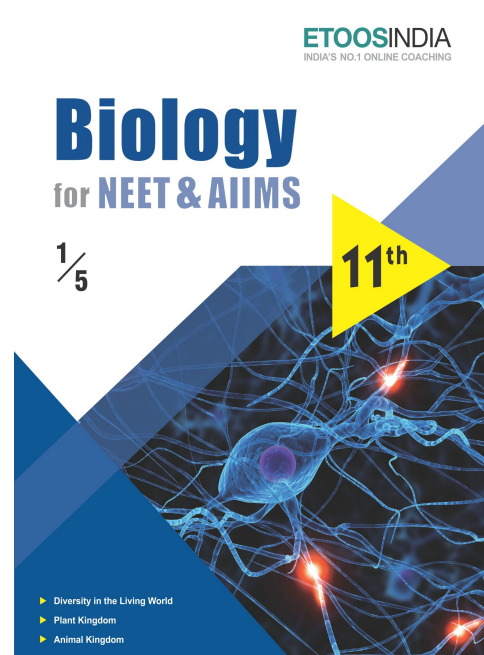
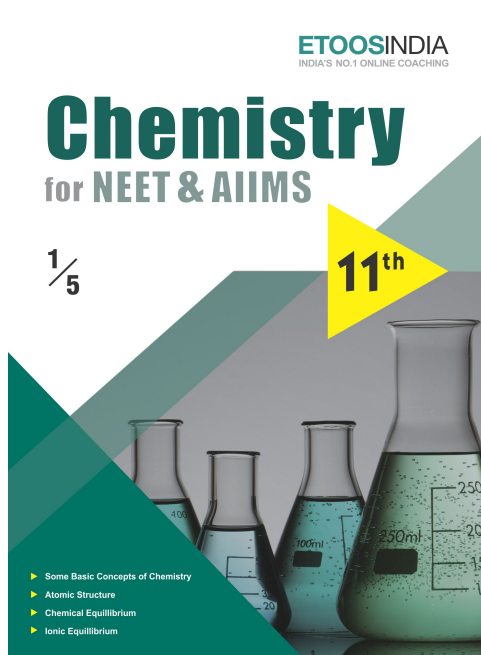
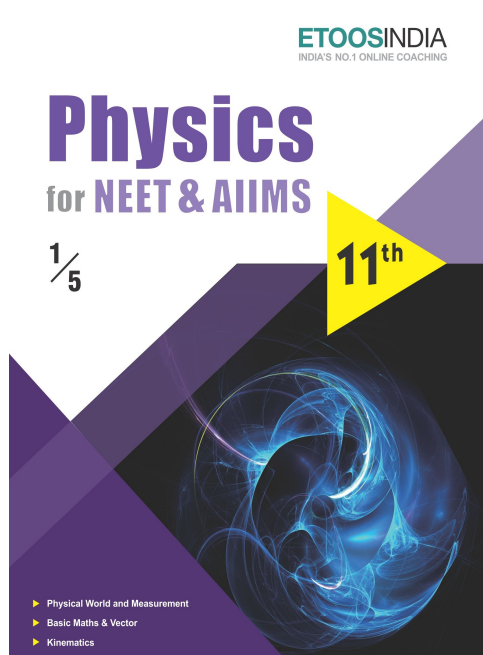


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SEXUAL REPRODUCTION IN FLOWERING PLANTS

“A great teacher is not simply one who imparts knowledge to his students, but one who awakens their interest in it and makes them eager to pursue it for themselves. He is a spark plug, not a fuel pipe. The reason colleges exist is to bring students into contact with contagious personalities, for otherwise they might as well be correspondence schools.”

“EDMUND WARE SINNOTT (1942-1968)”

INTRODUCTION

The myriads of flowers that we enjoy gazing at, the scents and the perfumes that we swoon over, the rich colours that attract us, are all there as an aid to sexual reproduction. reproduction is a vital process without which species cannot survive for long.

An individual increases its number by asexual or sexual means. Sexual mode of reproduction enables creation of new variants so that survival advantage is enhanced. Flowers do not exist only for us to be used for our own selfishness. all flowering plants show sexual reproduction. If we look at the diversity of structures of the inflorescences, flowers and a floral parts, it shows an amazing range of adaptations to ensure formation of the end products of sexual reproduction, the seeds as well as fruits.

This chapter will help us to deal and understand the morphology, processes and structure of sexual reproduction in flowering plants (angiosperms).

