chances of survival of the new plants.

iii. Genetically uniform parental type seedlings

are obtained from nucellar embryos, thus nucellar adventive polyembryony is of great significance in horticulture.

iv. Plantlets obtained from these embryos are disease free.

v. These embryos can be isolated and growth on embryo culture to produce clones.

Q.81 Fill in the blanks:

The ..... collects the pollen grains.

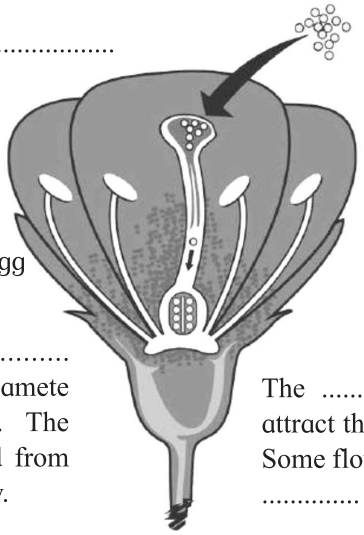
The male whorl, called the ..... produces ..... .

The pollen grains represent the .....

The ..... contains the egg or ovum.

..... takes place when one male gamete and the egg fuse together. The fertilised egg grows into seed from which the new plants can grow.

The ..... is the base of the flower to which other floral parts are attached.



..... is the transfer of pollen grains from anther of the flower to the stigma of the same or a different flower

Once the pollen reaches the stigma, pollen tube traverses down the ..... to the ovary where fertilisation occurs.

The ..... are coloured to attract the insects that carry the pollen. Some flowers also produce ..... or ..... that attracts insects.

The whorl ..... is green that protects the flower until it opens.

Ans :

The ..stigma..... collects the pollen grains.

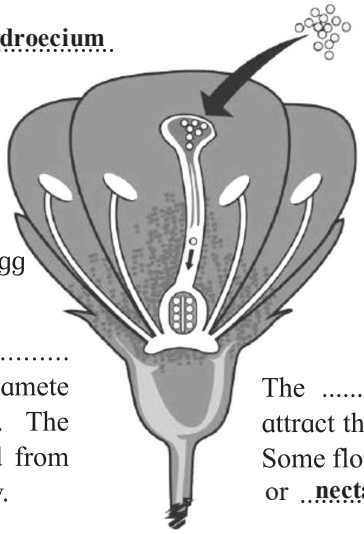
The male whorl, called the ..androecium.. produces ..pollen grains.. .

The pollen grains represent the ..male gametophyte..

The ..embryo sac.. contains the egg or ovum.

..Syngamy (fertilization).. takes place when one male gamete and the egg fuse together. The fertilised egg grows into seed from which the new plants can grow.

The .....thalamus..... is the base of the flower to which other floral parts are attached.



..Pollination..... is the transfer of pollen grains from anther of the flower to the stigma of the same or a different flower

Once the pollen reaches the stigma, pollen tube traverses down the .....style..... to the ovary where fertilisation occurs.

The .....petals..... are coloured to attract the insects that carry the pollen. Some flowers also produce ..sweet odour.. or ..nectar.. that attracts insects.

The whorl .....calyx..... is green that protects the flower until it opens.

❑❑❑

ANSWER KEY

Entrance Corner Set-1

1. (a) 2. (b) 3. (b) 4. (c) 5. (c)
6. (a) 7. (b) 8. (c) 9. (c) 10. (b)
11. (d) 12. (d) 13. (c) 14. (a) 15. (a)
16. (a) 17. (c) 18. (b) 19. (c)

Solution:

2-(b) Water hyacinth (Eichhornia) is the example of offset. This is sub aerial modification of stem. It is like runner but internodes are thick and short.

3-(b) In Pistia (water lettuce) vegetative propagation occurs by offset where one internode long runners grow horizontally along the soil surface and gives rise to new plants either from axillary or terminal buds.

4-(c) Vegetative propagation in mint occurs through sucker.

5-(c) Vegetative reproduction in Agave occurs through bulbils. Bulbils are the specialised buds vegetative or floral that modify into a swollen structure. It seperates from the parent plant and on approach of favourable condition gives rise to new plant.

