SAMPLE CONTENT

Absolute

NEET-UG BIOLOGY Vol - II

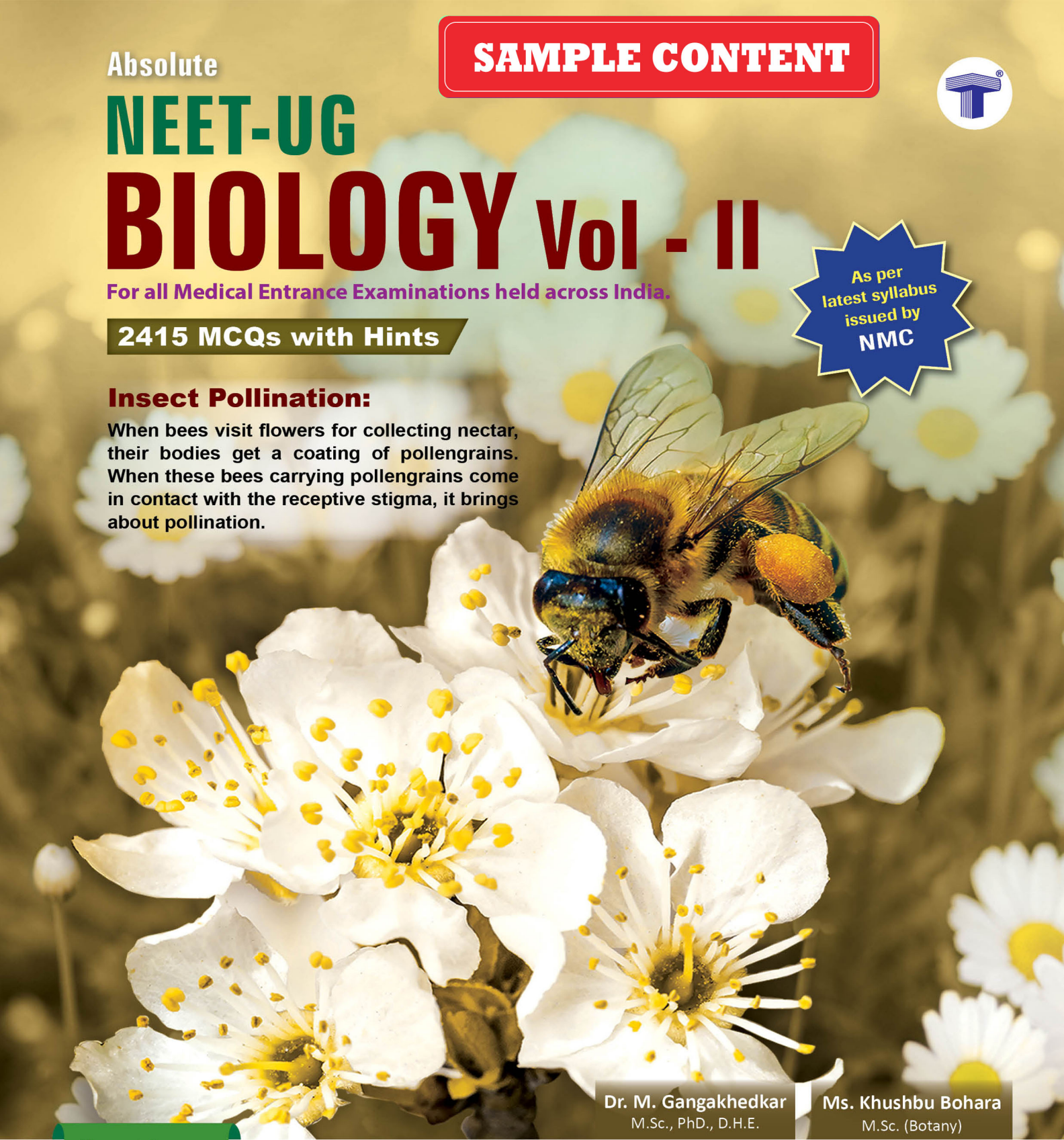
For all Medical Entrance Examinations held across India.

2415 MCQs with Hints

As per latest syllabus issued by NMC

Insect Pollination:

When bees visit flowers for collecting nectar, their bodies get a coating of pollengrains. When these bees carrying pollengrains come in contact with the receptive stigma, it brings about pollination.



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M.Sc. (Botany)

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Absolute
NEET (UG)
Biology Vol. II

Now with more study techniques

Salient Features

- Comprehensive theory for every topic
- Subtopic-wise segregation of MCQs for efficient practice
- Exhaustive coverage of questions including questions from previous years' NEET (UG) and other competitive examinations upto year **2024**:
  - **2463** MCQs
  - Solutions to the questions are provided for better understanding
- Includes **Smart Keys:** Multiple study techniques to enhance understanding and problem solving:
  - ***Smart Code*** - ***Smart tip*** - ***Caution***
  - ***Think out of the box***
- Quick Review provided at the end of every chapter to facilitate quick revision
- Neat and labelled authentic diagrams
- Includes Question Paper and Answer Keys (Solution through Q.R. code) of:
  - NEET (UG) 2024
- Topic Test provided in each chapter for self-assessment
- Q.R. codes provide:
  - Video/PDF links for boosting conceptual retention
  - Answers & Solutions to Topic Tests
  - Solutions of NEET (UG) 2024 question paper

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PREFACE

'Absolute Biology Vol - II' is a complete guidebook, extremely handy for the preparation of various competitive examinations like NEET (UG). This edition provides an unmatched comprehensive amalgamation of theory with MCQs. The chapters are compiled according to the latest syllabus for **NEET (UG) 2024** examination. Although the alignment runs parallel to NCERT curriculum, the structure of the chapters prioritizes knowledge building of the students. The book provides the students with scientifically accurate context, several study techniques and skills required to excel in these examinations.

In this book, the Theoretical Concepts are presented elaborately along with diagrams that enable better preparation of the basics of topics for any competitive examination.

The MCQs are framed considering the importance given to every topic as per the NEET (UG) exam to form a strong foundation. They are a healthy mix of questions based on higher order thinking, theory and diagram based concepts.

The level of difficulty of these questions is at par with that of various competitive examinations held across India. Questions from various examinations such as NEET (UG), MHT CET, AIIMS, CPMT, AFMC, JIPMER, TS EAMCET, BCECE, AP EAMCET, AP EAPCET are covered exclusively.

Features in each chapter:

- Coverage of **'Theoretical Concepts'** that form a vital part of any competitive examination.
- **'Multiple Choice Questions'** are segregated topic-wise to enable easy assimilation of questions based on the specific concept.
- **'Quick Review'** covers all tables/ flow charts to summarize the key points in chapter, making it useful for students to glance at while revising at the last minute.
- **'Topic Test'** has been provided at the end of each chapter to assess the level of preparation of the student on a competitive level.

All the features of this book pave the path of a student to excel in their examinations. The features are designed keeping the following elements in mind: Time management, easy memorization or revision and non-conventional yet simple methods for MCQ solving.
To keep students updated, the book covers selective solved questions of **NEET (UG) 2024** to offer students a glimpse of the complexity of questions asked in entrance examination.

We hope the book benefits the learner as we have envisioned.

A book affects eternity; one can never tell where its influence stops.

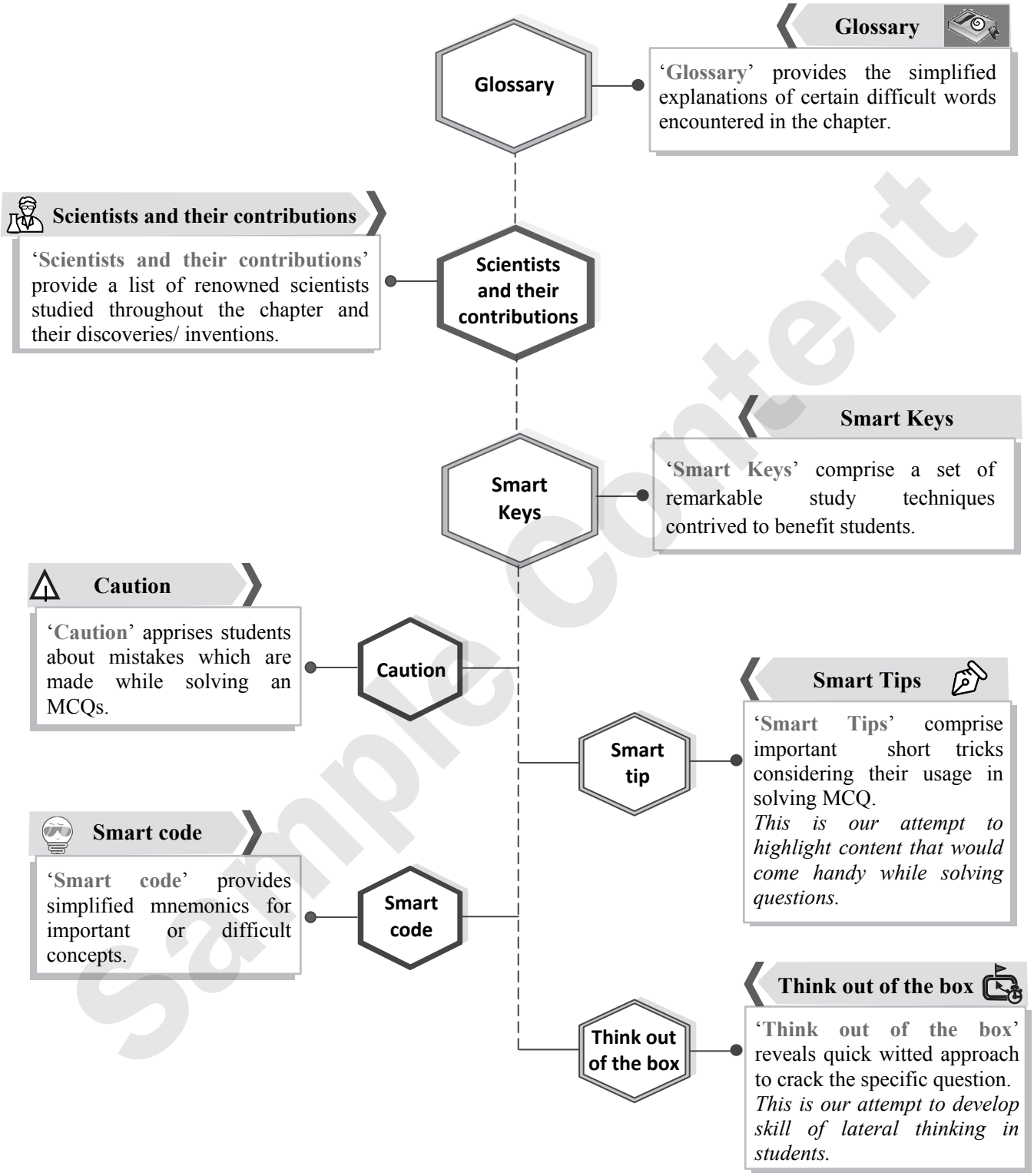
Publisher

Edition: Eighth

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.

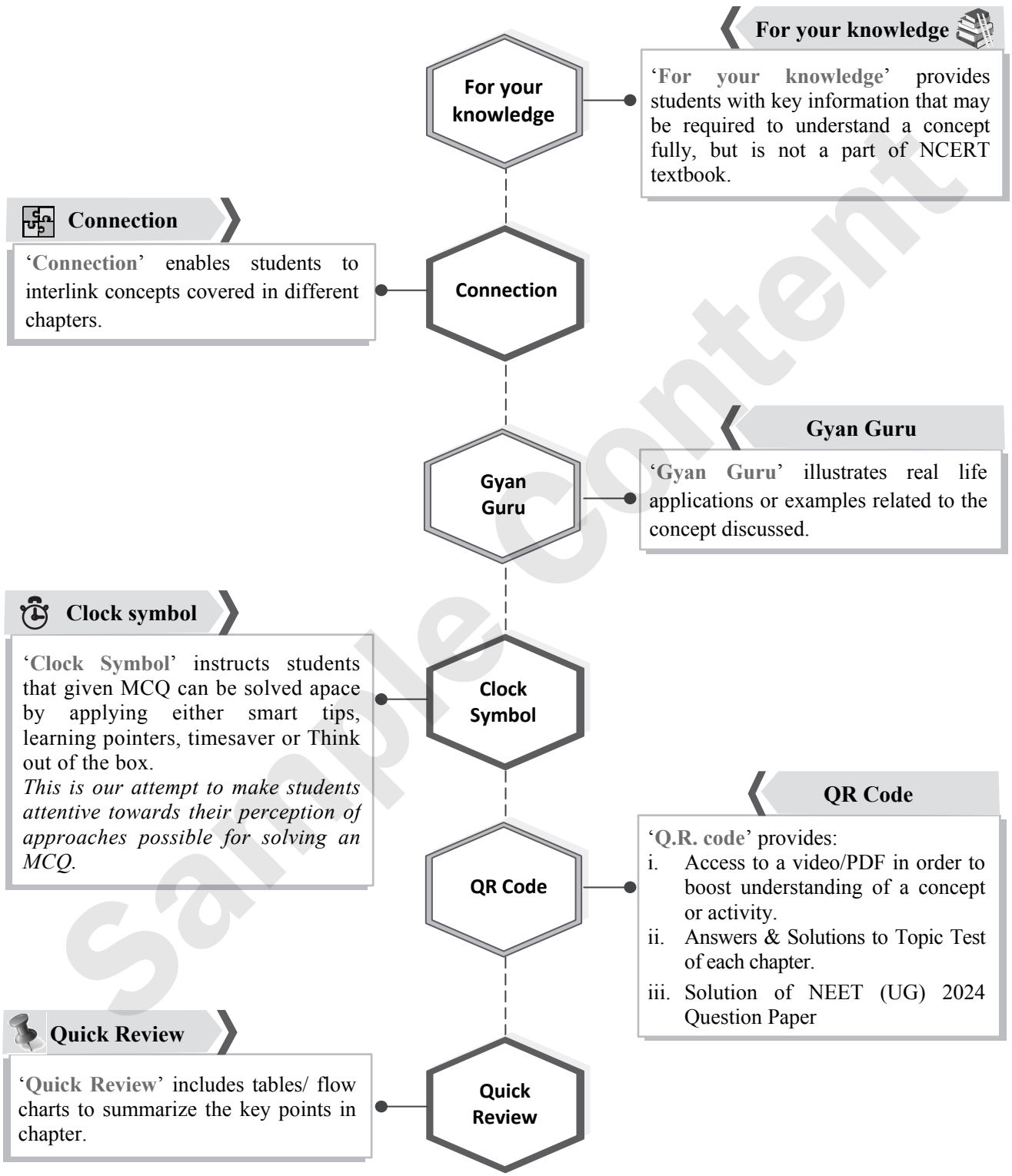
Please write to us on: mail@targetpublications.org

KEY FEATURES



To be continued…

KEY FEATURES



Frequently Asked Questions

- **Why Absolute Series?**

  Gradually, every year the nature of competitive entrance exams is inching towards conceptual understanding of topics. Moreover, it is time to bid adieu to the stereotypical approach of solving a problem using a single conventional method.