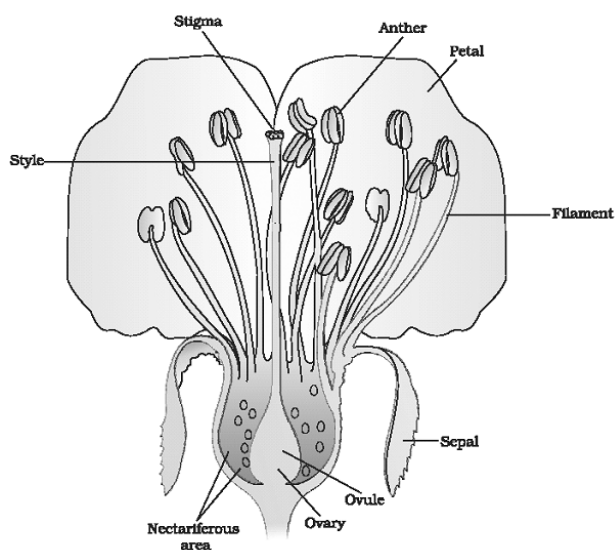
SEXUAL REPRODUCTION IN FLOWERING PLANTS

INTRODUCTION

- **Angiosperm** originated in **Mesozoic era**.
- Angiosperm originated either in the beginning of **Cretaceous** period or in ending of **Jurassic period** of **Mesozoic era**. It means they are originated between **Cretaceous** and **Jurassic** period on the earth.
- **Angiosperm** dominated over the earth in **Coenozoic era**. So this era is known as “**Golden Period of Angiosperms**”.
- First of all **N. Grew** realized the fact, that **Stamens** are **male sex organ** of flower (**Anatomy of plants**)
- **Sexuality** in plant first of all reported by **Jacob Camerarius**.
- He reported **Anthers** are the **male sex organ** and **Ovary** with **style** and **stigma** are **female sex organ** and for the formation of seed, interaction is essential in between both the sex organs.
- **Significance of pollination** and **role of insects in pollination** was recognized by **Josheph Kolreuter**.
- **C.F. Wolf** – **Father of plant Embryology**.
- **Prof. P. Maheshwari** – **Father of Indian plant Embryology**. He wrote a book – ‘**An Introduction to Embryology of Angiosperms**’.

CLASSIFICATION

- Class - Dicotyledonae
Subclass - Polypetalae
Series - Thalamiflorae
Order - Parietals
Family - Cruciferae or Brassicaceae
Genus - **Capsella**
Species - **Bursa pastoris** [Common name “**Shepherd’s purse**”]

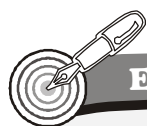


STRUCTURE OF FLOWER

SEXUAL REPRODUCTION IN FLOWERING PLANTS

- Difference between Monocotyledonous and Dicotyledonous seed :

S.No.	Monocotyledonous Seeds	Dicotyledonous Seeds
(i)	Only single cotyledon is present with embryo	Two cotyledon are present with embryo
(ii)	Generally cotyledon is thin or papery	Cotyledons are thick
(iii)	Generally seeds are endospermic	Generally seeds are non endospermic, some times may be endospermic
(iv)	Cotyledon is also called scutellum	Not called by this name
(v)	In seed plumule is covered by coleoptile and radicle is covered by coleorhiza.	Coleoptile and coleorhiza are not formed
(vi)	Plumule is in lateral position and cotyledon are is in terminal position	Plumule is in terminal position and cotyledons are present in lateral position
(vii)	Radicle degenerates after sometime and adventitious roots are formed at that place.	Radicle is responsible to form primary root.
(viii)	In some of the seeds, seed coats and cotyledon fused together e.g. Wheat etc.	Such types of seeds are not found.