6-(a) For union between stock and scion in grafting, first to occur is the formation of callus. Callus is more or less corky secondary tissue developed by woody plants over a wound. It is derived from cambium.

8-(c) In clone vegetative reproducing structures e.g., corn, bulb, tuber (potato) etc.

10-(b) In *Asphodelus*, the outer integument is curved so that this curved structure is known as caruncle.

15-(a) Sargassum is a brown alga. In brown algae, asexual reproduction occurs by means of spores and sexual reproduction varies from isogamy, anisogamy to oogamy.

Entrance Corner Set-2

1. (d) 2. (a) 3. (c) 4. (a) 5. (c)
6. (b) 7. (b)

Solution:

1-(d) Ubisch bodies of lipid nature are also secreted by tapetum.

2-(a) Ubisch bodies secreted by tapetum help in external thickening of exine as these bodies get coated with sporopollenin.

4-(a) Meiosis occurs in pollen mother cells of anther.

5-(c) Tapetum is the innermost wall layer of microsporangium that nourishes developing pollen grains.

7-(b) A microsporangium is generally surrounded by four wall layers - the epidermis, endothecium, middle layers and the tapetum. The outer three wall layers perform the function of protection and help in dehiscence of anther to release the pollen. The innermost wall layer is the tapetum. It nourishes the developing pollen grains. Cells of the tapetum are food rich and possess dense cytoplasm and generally have more than one nucleus. They disintegrate to liberate the contents which is absorbed by the developing spores.

Entrance Corner Set-3

1. (d) 2. (c) 3. (c) 4. (a) 5. (d)
6. (d) 7. (b) 8. (a) 9. (b) 10. (b)
11. (d) 12. (b) 13. (c) 14. (b) 15. (c)
16. (c) 17. (b)

Solution:

2-(c) Pollen grain is partially developed male gametophyte because the rest development completes on stigma when pollen grains start to germinate and produce pollen tube having two male nuclei.

3-(c) Exine is made up of sporopollenine (derived from carotenoid).

4-(a) It is outer most covering of tetrad microspores in microsporangium.

8-(a) Spore mother cells are diploid. These cells divide meiotically to form haploid spores. It may be micro/megaspores.

11-(d) Exine of pollen grain is made up of highly resistant fatty substance called sporopollenin, which is not degraded by any enzyme. It is not affected by high temperature, strong acid or strong alkali. Because of the sporopollenin, pollen grains are well preserved as microfossils.

12-(b) Parthenocarpic fruits are the fruits which are formed without fertilisation. These fruits are naturally seedless, e.g., banana.

13-(c) Pollen grain is a haploid, unicellular body. It is cuticularised and the cutin is of special type called sporopollenin, which is resistant to chemical and biological decomposition. It can withstand high temperatures as well as strong acids and alkalis. This is why, pollen wall is preserved for long periods in fosiil deposits. In addition pollen wall possisses proteins for enzymatic and compatability reactions.

14-(b) Sporopollenin is a major component of the tough outer (exine) walls of spores and pollen grains. It is chemically very stable and is usually well preserved in soils and sediments. It can withstand envrionmental extremes and cannot be degraded by enzymes and strong chemical reagents.

Entrance Corner Set-4

1.	(a)	2.	(b)	3.	(b)	4.	(d)	5.	(b)
6.	(c)	7.	(c)	8.	(c)	9.	(b)	10.	(d)
11.	(c)	12.	(c)	13.	(c)	14.	(b)	15.	(b)
16.	(d)	17.	(a)	18.	(d)	19.	(d)	20.	(a)
21.	(a)								

Solution:

1-(a) Depeding upon position of micropyle in realtion to chalaza, ovules are of 6 types in angiosperms. In amphitropous type the curvature is observed both in body of ovule and embryo sac. The embryo sac assumes horse shoe-shape. Micropyle is directed downwards. It is commonly found in families Papaveraceae, alismaceae and Butomaceae.

Circinotropous ovule is characteristic of family Cactaceae. Here the ovule is straight first but due to more growth on one side gets inverted and later becomes straight again.