  To be able to successfully crack the NEET (UG) examinations, it is imperative to develop skills such as data interpretation, appropriate time management, knowing various methods to solve a problem, etc. With Absolute Series, we are sure, you'd develop all the aforementioned skills and take a more holistic approach towards problem solving. The way you'd tackle advanced level MCQs with the help of Hints, Smart tips, Smart codes and Think out of the box would give you the necessary practice that would be a game changer in your preparation for the competitive entrance examinations.

- **What is the intention behind the launch of Absolute Series?**

  The sole objective behind the introduction of Absolute Series is to cater to needs of students across a varied background and effectively assist them to successfully crack the NEET (UG) examinations. With a healthy mix of MCQs, we intend to develop a student's MCQ solving skills within a stipulated time period.

- **What do I gain out of Absolute Series?**

  After using Absolute Series, students would be able to:

  a. assimilate the given data and apply relevant concepts with utmost ease.
  b. tackle MCQs of different pattern such as match the columns, diagram based questions, multiple concepts and assertion-reason efficiently.
  c. garner the much needed confidence to appear for competitive exams.
  d. apply easy and time saving methods to tackle tricky questions which will help ensure that time consuming questions do not occupy more time than you can allot per question.

- **How to derive the best advantage of the book?**

  To get the maximum benefit of the book, we recommend :

  a. Go through the detailed theory at the beginning of a chapter for concept clarity. Commit Smart Tips and Smart Codes into memory and pay attention to Caution.
  b. Using subtopic wise segregation as a leverage, complete MCQs in each subtopic at your own pace. Questions from exams such as NEET (UG) are tagged and placed along the flow of subtopic. Mark these questions specially to gauge the trends of questions in various exams.
  c. Be extra receptive to Think out of the box and application of Smart Tips and Smart Codes. Assimilate them into your thinking.

Best of luck to all the aspirants!

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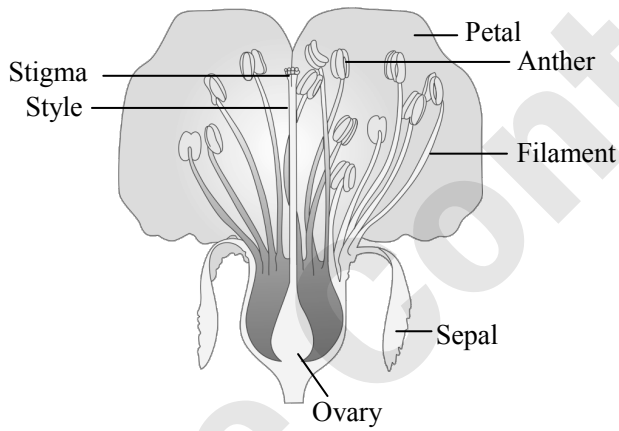
1 Sexual Reproduction in Flowering Plants

- Flower – A Fascinating Organ of Angiosperms
- Pre-Fertilization: Structures and Events
- Double Fertilization
- Post Fertilization: Structures and Events
- Apomixis and Polyembryony

Flower – A Fascinating Organ of Angiosperms

i. **Flower:** It is a modified shoot meant for sexual reproduction.
ii. Floral whorls of flowers:
   a. Accessory whorls: Calyx (Sepals) and Corolla (Petals)
   b. Reproductive whorls: Androecium (Stamen) and Gynoecium (Carpel)

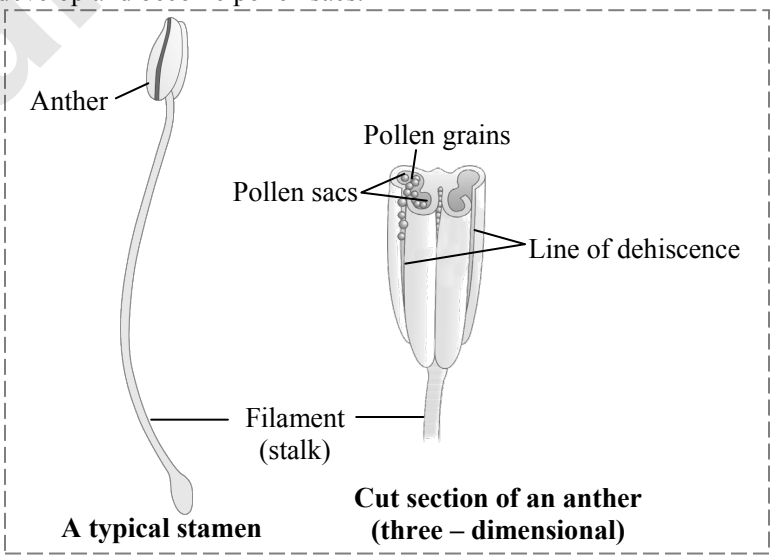


L.S. of a flower showing various parts

Pre–Fertilization: Structures and Events

Stamen, Microsporangium and Pollen grain

i. Stamen consists of two parts–**anther** and **filament** (Long slender stalk).
ii. Angiospermic anther is **bilobed** with each lobe having two theca (dithecous). Generally a longitudinal groove runs lengthwise separating the theca.
iii. Each anther lobe generally contains two pollen sacs or microsporangia. Thus, anther is **tetrasporangiate**.
iv. Numerous microspore mother cells are present in each microsporangium. They are diploid (2n).
v. Microsporangia develop and become pollen sacs.



A typical stamen

Cut section of an anther (three – dimensional)

vi. The microsporangial wall consists of four layers:

a. Epidermis:
Epidermis is the outermost layer of anther which consists of flattened cells and it is protective in function.

b. Endothecium:
Endothecium is inner to epidermis. It helps in dehiscence of anther.

c. Middle layers:
Below the endothecium, there are 1 – 3 middle layers of parenchyma cells.

d. Tapetum:
Innermost layer of anther wall is tapetum. It is nutritive in nature. It provides nourishment to the developing pollen grains. The cells of tapetum generally have more than one nucleus and possess dense cytoplasm.

Smart tip - 1

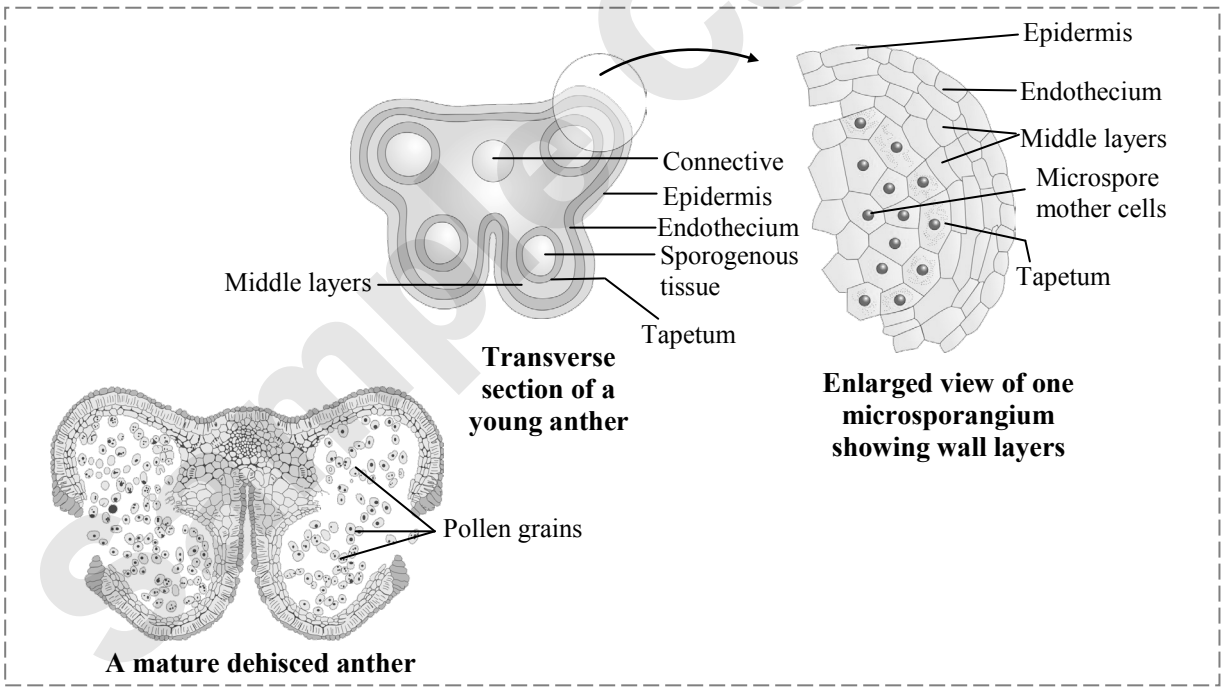
Wall layers of microsporangium (from outer side to inner side):
Epidermis → Endothecium → Middle layers → Tapetum
(Outermost) (Innermost)

➢ **Microsporogenesis:**
The process of formation of microspores from a pollen mother cell (PMC) is called as **microsporogenesis**.

Sporogenous tissue undergoes meiosis to form Microspore tetrad[G].

Sporogenous tissue $\xrightarrow{\text{Meiosis}}$ **Microspore tetrad → Pollen Mother Cell (PMC)** $\xrightarrow{\text{Meiosis}}$ **Microspore**

On maturity and dehydration of the anthers, the microspores dissociate from each other and develop into pollen grains which are then released with the dehiscence of anther.



Smart tip - 2

In a **dithecous anther** (bilobed anther with each lobe having two thecae):

4 Pollen sacs $\xrightarrow{\text{Each sac contains}}$ **Pollen Mother Cells (2n)** $\xrightarrow[\text{to produce}]{\text{Undergo meiosis}}$ **Microspores (n)**

Calculating number of microspores formed from MMC/PMC:
Number of microspores = n x 4
Where 'n' = number of MMC/PMC

➢ **Structure of pollen grain:**

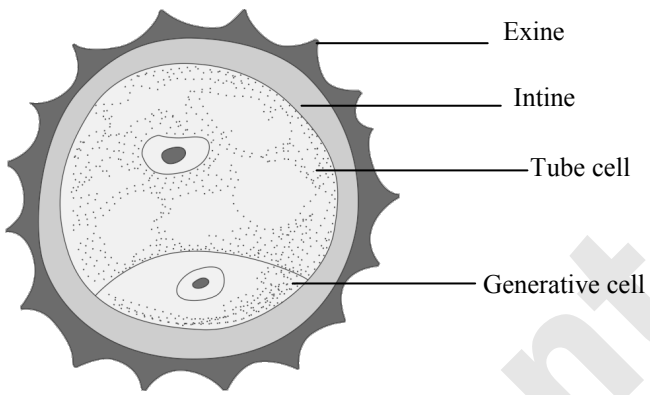
i. Pollen grains develop from the diploid microspore mother cells in pollen sacs of anther.

ii. Pollen grain is haploid, unicellular, uninucleate, spherical structure.
Size: 25–50 μm in diameter

iii. Pollen grain has a double layered wall – outer exine and inner intine.

a. Exine: It is the outer, thick and resistant layer. It is composed of sporopollenin which provides resistance to a pollen grain from high temperatures, strong acids and alkalis.

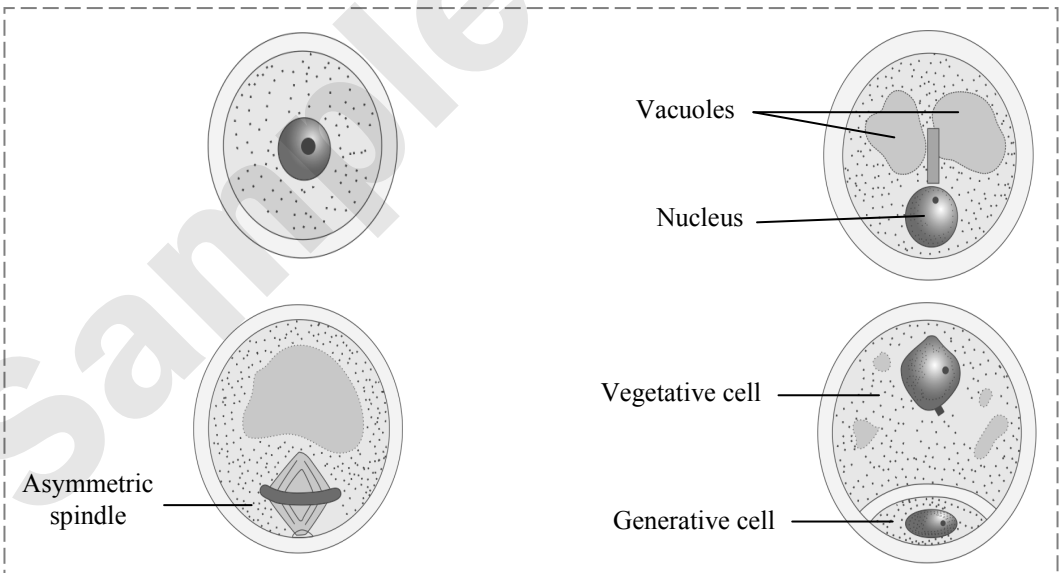
b. Intine: It is the inner layer of pollen grain which is composed of cellulose and pectin.



Pollen grain (Sectional view)

iv. At certain places, the exine remains thin (or absent). The thin areas are known as germ pore[G]. Pollen grain or microspore is the first cell of male gametophyte or immature male gametophyte.

v. The cytoplasm of pollen grain is surrounded by a plasma membrane. On maturity, a pollen grain contains two cells i.e. **Vegetative cell** and **Generative cell**.