ETOOS KEY POINTS

- **Self incompatibility** –
- It is recognized in 66 families of angiosperms.
- Morphologically self in compatibility is of two types :
 - (A) Heteromorphic self incompatibility
 - (B) Homomorphic self incompatibility
- **(A) Heteromorphic self incompatibility** – Occurrence of two (distyly) or three (tristyly) morphologically distinct mating type within a species, which can be easily recognized without a breeding test.
- The difference in the mating type is generally in the relative length of stamen and style
Ex. Primula, Lathyrum
- **(B) Homomorphic self incompatibility** – In this type all the mating type within a species are morphologically similar and requires proper breeding test, for their recognition.
- Depending upon the origin of factors determining the mating type on pollen side it is of two types
 - (i) Gametophytic self incompatibility (GSI)
 - (ii) Sporophytic self incompatibility (SSI)
- When two pollen tubes enter in an ovule and release their contents, it is possible that the egg may be fertilized by one male gamete from one tube and triple fusion may involves participation of male gamete from another tube.
- This phenomenon is called **Heterofertilization** eg. Zea mays.
- When the entry of male gamete is not accompanied by fusion. This phenomenon is called **semigamy**.
- The percentage of pollen germination and tube growth is better in large populations. This is called as **‘population effect’** or **‘crowding effect’**
- **B-Ca-inositol of Sugar complex** acts as **chemotropic agent for pollen tube growth**.
- Highest amount of **fat** is found in endosperm of **Coconut**.
- Embryonic development of **Capsella** is **endoscopic** because it is developed towards chalazal region of the zygote.

1. Flower :

- Flowers are objects of aesthetic senses, ornamental, social, religious and cultural values. "Flowers are morphological embryological marvels and site of sexual reproduction in Angiosperms." In the opinion of biologist as two of the four parts, Androecium and gynoecium are the important or sexual part of the plants. "A flower is a modified shoot for reproduction." Flowers bears reproductive organs where gametes are produced. Androecium represents the male reproductive organ and it consist of two parts (1) Anther (2) Filament"
- A typical anther is bilobed, dithecous and tetrasporangiate. Two microsporangia are present in each lobe of anther. "After maturation two microsporangia of each lobe fused together, hence mature anther has two microsporangia.

2. Microsporangia :

- Microsporangia surrounded by four layers:-
- (i) Epidermis- outer single celled thick layer.
 - (ii) Endothecium - It helps in dehiscence of anther.
 - (iii) Middle layer - it stores food.
 - (iv) Tapetum - nutritive. It is diploid/polyploid.

3. Microsporogenesis :

- During the sporogenesis, every cells of sporogenous tissues (microspore mother cell) can give rise to tetrad of microspores through meiosis. Normally tetrad of microspores are tetrahedral in shape. Each microspore mature into pollen grain.

4. Pollen grain :

- Pollen grains are bilayered in structure. Its outer layer is exine. It is made up of sporopollenin which is highly biological resistant material. "Inner layer is made up of pectocellulose. Germ pores are present on exine. The viability of pollen grains depends on temperature and humidity.

5. Microgametogenesis :

- After germination, mature pollen grain contain two cells :-
- (A) Bigger is vegetative cell with large nucleus
 - (B) Smaller cell is generative cell with small nucleus.
- Some times it is three celled stage. Generally pollen grains shed at two celled stage.
- Pollen grain can be stored for many years in liquid nitrogen (-196°) in pollen banks.

6. Carpel/Pistil :

- Carpel is unit of gynoecium and consist of three part :-
- (i) Stigma
 - (ii) Style
 - (iii) Ovary - one/many ovules attached with placenta inside the ovary

SOLVED EXAMPLE

Ex.1 Which one of the following is resistant to enzyme action

- (A) Pollen exine (B) Leaf cuticle
(C) Cork (D) Wood fibre

Sol. (A)

Ex.2 Pollengrain develops from ____ of anther

- (A) Epidermis
(B) Endothecium
(C) Tapetum
(D) Sporogenous tissue

Sol. (D)

Ex.3 Male gametes in angiosperms are formed by the division of

- (A) Microspore
(B) Generative cell
(C) Vegetative cell
(D) Microspore mother cell

Sol. (B) : Generative cell divides into two male gametes, if it has not divided already.

Ex.4 Exine of pollen grains is composed of

- (A) Pectocellulose (B) Lignocellulose
(C) Sporopollenin (D) Pollenkitt

Sol. (C) : Exine is made up of sporopollenin (derived from carotenoid).

Ex.5 The pollen grain is

- (A) An immature male gametophyte
(B) A mature male gametophyte
(C) Partially developed a male gametophyte
(D) Last stage of male gametophyte

Sol. (C) : Pollen grain is partially developed male gametophyte because the rest of the development is completed on stigma when pollen grains start to germinate and produces pollen tube having two male nuclei.