Orthotropous ovule is the most primitive and of simplest type. It is also known as atropous or straight ovule.

Anatropous ovule is the most common type of ovule found in angiosperms. Here the body of the ovule get inverted and micropyle is on lower side.

2-(b) Anatropus ovule is the most common type of ovule found in angiosperms. Here the body of the ovule gets inverted and micropyle is on lower side. It comes very close to the hilum and the chalaza is upwardly directed.

4-(d) Pollen grain is odd one among all the other three. Pollen grain is a male gametophytic structure whereas all the other three are found inside ovule (nucellus, micropyle and embryo sac).

5-(b) Antipodal cells and egg cell are haploid structures as they are formed after meiosis while the other nucellus, megaspore mother cell and p-rimary endosperm nucleus are diploid structures.

6-(c) Embryo sac occurs in ovule. Ovule is integumented megasporangium. It consists of nucleus covered by one or two integuments, mounted on a funicle, chalaza and micropyle. The ovule is vascularised.

7-(c) Female gametophyte of angiosperms is represented by embryo sac. The polygonum type of embryo sac contains 8-nuclei and 7 cells. It is found in more than 80% plant families. The nucleus of megaspore undergoes division and give rise to embryo sac or female gametophyte by the process of megagametogenesis.

Entrance Corner Set-5

1.	(b)	2.	(c)	3.	(b)	4.	(a)	5.	(b)
6.	(b)	7.	(a)	8.	(d)	9.	(c)	10.	(a)
11.	(d)	12.	(a)	13.	(b)	14.	(d)	15.	(d)

Solution:

4-(a) During double fertilisation in angiosperms, one male gamete fuses with the egg to form the diplid zygote (syngamy or generative fertilisation). The diploid zygote finally develop-s into embryo. The other male gamete fuses with the two polar nuclei (or secondary nucleus) to form the tripliod primary endosperm nucleus, PEN (triple fusion or vegetative fertilisation).

5-(b) In angiosperm, the functional megaspore is the first cell of female gametophyte. It enlarges and undergoes three nuclear mitotic divisions to form embryo sac.

6-(b) Filiform apparatus is a mass of finger like projections of the wall into the cytoplasm. It is present in synergids (help cells) of the embryo sac, in the micropylar region. It guides

the pollen tube inside the ovule towards the embryo sac.

7-(a) In angiosperms, microsporogenesis, i.e., formation of microspores (or pollen grains) occurs by the meiotic divisions of diploid microspore mother cells (or pollen mother cells). Microsporogenesis takes place in the anther. Megasporogenesis. i.e., formation of megaspores mother cells. Megasporogenesis takes place in the ovule.

8-(d) In the ovule, the pollen tube is attracted by secretions of synergids. Usually the pollen tube enters the embryo sac by passing into one of the two synergids and is guided by the filiform apparatus of the synergids in their movement. Pollen tube them breaks open and releases its contents in the embryo sac. Antipodals and synergids later degenerate.

9-(c) Gemmule and conidia are asexual propagules thus, no meiosis takes place in them. Megaspores are haploid which are formed as a result of meiosis of diploid megaspore mother cell. Meiocyte is any cell that undergoes meiosis.

10-(a) In angiosperms, body of the ovule consists of a mass of parenchymatous cells called nucellus, which is equivaient to megasporangium. A megasporangium alongwith its protective integuments is called as an ovule.

11-(d) In angiosperms, microsporogenesis, i.e., formation of microspores (or pollen grains) occurs by the meiotic divisions of diploid microspore mother cells (or pollen mother cells). Microsporogenesis takes place in the anther. Megasporogenesis. i.e., formation of megaspores mother cells. Megasporogenesis takes place in the ovule.

12-(a) In angiosperms, the functional megaspore is the first cell of female gametophyte. It enlarges and undergoes three nuclear mitotic divisions to form embryo sac.

13-(b) Within the embryo sac 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. The synergids have special cellular thickenings at the micropylar tip called filiform apparatus, which plays an important role in guiding the pollen tubes into the synergid. Three cells are at the chalazal end and are called the antipodals. The large central cell, has two polar nuclei.