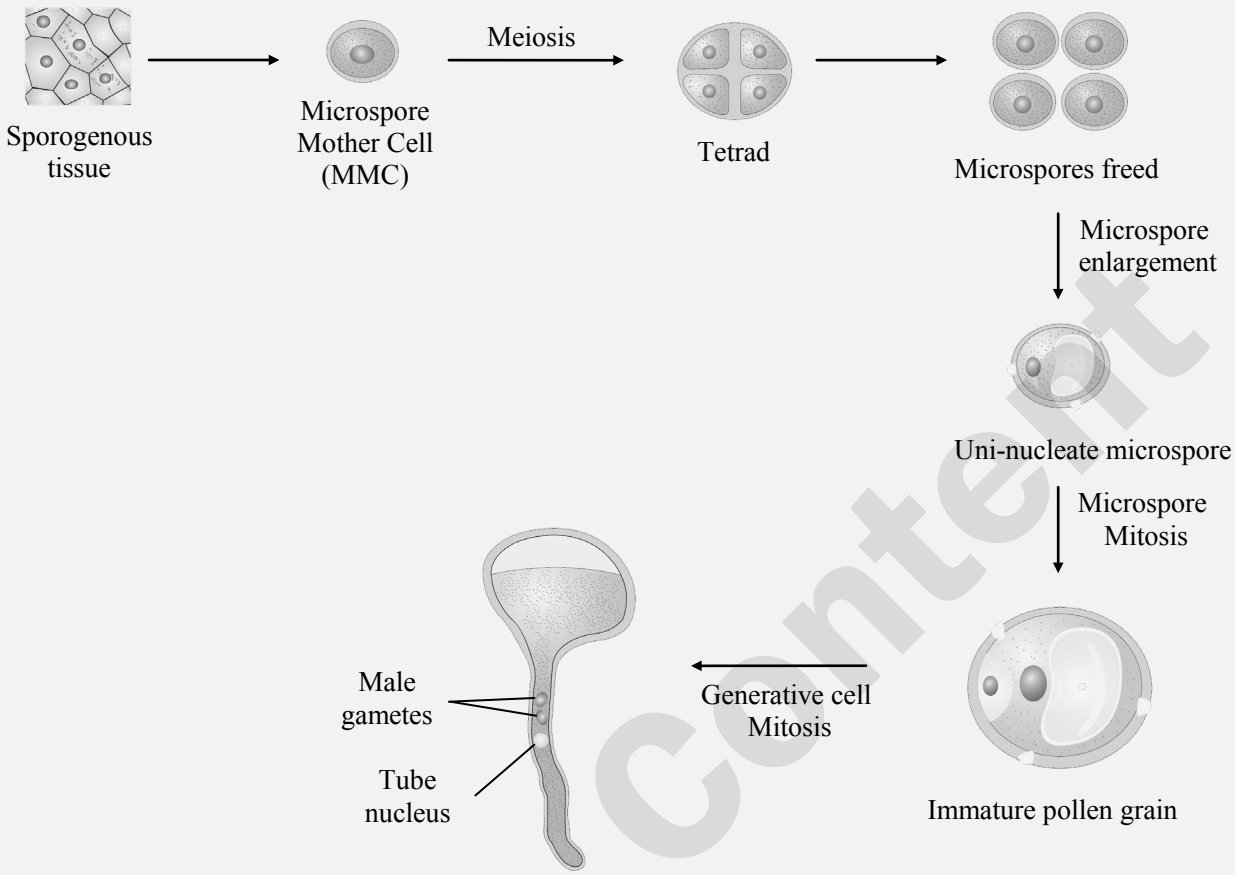
Different stages showing maturation of microspore into pollen grain

vi. Vegetative cell is bigger, with abundant food reserve and possesses large irregularly shaped nucleus.

vii. Generative cell is small, spindle shaped, float in cytoplasm of vegetative cell and possesses dense cytoplasm and nucleus.

viii. In over 60% Angiosperms, pollen grains are shed at the 2-celled stage. In the remaining species, generative cell undergoes mitotic division to produce 2 male gametes before the pollen grains are shed (3-celled stage).

For your knowledge



➢ **Harmful effects of Pollen grains:**

i. Pollen grains of many species cause severe allergies and bronchial afflictions leading to chronic respiratory disorders like asthma and bronchitis.

ii. *Parthenium* (Carrot grass) causes pollen allergy.

➢ **Uses /Benefits of Pollen grains:**

i. Rich in nutrients.

ii. Pollen tablets are used as food supplements.

iii. A large number of pollen products in the form of syrups and tablets are available in the market in western countries.

iv. Pollen consumption enhances the performance of athletes and race horses.

➢ **Pollen Viability and Storage:**

i. Viability of pollen grain is highly variable and to some extent depends on the prevailing temperature and humidity.

ii. In rice and wheat, pollen grains remain viable for 30 minutes of their release, whereas in some members of Rosaceae, Leguminosae, Solanaceae, they remain viable for months.

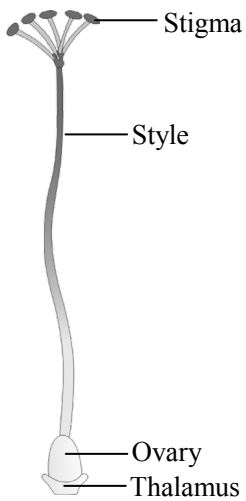
iii. Pollen grains of a large number of species can be stored in liquid nitrogen (–196 °C) for many years.

iv. These stored pollen can be used as pollen banks.

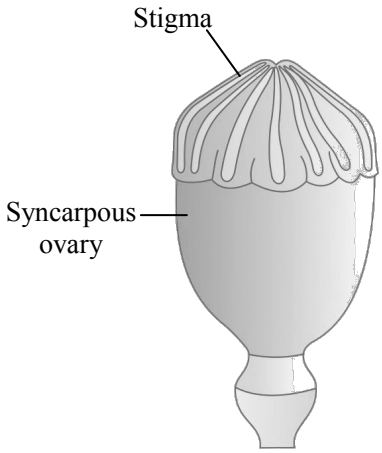
The Pistil, Megasporangium (Ovule) and Embryo Sac

Gynoecium (female reproductive part of a flower) consists of carpels or pistils or megasporophylls. They may be free (apocarpous) or united (syncarpous).

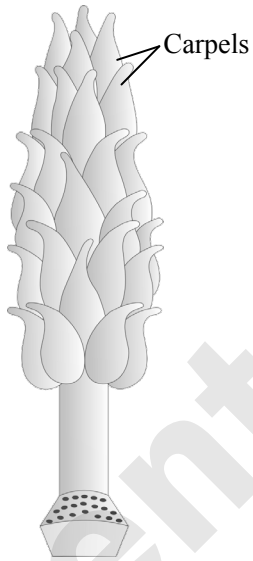
Each carpel has three parts: **Ovary, Style and Stigma.**



Pistil from *Hibiscus* flower



Multicarpellary, syncarpous pistil (*Papaver*)



Multicarpellary, apocarpous pistil (*Michelia*)

i. Ovary:
It is a swollen portion present at the base and contains one or many ovules which possess female gamete. Inside the ovule, locule (ovarian cavity) is present. Placenta is present inside the locule.

ii. Style:
It is a tube-like structure called as style which possesses stigma at its tip.

iii. Stigma:
It is a receptive part of carpel which receives pollen grains during pollination.

iv. Structure of ovule:
Ovule is the integumented megasporangium.
It shows the following structures:

a. Funicle:
The stalk of ovule is called funicle which attaches the ovule with placenta.

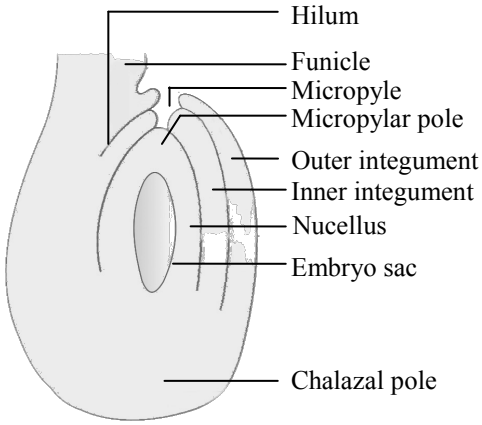
b. Hilum:
The point of attachment of the body of the ovule to the funicle is known as hilum.

c. Integuments:
Protective envelopes which encircle the ovule, except at the micropyle.

d. Nucellus:
Mass of cells enclosed within the integuments. They have abundant reserve food material.

e. Chalaza:
The basal part of nucellus from where the integuments develop is called chalaza.

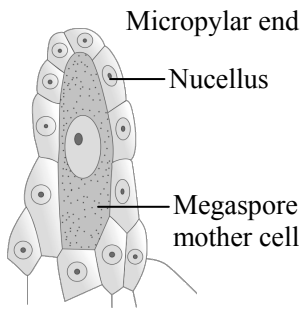
f. Micropyle:
A narrow opening in the integuments at the terminal end of nucellus is called micropyle.



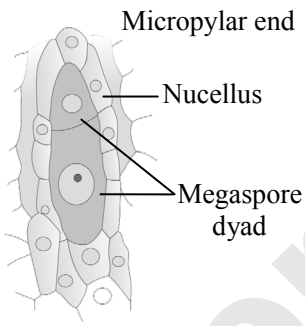
A diagrammatic view of typical Anatropous Ovule

➢ **Development of female gametophyte in angiosperms:**

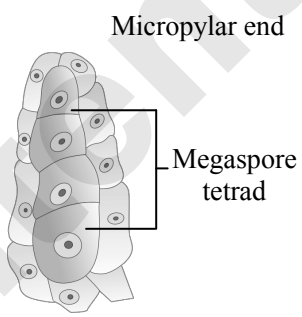
i. Ovules generally differentiate a single Megaspore Mother Cell (MMC) in the micropylar region of the nucellus.
ii. At maturity, **megaspore mother cell** undergoes meiosis to form four haploid **megaspores,** arranged in a linear tetrad.
iii. The formation of megaspore from megaspore mother cell is called **megasporogenesis.**
iv. Out of the four haploid megaspores, upper 3 (towards micropylar end) degenerate and one at the base remains functional. It is the 1st cell of female gametophyte.
v. The functional megaspore enlarges and undergoes mitotic nuclear division to produce two nuclei.
vi. These nuclei, migrate to opposite poles of the megaspore.
vii. At each pole, nucleus divides twice to form 4 nuclei, 4 at each pole. Nuclear divisions are not followed immediately by cell wall formation.
viii. The functional megaspore enlarges gradually and becomes 8-nucleate embryo sac (female gametophyte).



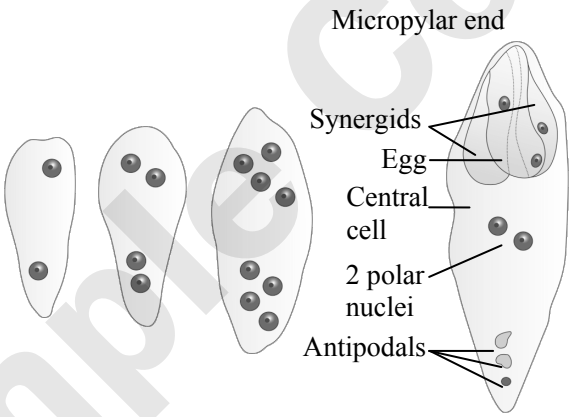
Large megaspore mother cell



Megaspore dyad

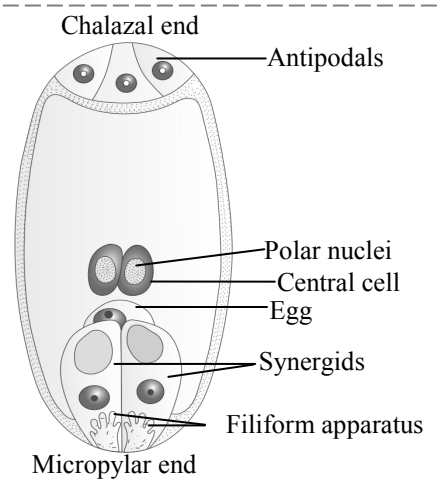


Megaspore tetrad



Stages of embryo sac (1, 2, 4 and 8 – nucleate)

ix. The two nuclei, one from each pole (polar nuclei) migrate to the centre and fuse to form **diploid secondary nucleus**.
x. The three nuclei at the chalazal end form **antipodal cells** while the three at the micropylar end form **egg apparatus** of which one in the centre is **egg** and the other two are **synergids**.
xi. **The embryo sac is 7-celled and 8-nucleated.**
xii. 6 of 8 nuclei are surrounded by cell walls and organised into cells, the other two nuclei (polar nuclei) are situated below the egg apparatus in the large central cell.
xiii. The development of female gametophyte in angiosperms is completely **endosporic,** i.e. within the megaspore and **monosporic** as female gametophyte develops from a single megaspore. (However in some angiosperms, it may be bisporic or tetrasporic).



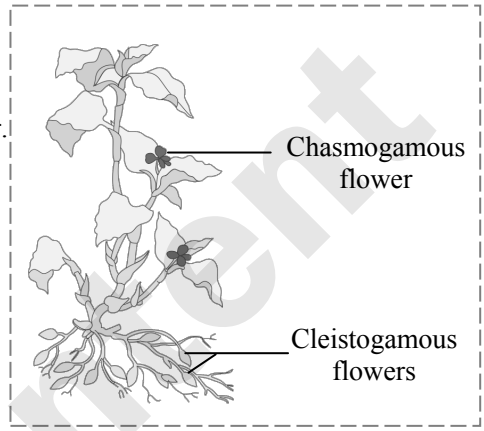
Mature Embryo Sac

Smart tip - 3

Haploid: Pollen grains, Male gametes, Vegetative and generative cell of pollen grain, Antipodals, Egg, Synergids
Diploid: Anther, Sporogenous tissue, Microspore mother cells, Ovule, Integuments, Nucellus, Megaspore mother cells, Secondary nucleus, Zygote, Embryo, Perisperm, Scutellum
Triploid: Primary endosperm cell, endosperm

➢ **Pollination**

Transfer of pollen grain from anther to stigma is called pollination.
During pollination, stigma receives the pollen.



➢ **Types of pollination:**

i. **Autogamy:**

Transfer of pollen grains from anther to the stigma of same flower.

a. Chasmogamous flowers:
They have exposed anthers and stigma.

b. Cleistogamous flowers:

1. They do not open at all.
2. When anther dehisces in the flower bud, pollen grains come in contact with stigma and pollination occurs.
3. They are autogamous with no chance of cross pollination.
4. Produce assured seed set even in absence of pollinators.

Chasmogamous and Cleistogamous flowers are produced by plants such as *Viola* (common pansy), *Oxalis* and *Commelina*.