Ex.6 If there are 1280 microspores in a tetralocular anther, how many microspore mother cells will be there in its each pollen chamber

- (A) 80 (B) 160
(C) 240 (D) 1280

Sol. (A)

Ex.7 If you want to develop hybrid seeds within a bisexual flower which of the following parts need to be removed from the same flower

- (A) Stigma (B) Ovary
(C) Anther (D) Oviduct

Sol. (C)

Ex.8 If the number of chromosomes in root cells is 14, what will be the number of chromosomes in synergids cells of an ovule of that parent

- (A) 7
(B) 14
(C) 21
(D) Incomplete information

Sol. (A) : 7; the number of chromosomes in root cells in $2n$ while it is n in synergids because it develops by reductional division.

Ex.9 Which one of the most common embryo sac in flowering plant

- (A) Monosporic 8 nucleated and 7 celled
(B) Monosporic' 7 celled and 7 nucleated
(C) Bisporic, 8 nucleated and 7 celled
(D) Bisporic, 7 nucleated and 8 celled

Sol. (A)

Ex.10 Synergids of the polygonum type embryo sac are

- (A) Haploid (B) Diploid
(C) Triploid (D) Polyploid

Sol. (A) : AH cells in the ovule (integument, nucellus, funicle, hilum) are diploid ($2x$) but embryo sac (synergids, antipodal cells, egg cell) is haploid.

Ex.11 Presence of many embryos (Polyembryony) is a characteristic feature of

- (A) Citrus (B) Mango
(C) Banana (D) None of these

Sol. (A) : In angiosperms, citrus have two or more than two embryos in one seed. It is called polyembryony.

Ex.12 A dicotyledonous plant bears flowers but never produces fruits and seeds. The most probable cause for the above situation is

- (A) Plant is dioecious and bears only pistillate flowers
(B) Plant is dioecious and bears both pistillate and staminate flowers
(C) Plant is monoecious
(D) Plant is dioecious and bears only staminate flowers

Sol. (D)

Exercise # 1

SINGLE OBJECTIVE

NEET LEVEL

1. Intine of pollen grains is composed of
(A) Lipid and protein (B) Cellulose and pectin
(C) Lignin and cutin (D) Pectin and lignin
2. Anther is generally composed of
(A) One sporangium (B) Two sporangium
(C) Three sporangium (D) Four sporangium
3. A microspore mother cell forms
(A) An ovule (B) An embryo sac
(C) A pollen sac (D) Pollen grains
4. At the time of pollination, how many cells are formed in the pollen grains
(A) One (B) Two
(C) Three (D) Four
5. Generally in the wall of the anther lobes how many middle layers are formed
(A) Seven (B) Three
(C) Six (D) Nine
6. Branched type of pollen tube is formed in
(A) *Cucurbita* (B) *Salvia*
(C) China rose (D) *Solanum*
7. Endothecium layer of anther lobes is present
(A) Outside the epidermis
(B) Just inside the epidermis
(C) In the innermost layer
(D) In the middle region
8. If the leaf cell has 8 chromosomes, it is most likely that
(A) Zygote will have 4 chromosomes
(B) Gametes will have 8 chromosomes
(C) Gametes will have 4 chromosomes
(D) Zygote will have 16 chromosomes
9. During meiosis in pollen mother cell the daughter cells are interconnected by passages. The whole structure is called
(A) Symplast (B) Plasmodesmata
(C) Syncytium (D) Coenocyte
10. Before dehiscence of anther
(A) Middle layers enlarge
(B) Endothecium develops fibrous thickenings
(C) Tapetum develops fibrous thickenings
(D) Epidermis degenerates
11. Pollinia are sac like structures
(A) Which secrete yellow substance called pollen kit
(B) Which are found in megasporangia
(C) In which anther lobes are present
(D) In which pollen grains are present in mass
12. Tectum, baculum, foot layer are the different parts of
(A) Microspore wall
(B) Microspore mother cell wall
(C) Megaspore wall
(D) Megaspore mother cell wall
13. A schematic illustration of the pollen grain is called
(A) Pollenogram (B) Palenogram
(C) Histogram (D) Parallelogram
14. If the developing microspore mother cells draw nourishment by contacting the tapetal cells, the type of tapetum is called
(A) Plasmodial tapetum (B) Secretory tapetum
(C) Amoeboid tapetum (D) Endothelium
15. The function of endothecium is
(A) Nutritional (B) Mechanical support
(C) Dehiscence (D) Protection
16. One pollen mother cell may produce four germinating pollen grains, each with two male nuclei and one tube nucleus. How many meiotic divisions are necessary to bring this about
(A) Two (B) One
(C) Three (D) Four
17. The germ pores on the pollen grains are found on the
(A) Exine only (B) Intine only
(C) Both exine and intine (D) Vegetative cell
18. Generally how many megaspores take part in the development of female gametophyte
(A) One (B) Two
(C) Three (D) Four
19. The cells in embryo sac which act as haustoria are
(A) Antipodal cells
(B) Synergids
(C) Egg and synergids
(D) Antipodals and synergids