14-(d) On reaching of pollen tube inside the embryo sac, the 2 male gametes are discharge through a sub-terminal pore in pollen tube. The contents of pollen tube are discharge in the synergid and the pollen tube does not grow beyond it in the embryo sac. Further the cytoplasm of pollen tube is restricted to chalazal end of this synergid cell.

15-(d) On the basis of number of megaspore nuclei taking part in development of female gametophyte or embryo sac, there are 3 types of embryo sacs-

i. Monosporic type- In this type the single nucleus of functional megaspore undergoes 3 mitotic divisions to form 8 nuclei, 7 cells.

ii. Bisporic type- Here embryo sac develops from 2 megaspore nuclei out of 4 nuclei formed after reduction division of MMC. It is also 8 nucleated.

iii. Tetrasporic type- Here all the 4 megaspore nuclei formed after reduction division of megaspore mother cell are functional and take part in development of embryo sac. It is further of different types. Fritillaria type, Plumbago type and Adoxa type are 8 nucleated.

Entrance Corner Set-6

1.	(c)	2.	(a)	3.	(a)	4.	(a)	5.	(d)
6.	(d)	7.	(b)	8.	(c)	9.	(b)	10.	(b)
11.	(b)	12.	(c)	13.	(a)	14.	(c)	15.	(d)
16.	(d)	17.	(b)	18.	(a)	19.	(b)		

Solution:

1-(c) In Vallisneria, water pollination occurs while mulberry and maize undergo wind pollination. In cucumber, animal pollination is observed.

2-(a) In cleistogamy, as the flowers never open so there is no alternative of self pollination. It is invariably autogamous. In xenogamy,

pollination takes place between two flowers of different plants (genetically and ecologically.) It can occur by wind, water, insects and animals.

Chasmogamy occurs when the flowers expose their mature anther and stigma to the pollinating agents. Geitonogamy is the pollination taking place between the two flowers of the same plant or genetically similar plant. Genetically, it is self pollination but as the agency is involved it is ecologically cross pollination.

3-(a) Autogamy and geitonogamy are two forms of self pollination. In autogamy, pollen falls on stigma of the same flower. While in geitonogamy pollens from a flower fall on the stigma of some other flower of the same plant. Papaya is a dioecious plant thus both autogamy and geitonogamy are prevented in it.

4-(a) Some plants such as Viola (common pansy), Oxalis, and Commelina produce two types of flowers-chasmogamous flowers which are similar to flower of other species with exposed anthers and stigma and cleistogamous flowers which do not open at all. In such flowers buds, pollen grains come in contact with the stigma to effect pollination. Thus, cleistogamous flowers produce assured seed-set even in the absence of pollinators.

5-(d) Anemophily is the pollination by wind. Anemophilous plants are characterized by small flowers, pollens present in large number which are small, dry and light in weight, number of ovules generally reduced in ovary, feathery or brushy stigma to recieve the pollen. All these features are shown by coconut flower.

In Vallisneria, pollination occurs outside water called epihydrophily. Callistemon (Bottle brush) is pollinated by birds and is an example of entomophily.

6-(d) In an orchid Ophrys speculum, there is most interesting and unique mechanism of pollination. Here pollination occurs by a wasp called Colpaaurea. In this orchid, pollination occurs by act of pseudocopulation. The appearance and odour of Ophrys is similar to female wasp and are mistake by male wasps and they land on Ophrys flowers to perform act of pseudocopulation and thus pollination takes place. This plant-insect relationship is useful only to plant.

7-(b) Geitonogamy involves transfer of the pollen from one flower of a plant to the stigma fo another flower of the same plant, e.g., in maize. As the pollen has to move from one flower to another flower, it requires a pollinating agent. Yet it is genetically similar to autogamy, as both the flowers of the plant, share the same genotype of the plant.

8-(c) The term pollination refers to the transfer of pollen from anther to stigma. Because pollens are found only in angiosperms and gymnosperms so this phenomenon relates to angiosperms and gymnosperms only.