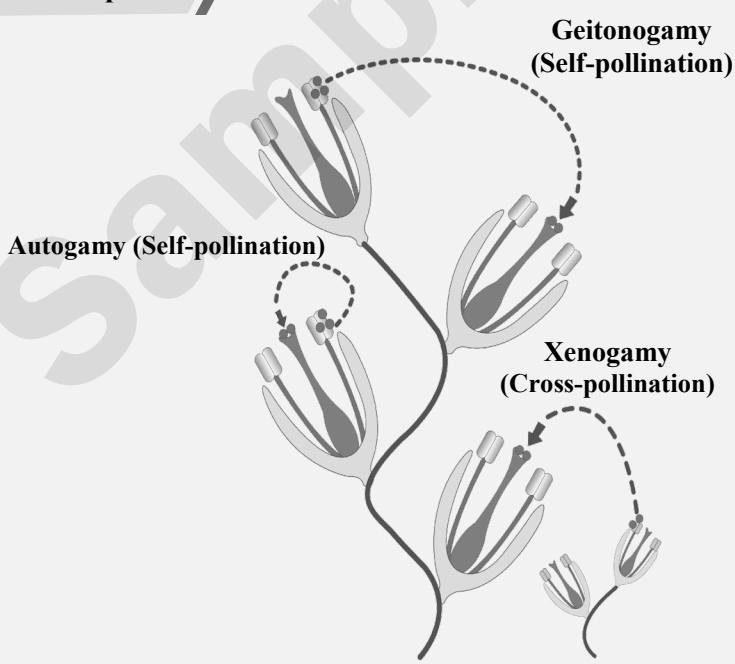
ii. **Geitonogamy**

Transfer of pollen grains from anther to the stigma of another flower produced on same plant.
Geitonogamy is functionally cross-pollination which involves a pollinating agent.
Genetically it is similar to autogamy as the pollen grains come from the same plant.

iii. **Xenogamy**

Transfer of pollen grains from anther to the stigma of another flower produced on a different plant belonging to the same species.
This type of pollination brings genetically different types of pollen grains to the stigma.

Smart tip - 4



Diagrammatic representation of autogamy, geitonogamy and xenogamy

➢ **Agencies of pollination:**

i. **Abiotic agents :** Wind and water

ii. **Biotic agents (Animals):** Insects and birds

For your knowledge

- **Anemophily:** The transfer of pollen grains through wind is called as anemophily.
- **Hydrophily:** The transfer of pollen grains through the agency of water is called hydrophily.
  Two types of Hydrophily:
  a. **Hypohydrophily:** Pollination takes place below the water surface in submerged female flowers.
  b. **Epihydrophily:** Pollination occurs on the surface of water.
- **Entomophily:** Pollination through the agency of insects is called entomophily.

Abiotic agencies of pollination:

i. **Pollination by Wind:**

Pollen grains are transferred from anther of one flower to the stigma of another flower by wind. It is considered as the most primitive type of pollination.

Flowers pollinated by wind exhibit following characters:

a. These flowers are unisexual, inconspicuous, colourless, nectarless and odourless.
b. They produce very large quantity of dusty pollens because numerous pollen grains are wasted in this method. Pollen grains are light and non-sticky.
c. Long style of these flowers bear feathery, hairy, sticky and branched stigma to trap pollen grains.
d. Stamens are with versatile and exposed anthers.
e. Flowers pollinated by wind frequently have a single ovule in each ovary and numerous flowers packed into an inflorescence.
   e.g. Corn cob, grasses.

ii. **Pollination by water:**

Pollen grains are transferred from anther of one flower to the stigma of another flower by agency of water.

e.g. *Vallisneria, Hydrilla* (Fresh-water), *Zostera* (Marine)

In *Vallisneria*, female flower reaches the water surface by the long stalk and the pollen grains are released on to the surface of water. Some of the pollen grains reach the stigma of female flowers by water currents and thus pollination occurs.

In *Zostera*, female flowers remain submerged in water and pollination takes place inside the water.

Such flowers which are pollinated by water exhibit the following characters:

a. Pollen grains are ribbon-like.
b. They are protected from wetting by a mucilaginous covering.

CAUTION

Not all aquatic plants use water for pollination.

In aquatic plants like water hyacinth and water lily, flowers emerge above the water level and are pollinated by insects or wind.

➢ **Biotic agencies of pollination:**

A large number of flowering plants use a variety of animals as pollinating agents. Butterflies, bees, flies, beetles, wasps, moths, ants, birds (sunbirds and humming birds) and bats are the common pollinating agents.

i. Pollen grains are transferred from anther of one flower to the stigma of another flower by agency of insects is known as entomophily.

Entomophilous flowers exhibit following characters:

a. Entomophilous flowers are large, brightly coloured, produce pleasant fragrance and nectar.
b. The nectariferous glands secrete nectar for feeding the visiting insects. Nectariferous glands are positioned such that an insect must touch both the anthers and the stigmas to carry out pollination.
c. They have spiny exine and sticky stigma.
d. Floral rewards are usually nectar and pollen grain.
e. When an insect sits on the flowers for harvesting the floral rewards, its body comes in contact with the anthers and stigma.

f. Due to this, the body of the insect gets covered with the sticky pollen grains. When this insect comes in contact with a receptive stigma it brings about pollination.
e.g.
1. *Amorphophallus* → Tallest flower (6 feet in height) → provides floral rewards as safe place to lay eggs for insects.
2. Species of moth and *Yucca* plant → Both cannot complete their life cycles without each other. Moth deposits eggs in locule of ovary, flower gets pollinated by moth. Larvae of moth come out of the eggs as the seeds develop.
3. Pollen/nectar robbers → These are floral visitors (insect) which consume pollen or nectar without bringing about pollination.

ii. If the flowers are small, a number of flowers are clustered into an inflorescence to make them conspicuous.
iii. Animals such as some primates (lemurs), arboreal (tree-dwelling) rodents, or even reptiles (gecko lizard and garden lizard) have also been reported as pollinators in some species.

Outbreeding devices and pollen pistil interaction

➢ **Outbreeding devices for cross pollination:**
Many plants develop outbreeding devices to avoid self-pollination, as cross pollination is preferred by majority of flowering plants.

i. Pollen release and stigma receptivity not synchronised:
Pollen is released before stigma becomes receptive or stigma becomes receptive before pollen is released.

ii. Position of anther and stigma:
Both the anthers and stigma are placed at different positions so that pollen cannot come in contact with stigma of the same flower.
Both the above devices prevent autogamy.

iii. Production of unisexual flowers:

In monoecious[G] plants (e.g. Castor, maize), autogamy is prevented but not geitonogamy.

In dioecious[G] plants, both autogamy and geitonogamy are prevented. For e.g. Papaya.

iv. Self-incompatibility:
It is a phenomenon in which genetic mechanism of flower prevents the fusion of gametes of genetically similar plants. This is also called as self-sterility and intraspecific incompatibility.

➢ **Pollen pistil interaction:**

i. All the events from deposition of pollen grain on the stigma to the entry of pollen tube in the ovule are referred to as pollen pistil interaction.
ii. In cross pollination, there are chances that wrong type of pollen grains may fall on stigma. If wrong type of pollen grain falls on the stigma, post pollination development in the pollen grain does not take place. Stigma recognizes only the right type of pollen grain.
iii. Generally, only one pollen tube is formed from a pollen grain (monosiphonous). However, more than one pollen tube may be produced from a pollen grain (polysiphonous).
iv. In self-incompatible pollen grain, some factors on exine may produce rejection response on stigmatic surface.
v. The pistil is adequately equipped with devices to allow the pollen of only right type to function normally, others are discarded.
vi. After reaching the ovary, pollen tube enters the ovule through the micropyle and then enters one of the synergids through the filiform apparatus and bursts to release male gametophyte. All these events are part of pollen – pistil interaction.
vii. Incompatibility is the inability of functional male and female gametes to effect fertilization in particular combinations. Incompatibility operates between species (interspecific) as well as within species (intraspecific).

➢ **Artificial hybridization** → Essential for crop improvement programme.
In crossing experiments, emasculation and bagging are used to prevent contamination of stigma with unwanted pollen.
Emasculation → Removal of anther from the flower bud if the parent plant bears bisexual flowers.
Bagging → Emasculated flowers are covered with a bag of suitable size, generally made of butter paper to prevent contamination of stigma by unwanted pollen. When the stigma of bagged flower becomes receptive, mature pollen grains are collected from anthers of the male flower and dusted on the stigma. Such flowers are then rebagged till the fruits develop.
Emasculation is not needed if the female parent bears unisexual flowers.

Students can scan the Q.R. code in Quill - The Padhai App to get information about ***Emasculation and Bagging.***

DOUBLE FERTILIZATION

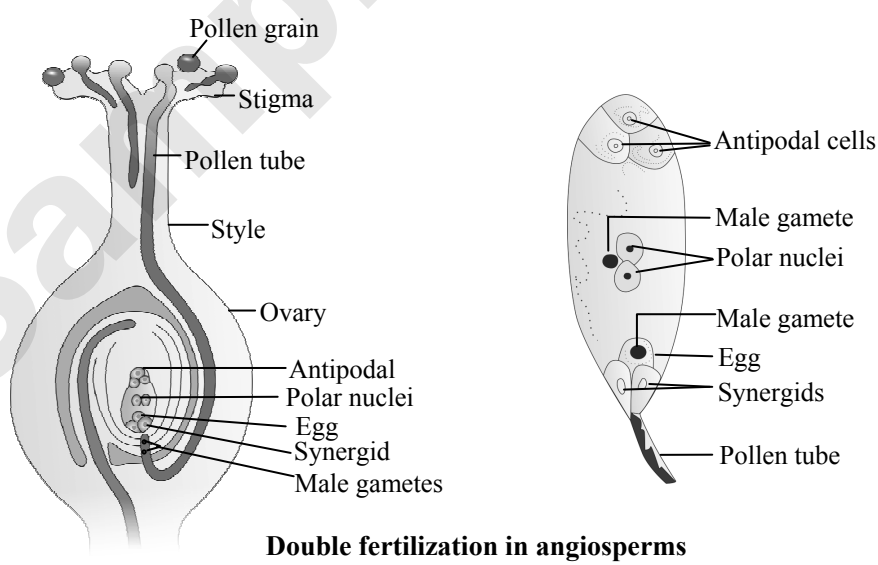
The fusion of one male gamete with egg and that of another male gamete with two polar nuclei (secondary nucleus) is called as **double fertilization**. It is the characteristic feature of angiosperms.
It consists of two processes:

i. Syngamy:
It is a fusion of first male gamete with egg. It results in diploid zygote which develops to form embryo.

ii. Triple Fusion:
It is a fusion of second male gamete with two polar nuclei (secondary nucleus). It results in formation of triploid PEN (Primary Endosperm Nucleus) which develops to form endosperm.
Since both male gametes participate in fertilization, it is called double fertilization.

➢ **Process of double fertilization is described as follows:**

i. After pollination, the intine of the pollen grain forms pollen tube and passes through the germ pore.
ii. The pollen tube with two male gametes and tube nucleus runs through the style and finally turns towards the micropylar end of the ovule in the cavity of the ovary.
iii. On piercing the nucellus, the pollen tube penetrates the embryo sac and reaches the egg apparatus passing either between the egg and synergids or between one synergid and wall of embryo sac.
iv. Ultimately, the tip of the pollen tube bursts and two male gametes are discharged.
v. One of these male gametes fuses with the egg cell or oosphere causing fertilization, as a result of which diploid oospore or zygote is formed. This is called as **first fertilization or syngamy.**
vi. The other male gamete fuses with the two polar nuclei (secondary nucleus) forming the triploid endosperm nucleus which later on gives rise to endosperm. This is called as **triple fusion or second fertilization.**
vii. Thus, this process of fertilization which occurs twice in the same embryo sac at a time by two male gametes (syngamy and triple fusion) is called **double fertilization.**



Double fertilization in angiosperms

Students can scan the Q.R. code in Quill - The Padhai App to get information about ***Double fertilization.***

Post Fertilization: Structures and Events

Post fertilization events include development of embryo and endosperm, maturation of ovules into seeds and ovary into fruit.

i. Development of endosperm:

It is a nutritive tissue produced by fusion of secondary nucleus with a male gamete. It provides nutrition to the growing embryo.

Free Nuclear Endosperm:

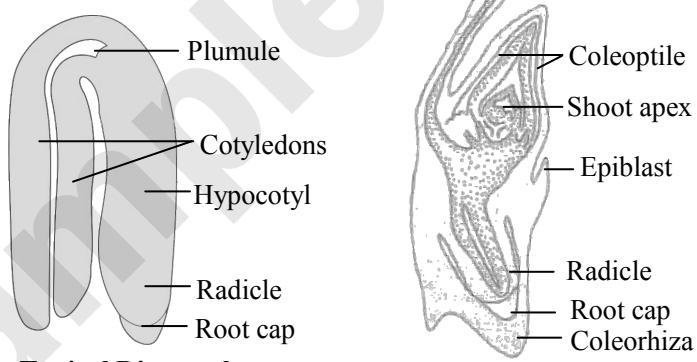
a. PEN undergoes successive nuclear divisions to form free nuclei.
b. Subsequently, cell wall formation takes place and the endosperm becomes cellular.
c. Coconut water from tender coconut is a free-nuclear endosperm (made up of thousands of nuclei) and the surrounding white kernel is cellular endosperm.

Endospermic Seed → Endosperm persists in mature seed. It is used up during seed germination.
e.g. Castor, coconut

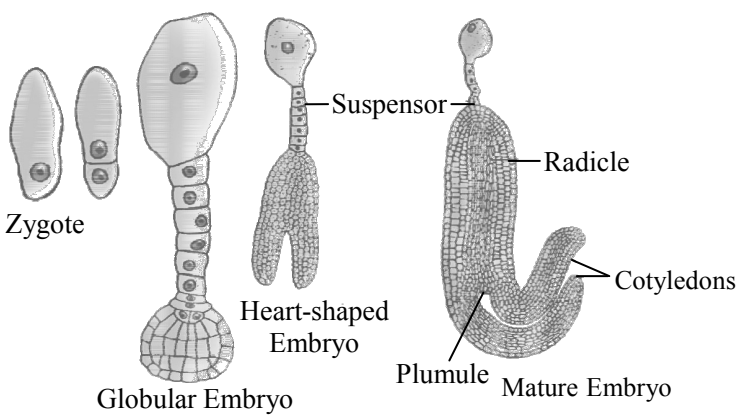
Non-endospermic Seed → Endosperm is completely used up by the developing embryo.
e.g. Pea, groundnut, bean.

ii. Development of embryo:

a. Embryo develops at the micropylar end of embryo sac where zygote is present.
b. Most zygotes divide only after certain amount of endosperm is formed to assure nutrition to the developing embryo.
c. The early stages of embryo development (embryogeny) are similar in both monocotyledons and dicotyledons.
d. Stages of embryo development: zygote → proembryo → globular, heart-shaped and mature embryo.
e. A typical dicot embryo consists of embryonal axis and two cotyledons.
f. **Epicotyl** → Part of embryonal axis above the level of cotyledons. It terminates with **plumule (stem tip).**
g. **Hypocotyl** → Part of embryonal axis below the level of cotyledons. It terminates in **radicle (root tip).**
h. Root cap covers the root tip.
i. Embryos of monocot plants (e.g. grass family) have only one cotyledon called **scutellum** situated towards one side (lateral) of the embryonal axis.
j. Coleorrhiza covers the radicle and root cap, while coleoptile encloses few leaf primordia in monocots.