Exercise # 2**SINGLE OBJECTIVE****AIIMS LEVEL**

1. In a pollen grain, larger nucleus is
(A) Generative nucleus (B) Tube nucleus
(C) Vegetative nucleus (D) None of these
2. Development and formation of pollen grains in anther of the stamen is known as
(A) Pollination (B) Fertilization
(C) Microsporogenesis (D) Megasporesogenesis
3. Which of the following is correct statement
(A) Gametes are diploid
(B) Spores are invariably haploid
(C) Spores and gametes are invariably haploid
(D) Gametes are invariably haploid
4. In anther culture, the androgenic haploid plants are obtained from
(A) Young pollen grain (B) Connective tissue
(C) Anther tapetum (D) Anther wall
5. In monocots, male gametophyte is
(A) Microspore (B) Megaspore
(C) Tetrad (D) Nucellus
6. The odd one is
(A) Micropyle (B) Embryo sac
(C) Nucellus (D) Pollen grain
7. In plants meiosis occurs in
(A) Anther (B) Root tip
(C) Cambium (D) Pollen grain
8. Microsporogenesis is a synonym for
(A) Spermatogenesis
(B) Development of pollen
(C) Development of male gametophyte
(D) Development of female gametophyte
9. In anther culture, some diploid plants were reported with haploids. They have evolved from
(A) Prothallial cell of pollen grain
(B) Generative cell of pollen grain
(C) Cell of anther wall
(D) Exine of pollen grain
10. The anther wall consists of four wall layers where
(A) Endothecium lies inner to middle layers
(B) Tapetum lies just inner to endothecium
(C) Tapetum lies next to epidermis
(D) Middle layers lie between endothecium and tapetum
11. A typical anther wall has
(A) Endothecium and endothecium
(B) Endothecium and tapetum
(C) Exothecium, endothecium and tapetum
(D) Exothecium and tapetum
12. In flowering plants, a mature 'male gametophyte' is derived from a 'pollen mother cell' by
(A) Three mitotic divisions
(B) One meiotic and two mitotic divisions
(C) Two meiotic divisions
(D) A single meiotic division
13. Palynology deals with the study of
(A) Pollen grains (B) Chromosomes
(C) DNA (D) Genes
14. Which of the following is not functionally analogous with others in the group
(A) Archegonium (B) Oogonium
(C) Antheridium (D) Ovule
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. Collar like outgrowth arising from the base of ovule and forming a sort of third integument is known as
(A) Coma (B) Caruncle
(C) Aril (D) Operculum
17. Filiform apparatus is found in which part of angiosperms
(A) Sperm (B) Antipodal
(C) Egg (D) Synergid
18. An orthotropous ovule is one in which micropyle and chalaza are
(A) In straight line of funiculus
(B) Parallel to funiculus
(C) At right angles to funiculus
(D) Oblique to funiculus
19. The ovule in pea are
(A) Anatropous (B) Hemianatropous
(C) Campylotropous (D) Amphitropous
20. 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

Exercise # 3**PART - 1****MATRIX MATCH COLUMN**

1. Match the items in column -I with those in column - II and choose the correct answer

Column - I

- A. Funicle
- B. Integuments
- C. Chalaza
- D. Hilum
- E. Micropyle

- (A) A -ii; B - iii; C - v; D - iv; E - i
- (C) A -ii; B - iii; C - i; D - iv; E - v
- (E) A -iii; B - iv; C - v; D - i; E - ii

Column - II

- i. Small opening of ovule
- ii. Stalk of ovule
- iii. Protective envelopes of ovules
- iv. Junction part of ovule
- v. Basal part of the ovule

- (B) A -i; B -iii; C - ii; D - iv; E - v
- (D) A -ii; B - iv; C - v; D - i; E - iii

2. Match the entries in Column - I with those of Column- II and choose the correct answer

Column - I

- A. Cleistogamy
- B. Geitonogamy
- C. Entomophily
- D. Xenogamy

- (A) A - iii; B - i; C - v; D - ii
- (C) A - ii; B - iii; C - i; D - v

Column - II

- i. Insect pollination
- ii. Bud pollination
- iii. Pollination between flowers in the same plant
- iv. Wind pollination
- v. Cross pollination