Entrance Corner Set-7 & 8

1. (b) 2. (c) 3. (d) 4. (c) 5. (b)
6. (d) 7. (d) 8. (a) 9. (c)

Solution:

2-(c) Pollen-pistil interacion is the group of events that occur from the time fo pollen deposition over the stigma to the time of pollen tube entry into ovule. It is a safety measure to ensure that illegitimate crossing does not occur. Pollen grains of number for plants may settle over a stigma. the pollens belonging to same species would germinate while other fail to do so, but the pollen tube of the compatible pollen will grow through the style to reach the ovule whereas growth fo incompatible pollens will be arrested at stigmatic disc or sometimes in the beginning part of style.

3-(d) Style is traversed by the pollen tube to reach the ovule. It is of two types- hollow and solid. In hollow styles, the stylar canal is lined by glandular cells,which are usually multinucleate and polyploid wheareas solid style has a core fo transmitting tissue, composed of thin walled cells, through which the pollen tube moves.

Entrance Corner Set-9

1. (a) 2. (c) 3. (a) 4. (c) 5. (b)
6. (c) 7. (d) 8. (c) 9. (a) 10. (c)
11. (d) 12. (d) 13. (a) 14. (a) 15. (a)
16. (b) 17. (d) 18. (d)

Solution:

1-(a) Double fertilization is the simultaneous occurrence of syngamy and triple fusion. Syngamy involves fusion of one male gamete with egg cell to form zygote. The result of syngamy is zygote (2n) which ultimatley develops into embryo.

The second male gamete fuses with 2 polar nuclei or secondary nucleus to form triploid primary endosperm nucleus and this is called triple fusion. This primary endosperm nucleus (3n) ultimately develops into a nutritive tissue for developing embryo called endosperm.

2-(c) Double fertilization is the simultaneous occurrence of syngamy and triple fusion. Syngamy involves fusion of one male gamete with egg cell to form zygote. The result of syngamy is zygote (2n) which ultimatley develops into embryo.

The second male gamete fuses with 2 polar nuclei or secondary nucleus to form triploid primary endosperm nucleus and this is called triple fusion. This primary endosperm nucleus (3n) ultimately develops into a nutritive tissue for developing embryo called endosperm.

3-(a) Double fertilisation is the characteristic feature of angiosperms. This phenomenon first observed by Nawaschin and Guignard, 1898 in Lilium and Fritillaria. In angiosperms one male gamete fuses with the two polar nuclei to form triploid primary endosperm nucleus. The process is called triple fusion. These two acts together are known as double fertilisation.

4-(c) In most of the plants the pollen tube enters the ovule through the micropyle and the phenomenon is called as porogamy. Entry through chalaza is chalazogamy and through integuments or funiculus is mesogamy.

5-(b) Double fertilisation is the characteristic feature of angiosperms. This phenomenon first observed by Nawaschin and Guignard, 1898 in Lilium and Fritillaria. In angiosperms one male gamete fuses with the two polar nuclei to form triploid primary endosperm nucleus. The process is called triple fusion. These two acts together are known as double fertilisation.

Entrance Corner Set-10 & 11

1. (d) 2. (c) 3. (c) 4. (c) 5. (c)
6. (b) 7. (c) 8. (a) 9. (c) 10. (d)
11. (d) 12. (c) 13. (d) 14. (c) 15. (a)

Entrance Corner Set-12 & 13

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

Solution:

2-(a) In some seeds, the endosperm persists in the seed as food storage tissue. Such seeds are called endospermic or albuminous,e.g., castor, maize, wheat,barley, rubber, coconut.

3-(b) Perisperm is persistent nucellus. Endosperm formation is accompanied by degeneration of nucellus.

4-(d) Development of an organism from female gamete/egg without involving fertilisation is parthenogenesis and when a fruit is developed by this technique it is called parthenocarpy.

5-(a) Formation of gametophyte directly from sporophyte without meiosis and spore formation is apospory. The gametophyte thus has diploid number of chromosomes.Such gametophyte may form viable gametes which fuse to form tetraploid sporophyte. Apogamy is development of sporophyte directly from gametophytic tissue without fusion of gametes. Amphimixis is normal sexual reproduction. Parthenogenesis is development of embryo from egg without fertilisation.

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