Typical Dicot embryo **L.S. of Monocot embryo**



Development of Dicot embryo

iii. Development of seed:

A seed is a ripened fertilized ovule. A seed typically consists of seed coat(s), cotyledon(s) and an embryo axis. Depending upon presence and absence of endosperm, seeds are of two types:

a. Endospermic or albuminous seeds:

These seeds possess endosperm. e.g. maize, rice, castor, wheat, etc.

Generally, monocot seeds are endospermic or albuminous.

In some seeds (e.g. black pepper, beet), remnants of nucellus are persistent (**perisperm**).

b. Non-endospermic or ex-albuminous seeds:

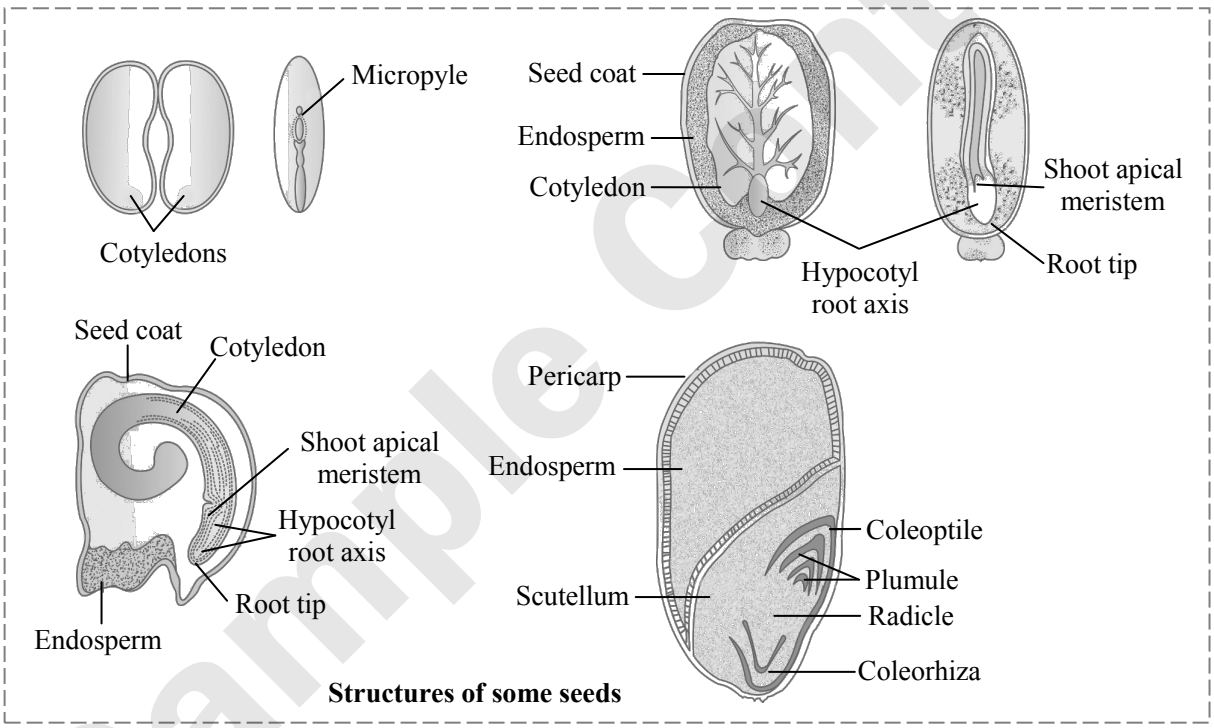
These seeds do not have endosperm as it is completely consumed during embryo development. e.g. Pea, beans, groundnut, mustard, etc.

Generally, dicot seeds are non-endospermic.

In non-endospermic or ex-albuminous seeds, cotyledons are thick and fleshy as they store the food.

CAUTION

Though castor is a dicot seed, it is endospermic.



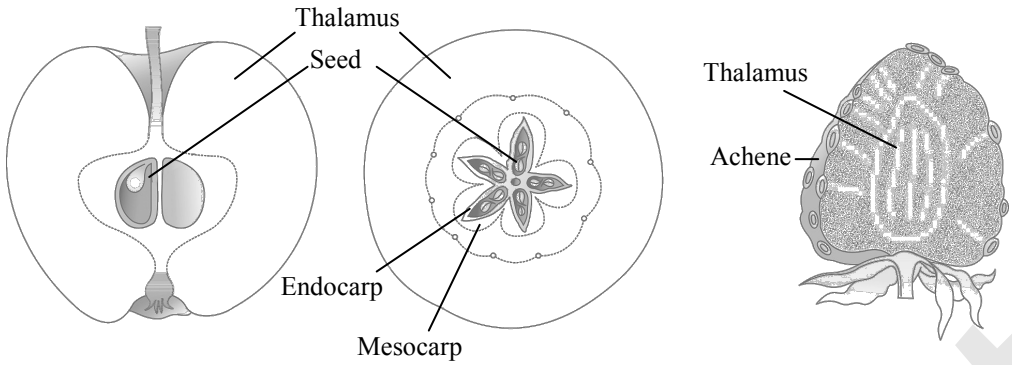
Structures of some seeds

Smart tip - 5

Endospermic seed→Albuminous seeds→Possess endosperm→Monocot seeds
e.g. Maize, rice, wheat, castor (dicot)
Non-endospermic seed→Ex-albuminous seeds→Do not possess endosperm→Dicot seeds
e.g. Pea, beans, groundnut, mustard

iv. Development of fruit:

a. A fruit is regarded as a mature or ripened ovary.
b. Ovary wall develops to form an outer covering known as **pericarp** which consists of **epicarp**, **mesocarp** and **endocarp**.
c. A true fruit is one which develops from a single ovary of a single flower. e.g. mango
d. A false fruit is one when other floral parts (e.g. thalamus) also take part in the formation of fruit. e.g. apple, strawberry, cashew.



False fruits (Apple and Strawberry)

Parthenocarpy:

In this, fruits are developed without fertilization. Hence, fruits are seedless. e.g. Banana

Parthenocarpy can be induced through application of growth hormones like gibberellins, e.g. seedless grapes.

v. Post fertilization changes:

a. Ovule (megasporangium) forms seed.
b. Ovary (carpel) forms fruit.
c. Egg cells forms embryo.
d. Nucellus forms perisperm.
e. Secondary nucleus forms endosperm.
f. Outer integument forms testa (outer seed coat)
g. Inner integument forms tegmen (inner seed coat)
h. Micropyle forms an opening in the seed (i.e. micropyle)

➢ **Significance of seed and fruit formation:**

The distribution and dominance of angiosperms on the earth is due to seeds. Success of seeds as propagule is due to the following characteristics:

i. Dormancy:

It is the temporary suspension of growth. One of the factors which control dormancy is presence of certain growth inhibitors in the seeds which prevent germination. During this period, seeds are dispersed at different places.

ii. Viability:

It is the functional ability of seeds to germinate after considerable dormancy period. Germination can be delayed till the onset of favourable conditions.

It was found that seeds of *Lupinus arcticus (Lupine)* excavated from Arctic Tundra germinated and flowered after an estimated record of 10,000 years of dormancy.

Recently 2000 years old viable seed is of the date palm, *Phoenix dactylifera* discovered during the archeological excavation at King Herod's palace near the Dead Sea.

iii. Reserve food:

Fully developed embryo is nourished by food stored in either endosperm or cotyledons during germination of seed and a seedling is produced.

iv. Protective coat:

The outer, hard seed coat i.e. testa gives protection against the mechanical shocks, fluctuations in temperature and dry conditions. Animals eat fruits and either throw away seeds or if consumed, they are not digested due to the hard seed coat and are removed through excreta.

v. Dispersal:

Some seeds produce various structures like wings, pappus calyx (persistent and hairy), hooks or sticky substances, and seeds are actively or passively transported to distant places.

vi. Edible fruits:

Many fruits are consumed by different organisms and seeds are thrown.

Thus, development of fruits and seeds play a significant role in the spread of the species.

Apomixis and Polyembryony

i. Apomixis:

Apomixis is an asexual mode of reproduction in which new individuals are formed without formation of gametes and their fusion.

It is a form of asexual reproduction that mimics sexual reproduction.

It is commonly seen in grasses and plants of family Asteraceae.

Seeds formed by the process of apomixis are called apomictic seeds.

Apomictic seeds have several advantages in agriculture and horticulture.

Apomictic seeds are formed by following methods:

a. In some species, diploid egg cell is formed without meiosis and develops into embryo without fertilization.
b. In many Citrus and Mango varieties, some nucellar cells which surround the embryo sac start dividing, protrude into the embryo sac and develop into embryos.

ii. Polyembryony:

It is the presence of more than one embryo in a seed.

It was first observed by Leeuwenhoek (1719) in citrus.

It is common in lemon, orange, onion, mango, groundnut, etc.

Hybrid seeds:

There has been extensive cultivation of hybrid varieties of many food and vegetable crops which we eat.

Cultivation of hybrids ⟶ Increased productivity.

Drawback of hybrids ⟶ Hybrid seeds have to be produced every year.

If seeds collected from hybrids are sown, the characters in the progeny will segregate. They do not maintain hybrid characters.

Production of hybrid seed is expensive, hence becomes too costly for farmers.

If hybrids are made into apomicts, then there will be no segregation of characters in the hybrid progeny.

Then, farmers can use hybrid seeds to raise new crop year after year, without buying hybrid seeds every year.

Active research is being carried out across the world in many laboratories to understand the genetics of apomixis and for transferring apomictic genes into hybrids varieties.

Glossary

Word	Meaning
Dioecious plant	It denotes the unisexual condition→ both male and female flowers may be present on the different plants
Germ Pore	A pore/pit/thin area on pollen grain through which germ tube exits upon germination.
Microspore tetrad	Microspores are arranged in a cluster of four cells.
Monoecious plant	It denotes the bisexual condition→ both male and female flowers may be present on the same plant

Quick Review

SEXUAL REPRODUCTION IN FLOWERING PLANTS

It is the process of development of new plants by the fusion of male and female gametes.

Flower

It is a condensed modified shoot specialized for sexual reproduction in plants.

Androecium

- It is the male reproductive whorl of a flower.
- It is made up of stamens.
- **Stamens** → Filament, Anther

Microsporangium

- The bilobed anther has 4 pollen sacs (Microsporangium).
- Each diploid microspore mother cell (2n) divides meiotically to form four haploid microspores (n) or pollen grains.

Male gametophyte

- The protoplast of pollen grain divides mitotically to form two unequal cells – a small generative cell and large vegetative (tube) cell.
- This is the 2-celled male gametophyte.
- Further development is completed on the stigma after pollination.

Pollination

- It is the transfer of pollen grains (2-celled stage) from anther to the stigma of a flower by means of pollinating agencies.
- **Two types** → Self-pollination (Autogamy), Cross pollination (Allogamy)
- **Various pollinating agencies** → Wind (Anemophily), Water (Hydrophily), Insects (Entomophily).

Post-fertilization changes

After fertilization, a series of changes take place inside the ovule.

- Ovule (Megasporangium) → Seed
- Ovary (Carpel) → Fruit
- Egg cell → Embryo
- Secondary nucleus → Endosperm
- Ovary wall → Pericarp
- Outer integument → Testa
- Inner integument → Tegmen

Gynoecium

- It is the female reproductive whorl.
- It is made up of carpels.
- **Carpels** → Ovary, Style, Stigma

Megasporangium

- Ovule is the integumented megasporangium.
- One of the archesporial cells acts as megaspore mother cell and undergoes meiosis to form 4 haploid megaspores.
- Out of these, upper 3 (towards micropylar end) degenerate and only the basal one (towards chalazal end) remains functional.

Female gametophyte

- The functional megaspore undergoes three successive mitotic divisions to form 8-nucleated (7-celled) female gametophyte.
- 2 Synergids, 1 Egg cell, 1 Secondary nucleus, 3 Antipodal cells → Female gametophyte.

Fertilization

- After pollination, pollen grains germinate on the stigma.
- Intine of the pollen grain comes out to form the pollen tube through the germ pore.
- Generative cell of pollen grain divides by mitosis to form, 2 haploid male gametes.
- The pollen tube enters the embryo sac.
- The two haploid non-motile male gametes are brought upto the female gametophyte by means of pollen tube (Siphonogamy).
- The pollen tube burst inside the embryo sac releasing the two male gametes.
- One male gamete (n) fuses with the egg (n) to form diploid zygote (2n) → 1st Fertilization (Syngamy)
- Other male gamete (n) fuses with secondary nucleus (2n) to form Primary Endospermic Nucleus (3n) → 2nd Fertilization (Triple fusion).
- Double fertilization = Syngamy + Triple fusion.

Multiple Choice Questions

Flower – A Fascinating Organ of Angiosperms

1. Flower is a highly modified and condensed reproductive shoot specially meant for
   (A) vegetative reproduction
   (B) sexual reproduction
   (C) asexual reproduction
   (D) parthenocarpic reproduction

2. Androecium is made up of
   (A) stamens (B) ovules
   (C) style (D) anther whorl

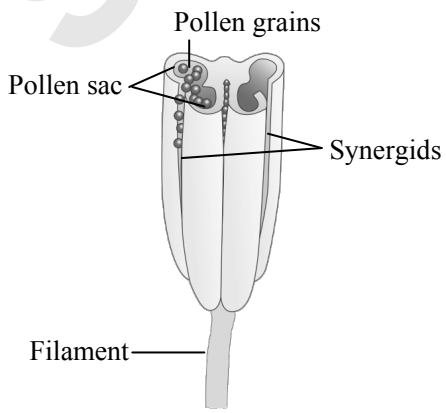
3. Find out the odd one.
   (A) Stamen (B) Carpel
   (C) Anther (D) Filament

4. Among the terms listed below, those that of are not technically correct names for a floral whorl are
   i. Androecium ii. Carpel
   iii. Corolla iv. Sepal
   [NCERT Exemplar]
   (A) i and iv (B) iii and iv
   (C) ii and iv (D) i and ii

5. **Assertion:** In Angiosperms, flowers are the units of sexual reproduction.
   Reason: The male and female reproductive structures are found in the flower.
   (A) Both assertion and reason are true and reason is the correct explanation of assertion.
   (B) Both assertion and reason are true but reason is not the correct explanation of assertion.
   (C) Assertion is true but reason is false.
   (D) Both assertion and reason are false.