- (B) A - i; B - v; C - ii; D - iii
- (D) A - v; B - iv; C - iii; D - ii

3. Match the following

Column - I

- A. Zoophily
- B. Ornithophily
- C. Entomophily
- D. Chiropterophily

- (A) A - iii; B - ii; C - i; D - iv
- (C) A - iv; B - i; C - ii; D - iii
- (E) A - iv; B - ii; C - iii; D - i

Column - II

- i. Pollination by birds
- ii. Pollination by insect
- iii. Pollination by bats
- iv. Pollination by animals

- (B) A - i; B - ii; C - iii; D - iv
- (D) A - iv; B - i; C - ii; D - iii

4. Match Column -I with Column - II and select the correct option from the codes given below.

Column -I

- A. Tallest flower
- B. Pronuba moth
- C. Anemophily
- D. Entomophily

- (A) A - ii; B - iv; C - i; D - iii
- (C) A - iii; B - ii; C - i; D - iv

Column - II

- i. Maize
- ii. Amorphophallus
- iii. Salvia
- iv. Yucca

- (B) A - ii; B - iv; C - iii; D - i
- (D) A - iv; B - iii; C - ii; D - i

Exercise # 4**PART - 1****PREVIOUS YEAR (NEET/AIPMT)**

1. Double fertilisation leading to initiation of endosperm in angiosperms require
[CBSE AIPMT 2000]
(A) Fusion of one polar nucleus and the second male gamete only
(B) Fusion of two polar nuclei and the second male gamete
(C) Fusion of four or more polar nuclei and the second male gamete only
(D) All of the above kinds of fusion in different angiosperms
2. Eight nucleate embryo sacs are
[CBSE AIPMT 2000]
(A) always tetrasporic
(B) always monosporic
(C) always bisporic
(D) Sometimes monosporic, sometimes bisporic and sometimes tetrasporic
3. Anemophily type of pollination is found in
[CBSE AIPMT 2001]
(A) Salvia (B) Bottle brush
(C) Vallisneria (D) Coconut
4. Adventive embryony in Citrus is due to
[CBSE AIPMT 2001]
(A) nucellus (B) integuments
(C) zygotic embryo (D) fertilised egg
5. In angiosperms all the four microspores of tetrad are covered by a layer which is formed by
[CBSE AIPMT 2002]
(A) pectocellulose (B) callose
(C) cellulose (D) sporopollenin
6. What is the direction of micropyle in anatropous ovule ?
[CBSE AIPMT 2002]
(A) Upward (B) Downward
(C) Right (D) Left
7. In angiosperms pollen tubes liberate their malegametes into the
[CBSE AIPMT 2002]
(A) central cell (B) antipodal cell
(C) egg cell (D) synergid
8. Which tupe of association is found in between entomophilious flower and pollinating agent ?
[CBSE AIPMT 2002]
(A) Mutualism (B) Commensalism
(C) Cooperation (D) Co-evolution
9. In a flowering plant, archesporium gives rise to
[CBSE AIPMT 2003]
(A) only tapetum and sporogenous cells
(B) only the wall of the sporangium
(C) both wall and the sporogenous cells
(D) wall and the tapetum
10. An ovule which becomes curved so that the nucellus and embryo sac lie at right angles to the funicle is
[CBSE AIPMT 2003]
(A) hemitropous (B) campylotropous
(C) anatropous (D) orthotropous
11. Through which cell of the embryo sac, does the pollen tube enter the embryo sac
[CBSE AIPMT 2005]
(A) egg cell (B) persistant synergid
(C) degenerated synergid (D) central cell
12. In a type of apomixis known as adventive embryony, embryos develop directly from the
[CBSE AIPMT 2005]
(A) nucellus or integuments
(B) zygote
(C) synergids or antipodals in an embryo sac
(D) accessory embryo sac in the ovule
13. Which one of the following represents an ovule, where the embryo sac becomes horse shoe-shaped and the funiculus and micropyle are close to each other ?
[CBSE AIPMT 2005]
(A) Amphitropous (B) Circinotropous
(C) Atropous (D) Anatropous
14. What would be the number of chromosomes in the cells of the aleuron layer in a plant species with 8 chromosomes in its synergids ?
[CBSE AIPMT 2006]
(A) 24 (B) 32
(C) 8 (D) 16
15. The arrangement of the nuclei in a normal embryo sac in the dicot plants is
[CBSE AIPMT 2006]
(A) 3 + 2 + 3 (B) 2 + 3 + 3
(C) 3 + 3 + 2 (D) 2 + 4 + 2
16. Which one of the following is surrounded by a callose wall ?
[CBSE AIPMT 2007]
(A) Microspore mother cell (B) Male gamete
(C) Egg (D) Pollen grain