Pre-fertilization: Structures and Events

1. Identify the INCORRECTLY labelled part in the given figure of an anther.



   (A) Filament (B) Pollen sac
   (C) Pollen grains (D) Synergids

2. Fertile part of stamen is
   (A) filament (B) anther
   (C) connective (D) both (B) and (C)

3. Proximal end of the filament of stamen is attached to the **[NEET (UG) P-I 2016]**
   (A) placenta
   (B) thalamus or petal
   (C) anther
   (D) connective

4. Anthers are
   (A) externally tetralocular
   (B) internally tetralocular
   (C) externally and internally trilocular
   (D) internally bilobed

5. Dithecous anthers are
   (A) bisporangiate
   (B) monosporangiate
   (C) trisporangiate
   (D) tetrasporangiate

6. Outermost layer of anther wall is made up of
   (A) epidermis
   (B) middle layers
   (C) endothecium and tapetum
   (D) sporogenous tissue

7. Endothecium layer of anther lobes is present
   (A) outside the epidermis
   (B) inner to the epidermis
   (C) in the innermost region
   (D) in the middle region

8. The outermost and innermost wall layers of microsporangium in an anther are respectively **[NCERT Exemplar]**
   (A) endothecium and tapetum
   (B) epidermis and endodermis
   (C) epidermis and middle layer
   (D) epidermis and tapetum

9. The position of the middle layer in the transverse section of a young anther is between
   (A) epidermis and endothecium
   (B) endothecium and tapetum
   (C) tapetum and sporogenous tissue
   (D) cells of sporogenous tissue

10. Generally in the wall of the anther lobes, how many middle layers are present?
    (A) Seven to ten (B) One to three
    (C) Six to seven (D) Nine to twelve

11. Tapetum is a part of
    (A) male gametophyte
    (B) female gametophyte
    (C) ovary wall
    (D) anther wall

12. Which of the following is a function of the innermost layer of pollen sac?
(A) It helps in dehiscence of anther.
(B) It provides mechanical support to anther.
(C) It is protective in nature.
(D) It nourishes the developing pollen grains.

13. Which one of the following layer of the anther wall helps in its dehiscence? **[MHT CET 2017]**
(A) Epidermis (B) Middle layer
(C) Endothecium (D) Tapetum

14. Which one of the following statements is correct? **[NEET (UG) 2013]**
(A) Hard outer layer of pollen is called intine
(B) Sporogenous tissue is haploid
(C) Endothecium produces the microspores
(D) Tapetum nourishes the developing pollen

15. What happens to tapetum on maturity?
(A) It persists.
(B) It becomes sticky.
(C) It degenerates.
(D) It becomes fibrous.

16. Pollen grain develops from _____ of anther. **[MH CET 2015]**
(A) epidermis
(B) endothecium
(C) tapetum
(D) sporogenous tissue

17. Development and formation of pollen grains in anther of the stamen is known as
(A) pollination
(B) fertilization
(C) microsporogenesis
(D) megasporogenesis

18. During microsporogenesis, meiosis occurs in **[NCERT Exemplar]**
(A) endothecium
(B) microspore mother cells
(C) microspore tetrads
(D) pollen grains

19. The development of male gametes in the pollen grains in angiosperms involves **[MHT CET 2018]**
(A) only one mitotic division
(B) two mitotic divisions
(C) both mitotic and meiotic divisions
(D) only one meiotic divisions

20. In angiosperms, the formation of two male gametes from a pollen grain involves _____ divisions. **[MH CET 2014]**
(A) one meiotic and one mitotic
(B) two meiotic and two mitotic
(C) only two mitotic
(D) only two meiotic

21. **Assertion:** Pollen Mother Cells (PMCs) are haploid.
Reason: PMCs divide by meiosis to produce two haploid microspores.
(A) Both assertion and reason are true and reason is the correct explanation of assertion.
(B) Both assertion and reason are true but reason is not the correct explanation of assertion.
(C) Assertion is true but reason is false.
(D) Both assertion and reason are false.

22. 250 microsporocytes will give rise to _____ microspores.
(A) 250 (B) 500
(C) 1000 (D) 2500

23. How many pollen grains are formed from 10 microspore mother cells by meiosis?
(A) 80 (B) 40 (C) 20 (D) 10

24. If there are 1280 microspores in a tetrasporangiate anther, how many microspore mother cells will be there in its each pollen chamber? **[MH CET 2015]**
(A) 80 (B) 160
(C) 240 (D) 1280

25. In a somatic cell, there are 16 chromosomes. What will be the number of chromosomes in the pollen mother cell of the plant?
(A) 16 (B) 8
(C) 24 (D) 32

26. In a dithecous anther, each pollen sac contains 1000 MMC. What is the total number of pollen-grains produced by the anther? **[KCET 2016]**
(A) 16,000 (B) 4,000
(C) 32,000 (D) 8,000

27. A total of 168 pollen grains with 14 chromosomes in each pollen grain are released from a mature microsporangium. Mention the correct ratio of pollen mother cells, generative cells, vegetative cells and male gametes produced by the microsporangium. **[AP EAM CET 2019]**
(A) 1:1:1:4 (B) 1:2:1:4
(C) 1:4:4:8 (D) 2:1:1:4

28. Pollen grains are formed in
(A) anther (B) stigma
(C) filament (D) pollen sac

29. Pollen grains are generally spherical measuring about **[KCET 2017]**
(A) 25-50 micrometers
(B) 25-50 millimeters
(C) 25-50 nanometers
(D) 25-50 centimeters

30. Each pollen grain formed by microsporogenesis is
(A) multicellular, binucleate, spherical structure
(B) unicellular, uninucleate, spherical or oval, haploid structure
(C) multicellular, uninucleate, oval, diploid structure
(D) unicellular, binucleate, spherical, haploid structure.

31. A thick, highly resistant outer layer of pollen wall is called
(A) exine (B) intine
(C) endothecium (D) tapetum

32. The exine of pollen grain is made up of [MHT CET 2018]
(A) chitin (B) cellulose
(C) sporopollenin (D) hemicellulose

33. During an excavation of soil, Pollen fossil were retrieved from deepest layer of soil. the pollen grains remained fossils because: [KCET 2020]
(A) The intine of pollen grains is made up of pectin.
(B) Exine has spiny Ornamentation.
(C) The exine of pollen grains is highly resistant to enzyme action.
(D) Pollen grains are asexual reproductive structures.

34. The intine of a pollen grain is made up of
(A) cellulose and pectin
(B) lipid and protein
(C) pectin and lignin
(D) lignin and cutin

35. The wall of pollen tube is made up of [MHT CET 2016]
(A) cellulose and pectin
(B) only sporopollenin
(C) lignin and pectin
(D) pectin and sporopollenin

36. The space inside the pollen grain from where the pollen tube emerges is
(A) micropyle (B) germ pore
(C) tapetum (D) sacs

37. In monocots, male gametophyte is
(A) microspore (B) megaspore
(C) tetrad (D) nucellus

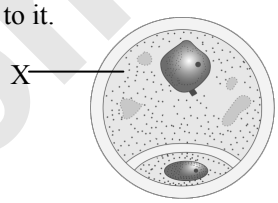
38. In the pollen grain before pollination, the smaller cell formed after mitotic division is called
(A) tube cell (B) generative cell
(C) vegetative cell (D) stalk cell

39. 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

40. **Assertion (A):** In some plants the generative cell divides and forms the two male gametes during pollen tube growth in stigma.
Reason (R): In plants which shed pollen in three cell stage, the pollen tube will have two male gametes from the beginning.
The correct option among the following is: [TS EAMCET 2021]
(A) A is true, R is true and R is the correct explanation for A
(B) A is true, R is true but R is not the correct explanation for A
(C) A is true but R is false
(D) A is false but R is true

41. In most of the angiosperms, 3-celled stage of the mature male gametophyte is reached
(A) before pollination
(B) after pollination
(C) during fertilization
(D) after fertilization

42. Identify X and select the correct option with respect to it.



(A) X is generative cell which floats in cytoplasm of vegetative cell
(B) X is vegetative cell which has abundant food reserve
(C) X is generative cell which further divides to form 2 male gametes
(D) X is male gamete which fuses with egg to form zygote

43. Male gametophyte in angiosperms produces [AIPMT Re-test 2015]
(A) three sperms
(B) two sperms and a vegetative cell
(C) single sperm and a vegetative cell
(D) single sperm and two vegetative cell

44. Which cell gives rise to two male gametes?
(A) Germ pore (B) Vegetative cell
(C) Generative cell (D) Tube cell

45. In angiosperms, a male gametophyte is developed from a pollen mother cell by _____. [MH CET 2019]
(A) one meiotic and two mitotic divisions
(B) two mitotic divisions
(C) one mitotic and two meiotic divisions
(D) a single meiotic division

46. Generative cell of a microspore undergoes which type of division?
(A) Mitosis (B) Meiosis
(C) Endomitosis (D) Either (A) or (C)

47. Haploids can be obtained from
(A) a pollen grains (B) root apex
(C) shoot apex (D) embryo

48. Among the following statements related to pollens, choose the correct one.
Statement I: In 40% of angiosperms pollen grains are shed at 3-celled stage.
Statement II: Intine is made of cellulose and pectin and it is discontinuous with germ pores.
[KCET 2018]
(A) Statement I is correct.
(B) Statement II is correct.
(C) Both statement I and statement II are Correct.
(D) Both statement I and statement II are Incorrect.

49. Pollen grains can be stored for several years in liquid nitrogen having a temperature of
[NEET (UG) 2018]
(A) –196°C (B) –80°C
(C) –120°C (D) –160°C

50. Pollen tablets are available in the market for
[AIPMT 2014]
(A) *In vitro* fertilization
(B) Breeding programmes
(C) Supplementing food
(D) *Ex situ* conservation

51. In which of the following sets of families, the pollen grains are viable for months?
[NEET (UG) Manipur 2023]
(A) Rosaceae, Liliaceae and Poaceae
(B) Leguminosae, Solanaceae and Rosaceae
(C) Solanaceae, Poaceae and Liliaceae
(D) Brassicaceae, Liliaceae and Poaceae

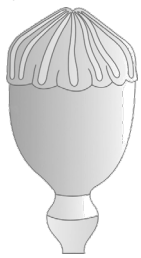
52. Study the following statements:
(I) Pollen grains of many species cause severe allergies and bronchial afflictions in some people often leading to chronic respiratory disorders.
(II) Pollen grains are rich in nutrients.
(III) Carrot grass has come into India as a contaminant with imported rice. **[GUJ CET 2021]**
(A) Statement I and III are correct, but statement II is incorrect.
(B) All statements are incorrect
(C) Statements I and II are correct but statement III is incorrect
(D) All given statements are correct

53. Which of the following statements is NOT correct? **[NEET (UG) P-I 2016]**
(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 pollen or nectar without bringing about pollination are called pollen/nectar robbers

54. In a flowering plant, the largest number of haploid cells occurs in
(A) ovule (B) microsporangia
(C) root tip (D) cambium

55. Which one of the following statements is NOT true? **[AIPMT 2015]**
(A) Pollen grains are rich in nutrients, and they are used in the form of tablets and syrups.
(B) Pollen grains of some plants cause severe allergies and bronchial afflictions in some people.
(C) The flowers pollinated by flies and bats secrete foul odour to attract them.
(D) Honey is made by bees by digesting pollen collected from flowers.

56. The diagram given below represents _____ type of ovary.



(A) Multicarpellary apocarpous
(B) Multicarpellary syncarpous
(C) Unicarpellary apocarpous
(D) Unicarpellary syncarpous

57. The ovule of an angiosperm is technically equivalent to **[NEET (UG) P-II 2016]**
(A) megaspore
(B) megasporangium
(C) megasporophyll
(D) megaspore mother cell

58. The stalk of ovule is called
(A) pedicel (B) petiole
(C) funicle (D) hilum

59. The base of the ovule is called
(A) chalaza (B) raphae
(C) micropyle (D) placenta

60. The narrow opening of integuments at the terminal end of nucellus is called
(A) funicle (B) embryo sac
(C) micropyle (D) chalaza

61. The point of attachment of funicle with chalazal end is called
(A) placenta (B) integument
(C) nucellus (D) hilum

62. The body of the ovule is fused within the funicle at: **[NEET (UG) P-I 2020]**
(A) Micropyle (B) Nucellus
(C) Chalaza (D) Hilum

63. Placenta is the point of attachment of
(A) filament with anther
(B) flower to thalamus
(C) ovules to the ovary
(D) style to the ovary

64. Nucellus is a mass of thin walled parenchymatous cells in the ovule. It is
(A) n (B) 2n (C) 3n (D) 4n

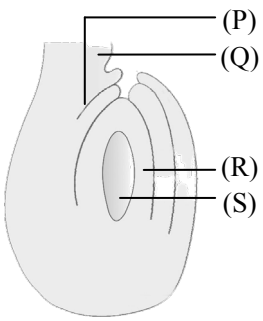
65. The megasporangium proper of an angiosperm ovule is represented by **[MHT CET 2017]**
(A) integument (B) funicle
(C) nucellus (D) micropyle

66. Find the ODD one.
(A) Micropyle (B) Embryo sac
(C) Nucellus (D) Pollen grain

67. From among the sets of terms given below, identify those that are associated with the gynoecium. **[NCERT Exemplar]**
(A) Stigma, ovule, embryo sac, placenta
(B) Thalamus, pistil, style, ovule
(C) Ovule, ovary, embryo sac, tapetum
(D) Ovule, stamen, ovary, embryo sac

68. Which of the following statement is WRONG about integument?
(A) It gives protection to nucellus and embryo sac.
(B) After fertilization it gets converted into seed coats.
(C) It provides nutrition to the embryo sac.
(D) It is absent at micropyle.

69. In the diagram of anatropous ovule given below, four parts (P, Q, R, S) have been marked. Identify the part which has abundant reserve food materials.



(A) P (B) Q (C) R (D) S

70. Formation of megaspores is called as
(A) microsporogenesis
(B) megasporogenesis
(C) porogamy
(D) chalazogamy

71. In a flower, if the megaspore mother cell forms megaspores without undergoing meiosis and if one of the megaspores develops into an embryo sac, its nuclei would be **[NCERT Exemplar]**
(A) haploid
(B) diploid
(C) a few haploid and a few diploid
(D) with varying ploidy

72. A linear tetrad of 4-cells lying in an axial row is formed during the development of
(A) embryo sac (B) ovary
(C) pollen grains (D) ovule

73. Identify the CORRECT statement. **[KCET 2021]**
(A) Only megaspore present towards chalazal end functional
(B) 3 megaspores present towards chalazal end degenerate gradually.
(C) Each megaspore mother cell, directly develops into a megaspore.
(D) Each female gametophyte is 7–celled & 7–nucleated structure.

74. In angiosperms, megaspores formed after meiosis of megaspore mother cell are arranged in _____ **[MHT CET 2016]**
(A) Isobilateral tetrad (B) Linear tetrad
(C) Tetrahedral tetrad (D) T-shaped tetrad

75. In angiosperms the correct sequence of events in formation of female gametophyte in the ovule is
i. 3 successive free nuclear divisions in functional megaspores.
ii. Degeneration of 3 megaspores.
iii. Meiotic division in megaspore mother cell.
iv. Migration of 3 nuclei towards each pole.
v. Formation of wall resulting in seven celled embryo sac.
Choose the **correct** answer from the options given below: **[NEET (UG) Manipur 2023]**
(A) ii, iii, i, iv, v (B) iii, ii, i, iv, v
(C) i, ii, iii, iv, v (D) iii, v, i, iv, ii

76. The haploid cell which divides by mitosis to form embryo sac is
(A) megaspore mother cell
(B) microspore mother cell
(C) functional megaspore
(D) non-functional megaspore

77. Which of the following is the first cell of female gametophytic generation in Angiosperms? **[MHT CET 2016]**
(A) Megaspore mother cell
(B) Microspore mother cell
(C) Functional megaspore
(D) Egg cell

78. Functional megaspore in an angiosperm develops into **[NEET (UG) 2017]**
(A) ovule (B) endosperm
(C) embryo sac (D) embryo

79. Embryo sac is
(A) megasporangium
(B) megaspore
(C) female gametophyte
(D) female gamete

80. Secondary nucleus is formed by fusion of
(A) two haploid nuclei
(B) one diploid and one triploid nuclei
(C) two diploid nuclei
(D) one haploid nuclei and one diploid nuclei

81. In a mature embryo sac, antipodal cells are present towards the
(A) micropylar region (B) chalazal region
(C) the egg (D) central cell

82. In a female gametophyte egg apparatus consists of
(A) egg
(B) egg and synergids
(C) egg and polar nuclei
(D) egg and antipodal cell

83. Which of the following pairs of plant parts are haploid?
(A) Nucellus and antipodals
(B) Antipodal and egg cell
(C) Antipodals and megaspore mother cell
(D) Nucellus and primary endosperm nucleus

84. Egg in female gametophyte is accompanied by **[WB JEEM 2015]**
(A) antipodal cells (B) synergids
(C) definitive nucleus (D) tube nucleus

85. Which of the following in embryo sac of angiosperms shows filiform apparatus? **[MHT CET 2016]**
(A) Antipodals (B) Polar nuclei
(C) Egg (D) Synergids

86. Filiform apparatus is characteristic feature of **[AIPMT Re-test 2015]**
(A) synergids (B) generative cell
(C) nucellar embryo (D) aleurone cell

87. Through which cell of the embryo sac, does the pollen tube enter the embryo sac?
(A) Egg cell
(B) Central cell
(C) Persistent synergid
(D) Degenerated synergid

88. Filiform apparatus is located at
(A) tip of microsporangium
(B) tip of the filament
(C) tip of megasporangium
(D) pericarp

89. Function of filiform apparatus is to **[AIPMT 2014]**
(A) Recognize the suitable pollen at stigma.
(B) Stimulate division of generative cell.
(C) Produce nectar.
(D) Guide the entry of pollen tube

90. In embryo sac, the cells that degenerate after fertilization are **[NCERT Exemplar]**
(A) synergids and primary endosperm cell
(B) synergids and antipodals
(C) antipodals and primary endosperm cell
(D) egg and antipodals

91. The number of synergids and antipodals present in a typical angiosperm embryo sac at maturity respectively are **[TS EAMCET 2017]**
(A) two and three (B) one and three
(C) three and two (D) one and two

92. A typical angiospermic embryo sac is
(A) bisporic eight–nucleate
(B) monosporic four–nucleate
(C) tetrasporic sixteen–nucleate
(D) monosporic eight–nucleate

93. Which is the most common type of embryo sac in angiosperms? **[NEET (UG) Odisha 2019]**
(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

94. 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

95. The pollen grain is related to the embryo sac as
(A) male gametophyte is to the egg
(B) male gametophyte is to the female gametophyte
(C) sperm is to the egg
(D) sperm is to the female gametophyte

96. A typical angiosperm embryo sac at maturity is: **[NEET (UG) 2021]**
(A) 8-nucleate and 8-celled
(B) 8-nucleate and 7-celled
(C) 7-nucleate and 8-celled
(D) 7-nucleate and 7-celled

97. How many meiotic and mitotic divisions are required to produce mature female gametophyte from megaspore mother cell?
(A) One meiosis, one mitosis
(B) One meiosis, two mitosis
(C) One meiosis, three mitosis
(D) Only three mitosis

98. The female gametophyte of an angiosperm is represented by three successive divisions of megaspore to form
(A) nucellus (B) embryo sac
(C) endosperm (D) antipodals

99. From the statements given below choose the option that is true for a typical female gametophyte of a flowering plant.
i. It is 8-nucleate and 7-celled at maturity.
ii. It is free-nuclear during the development.
iii. It is situated inside the integument but outside the nucellus.
iv. It has an egg apparatus situated at the chalazal end. **[NCERT Exemplar]**
(A) i and iv (B) ii and iii
(C) i and ii (D) ii and iv

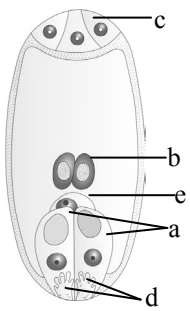
100. In an embryo sac of a typical angiosperm, there are
(A) egg, synergids and antipodals
(B) egg, synergids, polar nuclei and antipodals
(C) egg, synergids, central cell and polar nuclei
(D) egg, synergids and secondary cell

101. Starting from the innermost part, the correct sequence of parts in an ovule are **[NCERT Exemplar]**
(A) egg, nucellus, embryo sac, integument
(B) egg, embryo sac, nucellus, integument
(C) embryo sac, nucellus, integument, egg
(D) egg, integument, embryo sac, nucellus

102. How many megaspore mother cells are required to produce 100 eggs?
(A) 100 (B) 50 (C) 25 (D) 75

103. If the number of chromosomes in root cells is 14, what will be the number of chromosomes in synergids of an ovule of that parent?
(A) 7 (B) 14 (C) 21 (D) 28

104. In the diagram given below, parts labelled as 'a', 'b', 'c', 'd' and 'e' are respectively identified as
(A) Polar nuclei, filiform apparatus, antipodals, synergids, egg
(B) Polar nuclei, egg, antipodals, filiform apparatus, synergids
(C) synergids, Eggs, filiform apparatus, antipodals, polar nuclei
(D) Synergids, polar nuclei, antipodals, filiform apparatus, egg



105. Embryo sac is called monosporic when it develops from
(A) all the four megaspores
(B) only from two functional megaspores
(C) three megaspores of same size
(D) one of the functional megaspore out of the four megaspores

106. Which of the following is NOT haploid?
(A) Synergid
(B) Secondary nucleus
(C) Antipodal cells
(D) Egg cell

107. In angiosperm, the haploid, diploid and triploid structures of a fertilized embryo sac sequentially are: **[NCERT Exemplar; NEET (UG) 2023]**
(A) Antipodals, synergids, and primary endosperm nucleus
(B) Synergids, Zygote and Primary endosperm nucleus
(C) Synergids, antipodals and Polar nuclei
(D) Synergids, Primary endosperm nucleus and zygote

108. In majority of angiosperms **[NEET (UG) P-II 2016]**
(A) a small central cell is present in the embryo sac
(B) egg has a filiform apparatus
(C) there are numerous antipodal cells
(D) reduction division occurs in the megaspore mother cells

109. In angiosperms, microsporogenesis and megasporogenesis **[AIPMT Re-test 2015]**
(A) occur in ovule
(B) occur in anther
(C) form gametes without further divisions
(D) involve meiosis

110. Pollination is _____ **[AP EAPCET 2021]**
(A) transfer of gametes on stigma
(B) transfer of male gametes on stigma
(C) transfer of female gametes on stigma
(D) fusion of male and female gametes

111. Part of gynoecium which receives the pollen is called
(A) stigma (B) style
(C) ovule (D) ovary

112. Pollination characteristically occurs in
(A) angiosperms and fungi
(B) angiosperms and gymnosperms
(C) pteridophytes and angiosperms
(D) bryophytes and angiosperms

113. The process whereby a perfect flower is pollinated by its own pollen is called
(A) allogamy (B) autogamy
(C) xenogamy (D) hydrogamy

114. Autogamy can occur in a chasmogamous flower if [NCERT Exemplar]
(A) pollen matures before maturity of ovule
(B) ovules mature before maturity of pollen
(C) both pollen and ovules mature simultaneously
(D) both anther and stigma are of equal lengths

115. Cleistogamous flowers are [WB JEEM 2014]
(A) bisexual flowers which remain opened
(B) bisexual flowers which remain closed
(C) open female flower
(D) open male flower

116. **Assertion (A):** Cleistogamous flowers produce assured seed set in the absence of pollinators.
Reason (R): Cleistogamy is invariably an Autogamy. [AP EAM CET 2019]
(A) (A) is correct (R) is correct. (R) is correct explanation of (A).
(B) (A) is correct (R) is correct. (R) is not correct explanation of (A).
(C) (A) is correct (R) is not correct.
(D) (A) is not correct (R) is correct.

117. Given below are two statements:
Statement I: Cleistogamous flowers are invariably automatous
Statement II: Cleistogamy is disadvantageous as there is no chance for cross pollination
In the light of the above statements, choose the correct answer from the options given below: [NEET (UG) 2022]
(A) Statement I is correct but Statement II is incorrect
(B) Statement I is incorrect but Statement II is correct
(C) Both Statement I and Statement II are correct
(D) Both Statement I and Statement II are Incorrect

118. Even in the absence of pollinators, assured seed set will be there in [KCET 2018]
(A) Chasmogamous flowers
(B) Geitonogamy
(C) Cleistogamous flowers
(D) Xenogamy

119. Advantage of cleistogamy is [NEET (UG) 2013]
(A) higher genetic variability
(B) more vigorous offspring
(C) no dependence on pollinators
(D) vivipary

120. Which one of the following statement is correct? [KCET 2016]
(A) Chasmogamous flowers never exhibits autogamy.
(B) Chasmogamous flowers always exhibits geitonogamy.
(C) Cleistogamous flowers exhibits both autogamy and geitonogamy.
(D) Cleistogamous flowers always exhibits autogamy.

121. The term used for transfer of pollen grains from anthers of one plant to stigma of a different plant which, during pollination, brings genetically different types of pollen grains to stigma, is: [NEET (UG) 2021]
(A) Cleistogamy (B) Xenogamy
(C) Geitonogamy (D) Chasmogamy

122. Self-pollination which involves two different flowers of the same plant, is called [MH CET 2015]
(A) autogamy (B) geitonogamy
(C) xenogamy (D) hybridization

123. Which one of the following may require pollinators, but is genetically similar to autogamy? [AIPMT 2015]
(A) Geitonogamy (B) Xenogamy
(C) Apogamy (D) Cleistogamy

124. Geitonogamy involves [AIPMT 2014]
(A) Fertilization of a flower by the pollen from another flower of the same plant.
(B) Fertilization of a flower by the pollen from the same flower.
(C) Fertilization of a flower by the pollen from a flower of another plant in the same population.
(D) Fertilization of a flower by the pollen from a flower of another plant belonging to a distant population.

125. Transfer of pollen grains from anther to stigma of another flower of same plant is known as: [NEET (UG) Manipur 2023]
(A) Autogamy (B) Cleistogamy
(C) Geitonogamy (D) Xenogamy

126. Choose the correct statement from the following. [NCERT Exemplar]
(A) Cleistogamous flowers always exhibit autogamy.
(B) Chasmogamous flowers always exhibit geitonogamy.
(C) Cleistogamous flowers exhibit both autogamy and geitonogamy.
(D) Chasmogamous flowers never exhibit autogamy.

127. **Assertion:** Xenogamy involves transfer of pollen grains from the flower of one plant to the stigma of another plant.
Reason: This is the only type of pollination which brings genetically different types of pollen grains to the stigma. [TS EAM CET 2019]

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).
(B) Both (A) and (R) are true and (R) is not correct explanation of (A).
(C) (A) is true but (R) is false.
(D) (A) is false but (R) is true.

128. In which one of the following, both autogamy and geitonogamy are prevented? **[NEET (UG) Odisha 2019]**
(A) Maize (B) Wheat
(C) Papaya (D) Castor

129. The transfer of pollen grains of a flower to the stigma of another flower on a different plant within a species is called
(A) chasmogamy (B) xenogamy
(C) plasmogamy (D) geitonogamy

130. The flowers pollinated by wind are
(A) small, inconspicuous, without bright colours, fragrance and nectar
(B) large with bright colours and pleasant fragrance
(C) large with thick and fleshy floral whorls
(D) large and stout

131. What is the function of tassels in the corn cob? **[NEET (UG) 2023]**
(A) To trap pollen grains
(B) To disperse pollen grains
(C) To protect seeds
(D) To attract insects

132. Flowers which have single ovule in the ovary and are packed into inflorescence are usually pollinated by **[NEET (UG) 2017]**
(A) water (B) bee
(C) wind (D) bat

133. A particular species of plant produces light, non-sticky pollen in large numbers and its stigmas are long and feathery. These modifications facilitate pollination by **[NCERT Exemplar]**
(A) insects (B) water
(C) wind (D) animals

134. Largest amount of pollen is produced by plants which shows pollination by
(A) birds (B) animal
(C) wind (D) water

135. In wind pollinated flowers, pollen grains are
(A) dry (B) moist
(C) sticky (D) few in number

136. Which of the following is INCORRECT for wind-pollinated plants? **[NEET (UG) P-II 2020]**
(A) Many ovules in each ovary.
(B) Flowers are small and not brightly coloured.
(C) Pollen grains are light and non-sticky.
(D) Well exposed stamens and stigma.