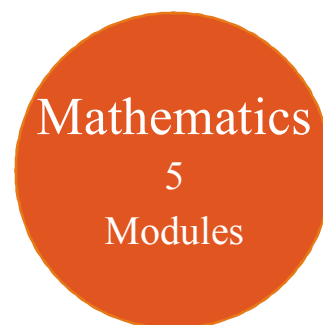
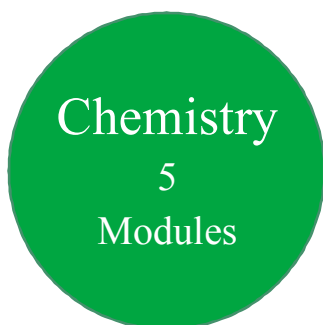
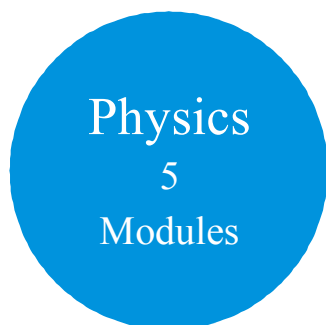
MOCK TEST

- In a dithecous anther, each pollen sac contain 1000 MMC. What is the total number of pollen grains produced by the anther ?
(A) 16,000 (B) 4,000 (C) 32,000 (D) 8,000
- Which of these is not a part of the anther wall ?
(A) Epidermis (B) Middle layers (C) Endothecium (D) Nucellus
(E) Tapetum
- The fibrous bands develop from cells of the anther wall layer known as
(A) Epidermis (B) Endothecium (C) Middle layers (D) Tapetum
- 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.
- In majority of angiosperms
(A) Egg has a filiform apparatus
(B) There are numerous antipodal cells
(C) Reduction division occurs in the megaspore mother cells
(D) A small central cell is present in that embryo sac.
- Match the items in column I with those in column II and choose the correct answer.

Column I	Column II
1. Funicle	A. Small opening of ovule
2. Integuments	B. Stalk of ovule
3. Chalaza	C. Protective envelopes of ovule
4. Hilum	D. Junction part of ovule and stalk
5. Micropyle	E. Basal part of the ovule

(A) 1-B ; 2-C ; 3-E ; 4-D ; 5-A
(B) 1-A ; 2-C ; 3-B ; 4-D ; 5-E
(C) 1-B ; 2-C ; 3-A ; 4 ; D ; 5-E
(D) 1-B ; 2-D ; 3-E ; 4-A ; 5-C
(E) 1-C ; 2-D ; 3-E ; 4-A ; 5-B
- In angiosperms, microsporogenesis and mega-sporogenesis
(A) Involve meiosis (B) Occur in ovule
(C) Occur in anther (D) Form gametes without further divisions
- Consider the following statements and choose the correct option.
A. The ovule is attached to the placenta by means of a stalk called filament.
B. the ovule fuses with the stalk in the region called hilum.
C. The two protective envelopes of ovule are called integuments.
D. The small opening in the tip of ovule are called germ pore.
Of the above statements
(A) A and D are correct (B) A and C are correct (C) B and D are correct (D) B and C are correct
(E) C and D are correct

11th Class Modules Chapter Details



PHYSICS	CHEMISTRY	BIOLOGY
<p>Module-1</p> <ol style="list-style-type: none"> 1. Physical World & Measurements 2. Basic Maths & Vector 3. Kinematics <p>Module-2</p> <ol style="list-style-type: none"> 1. Law of Motion & Friction 2. Work, Energy & Power <p>Module-3</p> <ol style="list-style-type: none"> 1. Motion of system of particles & Rigid Body 2. Gravitation <p>Module-4</p> <ol style="list-style-type: none"> 1. Mechanical Properties of Matter 2. Thermal Properties of Matter <p>Module-5</p> <ol style="list-style-type: none"> 1. Oscillations 2. Waves 	<p>Module-1(PC)</p> <ol style="list-style-type: none"> 1. Some Basic Concepts of Chemistry 2. Atomic Structure 3. Chemical Equilibrium 4. Ionic Equilibrium <p>Module-2(PC)</p> <ol style="list-style-type: none"> 1. Thermodynamics & Thermochemistry 2. Redox Reaction 3. States Of Matter (Gaseous & Liquid) <p>Module-3(IC)</p> <ol style="list-style-type: none"> 1. Periodic Table 2. Chemical Bonding 3. Hydrogen & Its Compounds 4. S-Block <p>Module-4(OC)</p> <ol style="list-style-type: none"> 1. Nomenclature of Organic Compounds 2. Isomerism 3. General Organic Chemistry <p>Module-5(OC)</p> <ol style="list-style-type: none"> 1. Reaction Mechanism 2. Hydrocarbon 3. Aromatic Hydrocarbon 4. Environmental Chemistry & Analysis Of Organic Compounds 	<p>Module-1</p> <ol style="list-style-type: none"> 1. Diversity in the Living World 2. Plant Kingdom 3. Animal Kingdom <p>Module-2</p> <ol style="list-style-type: none"> 1. Morphology in Flowering Plants 2. Anatomy of Flowering Plants 3. Structural Organization in Animals <p>Module-3</p> <ol style="list-style-type: none"> 1. Cell: The Unit of Life 2. Biomolecules 3. Cell Cycle & Cell Division 4. Transport in Plants 5. Mineral Nutrition <p>Module-4</p> <ol style="list-style-type: none"> 1. Photosynthesis in Higher Plants 2. Respiration in Plants 3. Plant Growth and Development 4. Digestion & Absorption 5. Breathing & Exchange of Gases <p>Module-5</p> <ol style="list-style-type: none"> 1. Body Fluids & Its Circulation 2. Excretory Products & Their Elimination 3. Locomotion & Its Movement 4. Neural Control & Coordination 5. Chemical Coordination and Integration

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12th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS	CHEMISTRY	BIOLOGY
<p>Module-1</p> <ol style="list-style-type: none"> 1. Electrostatics 2. Capacitance <p>Module-2</p> <ol style="list-style-type: none"> 1. Current Electricity 2. Magnetic Effect of Current and Magnetism <p>Module-3</p> <ol style="list-style-type: none"> 1. Electromagnetic Induction 2. Alternating Current <p>Module-4</p> <ol style="list-style-type: none"> 1. Geometrical Optics 2. Wave Optics <p>Module-5</p> <ol style="list-style-type: none"> 1. Modern Physics 2. Nuclear Physics 3. Solids & Semiconductor Devices 4. Electromagnetic Waves 	<p>Module-1(PC)</p> <ol style="list-style-type: none"> 1. Solid State 2. Chemical Kinetics 3. Solutions and Colligative Properties <p>Module-2(PC)</p> <ol style="list-style-type: none"> 1. Electrochemistry 2. Surface Chemistry <p>Module-3(IC)</p> <ol style="list-style-type: none"> 1. P-Block Elements 2. Transition Elements (d & f block) 3. Co-ordination Compound 4. Metallurgy <p>Module-4(OC)</p> <ol style="list-style-type: none"> 1. HaloAlkanes & HaloArenes 2. Alcohol, Phenol & Ether 3. Aldehyde, Ketone & Carboxylic Acid <p>Module-5(OC)</p> <ol style="list-style-type: none"> 1. Nitrogen & Its Derivatives 2. Biomolecules & Polymers 3. Chemistry in Everyday Life 	<p>Module-1</p> <ol style="list-style-type: none"> 1. Reproduction in Organisms 2. Sexual Reproduction in Flowering Plants 3. Human Reproduction 4. Reproductive Health <p>Module-2</p> <ol style="list-style-type: none"> 1. Principles of Inheritance and Variation 2. Molecular Basis of Inheritance 3. Evolution <p>Module-3</p> <ol style="list-style-type: none"> 1. Human Health and Disease 2. Strategies for Enhancement in Food Production 3. Microbes in Human Welfare <p>Module-4</p> <ol style="list-style-type: none"> 1. Biotechnology: Principles and Processes 2. Biotechnology and Its Applications 3. Organisms and Populations <p>Module-5</p> <ol style="list-style-type: none"> 1. Ecosystem 2. Biodiversity and Conservation 3. Environmental Issues

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