137. In *Vallisneria*, pollination occurs
(A) on surface of water
(B) blow surface of water
(C) trough wind
(D) deep in water

138. What type of pollination takes place in *Vallisneria*? **[NEET (UG) Odisha 2019]**
(A) Male flowers are carried by water currents to female flowers at surface of water.
(B) Pollination occurs in submerged condition by water.
(C) Flowers emerge above surface of water and pollination occurs by insects.
(D) Flowers emerge above water surface and pollen is carried by wind.

139. Which of the following aquatic plant does not show pollination by water? **[KCET 2021]**
(A) *Vallisneria* (B) *Hydrilla*
(C) Water hyacinth (D) *Zostera*

140. In water hyacinth and water lily, pollination takes place by: **[NEET (UG) P-I 2020]**
(A) water currents only
(B) wind and water
(C) insects and water
(D) insects or wind

141. In which of the following plants, hydrophily is common phenomenon? **[TS EAM CET 2019]**
(A) Water hyacinth (B) Water lily
(C) *Hydrilla* (D) *Amorphophallus*

142. Fragrance and presence of nectar secreting glands in a flower are adaptation for
(A) wind pollination
(B) insect pollination
(C) water pollination
(D) all of these

143. Insect pollinated flowers have
(A) sticky pollen with rough surface
(B) pollen with large quantity
(C) large sized pollen
(D) small pollen with dry surface

144. Large, colourful, fragrant flowers with nectar are seen in: **[NEET (UG) 2023]**
(A) bird pollinated plants
(B) bat pollinated plants
(C) wind pollinated plants
(D) insect pollinated plants

145. Identify the INCORRECT statement related to Pollination: **[NEET (UG) 2022]**
(A) Flowers produce foul odours to attract flies and beetles to get pollinated
(B) Moths and butterflies are the most dominant pollinating agents among insects
(C) Pollination by water is quite rare in flowering plants
(D) Pollination by wind is more common amongst abiotic pollination.

146. Which of the following are the important floral rewards to the animal pollinators? **[AIPMT 2015]**
(A) Colour and large size of flower
(B) Nectar and pollen grains
(C) Floral fragrance and calcium crystals
(D) Protein pellicle and stigmatic exudates

147. Attractants and rewards are required for **[NEET (UG) 2017]**
(A) anemophily (B) entomophily
(C) hydrophily (D) cleistogamy

148. Which one of the following plants shows a very close relationship with a species of moth, where none of the two can complete its life cycle without the other? **[NEET (UG) 2018]**
(A) Banana (B) *Yucca*
(C) *Hydrilla* (D) *Viola*

149. 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

150. Which one of the following is NOT true about self-pollination? **[MHT CET 2018]**
(A) A sure method
(B) Most economic
(C) Maintains genetic purity
(D) Favors evolution

151. From among the situations given below, choose the one that prevents both autogamy and geitonogamy. **[NCERT Exemplar]**
(A) Monoecious plant bearing unisexual flowers.
(B) Dioecious plant bearing only male or female flowers.
(C) Monoecious plant with bisexual flowers.
(D) Dioecious plant with bisexual flowers.

152. Which of the following characters is NOT required for autogamy? **[KCET 2017]**
(A) Flowers require synchrony in pollen release and stigma maturation
(B) Anthers and sigma should lie close to each other
(C) Flowers should be bisexual
(D) Required pollination agents

153. Which of the following is a character of Castor plant to avoid autogamy? **[MHT CET 2016]**
(A) Unisexuality (B) Protogyny
(C) Protandry (D) Heterostyly

154. A dioecious flowering plant prevents both: **[NEET (UG) 2017]**
(A) Autogamy and xenogamy
(B) Autogamy and geitonogamy
(C) Geitonogamy and xenogamy
(D) Cleistogamy and xenogamy

155. Continued self-pollination results in **[KCET 2015]**
(A) formation of unisexual flowers
(B) inbreeding depression
(C) gametes loose vigour
(D) self-incompatibility

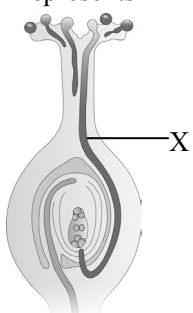
156. All the events from deposition of pollen grain on the stigma to the entry of pollen tube in the ovule are referred to as
(A) fertilization
(B) conjugation
(C) pollen – pistil interaction
(D) syngamy

157. The inability of functional male and female gametes to effect fertilization is called
(A) compatibility (B) incompatibility
(C) self – sterility (D) prepotency

158. In some plants, stigma and anther mature at different times because **[KCET 2019]**
(A) it attracts pollinators
(B) it facilitates self-pollination
(C) it prevents cross pollination
(D) it facilitates cross pollination

159. Find out the CORRECT sequence of events taking place in pollen – pistil interaction.
i. Pollen tube enters one of the synergids and bursts to release male gametes
ii. Pollen tube enters ovule through micropyle of ovary
iii. Pollen tube grows through the stigmatic tissue and then style
iv. Pistil recognizes the correct pollen and accepts it
(A) iv → iii → ii → i (B) iv → ii → iii → i
(C) i → iv → iii → ii (D) iii → iv → ii → i

160. In the diagram given below, the structure marked as 'X' represents



(A) Pollen tube (B) Antipodal
(C) Synergid (D) Egg cell

161. While planning for an artificial hybridization programme involving dioecious plants, which of the following steps would not be relevant? **[NCERT Exemplar]**
(A) Bagging of female flower
(B) Dusting of pollen on stigma
(C) Emasculation
(D) Collection of pollen

162. Identify the correct order of steps involved in artificial hybridization in plants **[KCET 2019]**
(A) Artificial pollination → Emasculation → Rebagging → Bagging
(B) Rebagging → Artificial pollination → Bagging → Emasculation
(C) Emasculation → Bagging → Artificial pollination → Rebagging
(D) Bagging → Artificial pollination → Rebagging → Emasculation

163. What is NOT true about emasculation of a flower while performing an artificial cross? **[MH CET 2015]**
(A) It is removal of anthers from flower.
(B) It is done before anthesis.
(C) It is to avoid self-pollination.
(D) It is done in flowers of plants selected as male parent.

164. 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 **[AP EAM CET 2019]**
(A) p, q, r, s, t (B) p, t, q, r, s
(C) t, p, s, r, q (D) p, r, q, s, t

165. The plants parts which consist of two generations one within the other:
(a) Pollen grains inside the anther
(b) Germinated pollen grain with two male gametes
(c) Seeds inside the fruit
(d) Embryo sac inside the ovule **[NEET (UG) P-I 2020]**
(A) (a), (b) and (c) (B) (c) and (d)
(C) (a) and (d) (D) (a) only

Double Fertilization

1. Double fertilization is exhibited by **[NEET (UG) 2017]**
(A) Gymnosperms (B) Algae
(C) Fungi (D) Angiosperms

2. Which of the following is without exception in angiosperms?
(A) Secondary growth
(B) Presence of vessels
(C) Double fertilization
(D) Autotrophic nutrition

3. In double fertilization, out of two male gametes
(A) one fuses with egg cell and the other with two polar nuclei (secondary nucleus).
(B) both fuse with egg cell.
(C) one fuses with egg cell and the other with antipodal cells.
(D) one fuses with antipodal cells and the other with synergids.

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

5. Double fertilization is **[NEET (UG) 2018]**
(A) Fusion of two male gametes with one egg
(B) Fusion of one male gamete with two polar nuclei
(C) Fusion of two male gametes of a pollen tube with two different eggs
(D) Syngamy and triple fusion

6. **Assertion (A):** Cellular thickenings at the micropylar tip guide the pollen tubes into the synergids.
Reason (R): Synergids have antipodals located at the chalazal end.
Which of the following is true? **[TS EAMCET 2018]**
(A) Both (A) and (R) are true and (R) is the correct explanation of (A).
(B) Both (A) and (R) are true, but (R) is not the correct explanation of (A).
(C) (A) is true, but (R) is false.
(D) (A) is false, but (R) is true.

7. Fertilization of egg takes place inside
(A) anther (B) stigma
(C) pollen tube (D) embryo sac

8. The process of fusion between male nucleus and egg nucleus is called as
(A) syngamy
(B) triple fusion
(C) double fertilization
(D) conjugation

9. The main embryo develops from the structure formed as a result of fusion of
(A) two polar nuclei of embryo sac
(B) egg cell and male gamete
(C) synergid and male gamete
(D) male gamete and antipodals

10. Triple fusion in angiosperm is the fusion of second sperm with
(A) antipodal cell and one synergid cell
(B) two antipodal cells
(C) two synergid cells
(D) two polar nuclei

11. In angiosperm, triple fusion is necessary for the formation of
(A) seed coat (B) fruit wall
(C) embryo (D) endosperm

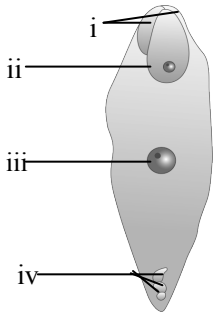
12. Which of the following acts as a passage for pollen tube to reach ovary to fertilize the egg?
(A) Style (B) Stigma
(C) Ovule (D) Placenta

13. 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

14. Pollen tube discharge its gametes in
(A) synergids (B) antipodals
(C) central cell (D) None of these

15. Number of nuclei taking part in double fertilization is
(A) 2 (B) 3 (C) 4 (D) 5

16. Identify label i, ii, iii and iv in the given figure of fertilized embryo sac.



	i.	ii.	iii.	iv.
(A)	Degenerating antipodal cells	Egg	Zygote	Degenerating male gametes
(B)	Primary endosperm cell	Synergids	Male gamete	
(C)	Degenerating synergids	Zygote	PEN	Degenerating antipodal cells
(D)	Degenerating antipodal cells	PEN	Zygote	Primary endosperm cell

17. The sequence of stages during embryogenesis of a dicotyledonous embryo is **[TS EAMCET 2019]**
(A) Proembryo → Globular embryo → Mature embryo → Heart shaped embryo
(B) Heart shaped embryo → Proembryo → Globular embryo → Mature embryo
(C) Mature embryo → Proembryo→Globular embryo → Heart shaped embryo
(D) Proembryo → Globular embryo → Heart shaped embryo → Mature embryo

18. Identify the correct ratio of haploid, diploid and triploid conditions of cells and tissues listed in the given table.

Pollen grain	Nucellus	Sporogenous tissue
Endosperm	Perisperm	Egg cell
Synergid	Zygote	Scutellum

[AP EAMCET 2019]
(A) 5:3:1 (B) 3:5:1
(C) 4:4:1 (D) 2:6:1

19. If the number of chromosomes in an endosperm of seed is 21, what will be the chromosome number in the secondary nucleus? **[MHT CET 2019]**
(A) 7 (B) 28 (C) 14 (D) 21

20. For the formation of 140 angiospermic seeds how many meiotic cell divisions are expected? **[MHT CET 2019]**
(A) 175 (B) 280 (C) 560 (D) 240

21. Genetic variations in the offsprings result due to
(A) fragmentation
(B) micropropagation
(C) meiosis and syngamy
(D) apospory and apogamy

22. Embryo sac is to ovule as _____ is to an anther. **[NCERT Exemplar]**
(A) stamen (B) filament
(C) pollen grain (D) androecium

23. An angiospermic plant has to produce 88 viable ovules. How many meiotic divisions will be needed to produce equal number of female gametophytes by this plant?
(A) 88 (B) 22 (C) 44 (D) 132

24. In an angiosperm a female plant having 2n = 24 is crossed with a male plant having 2n = 12. What will be the chromosome number of the endosperm? **[MHT CET 2016]**
(A) 12 (B) 18 (C) 24 (D) 30

25. If the endosperm of an angiosperm has 24 chromosomes, what would be the number of chromosomes in the megaspore mother cell of the same plant?
(A) 8 (B) 16 (C) 24 (D) 32

26. If the haploid number in a flowering plant is 14. What shall be the number of chromosomes in integuments, antipodal cells, embryo, endosperm and nucellus respectively?
(A) 14, 28, 7, 42, 21 (B) 7, 14, 42, 28, 14
(C) 28, 14, 28, 42, 28 (D) 28, 42, 14, 28, 14

27. With respect to angiosperms, identify the INCORRECT pair from the following. **[KCET 2014]**
(A) Antipodals – 2n
(B) Vegetative cell of male gametophyte – n
(C) Primary endosperm nucleus – 3n
(D) Cells of nucellus of ovule – 2n

28. What will be the respective ploidy of the cells of the nucellus, MMC (Megaspore Mother Cell), the functional megaspore and female gametophyte? **[GUJ CET 2021]**
(A) 2n, n, n, n (B) 2n, n, n, 2n
(C) 2n, 2n, n, n (D) n, 2n, n, 2n

29. An angiospermic male plant with 24 chromosomes in its pollen mother cells is crossed with female plant bearing 24 chromosomes in its root cells. What would be the ploidy of embryo and endosperm respectively formed after this cross? **[MH CET 2014]**
(A) 24 and 48 (B) 24 and 24
(C) 48 and 72 (D) 24 and 36

30. If the cells of the nucellus in the angiosperm ovule contains 24 chromosomes, what will be the number of chromosomes in the endosperm of a self-pollinated flower? **[MHT CET 2017]**
(A) 12 (B) 24 (C) 36 (D) 48

31. 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

32. A plant produced 50 flowers. Ovary of each flower has 50 ovules. How many fruits and seeds are produced by that plant respectively? **[EAMCET 2016]**
(A) 50, 50 (B) 50, 100
(C) 50, 2500 (D) 2500, 2500

33. For formation of 60 zygotes in a tobacco plant, the minimum number of meiosis involved will be
(A) 63 (B) 60 (C) 75 (D) 120

34. 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

Post Fertilization Structures and Events

1. Which among these is NOT a post fertilization event? **[KCET 2016]**
(A) Fruit formation (B) Gametogenesis
(C) Seed formation (D) Embryogenesis

2. Which one of the following statements regarding post-fertilization development in flowering plants is INCORRECT? **[NEET (UG) 2019]**
(A) Central cell develops into endosperm
(B) Ovules develop into embryo sac
(C) Ovary develops into fruit
(D) Zygote develops into embryo

3. The endosperm in angiosperms is formed
(A) after fertilization
(B) before fertilization
(C) along with fertilization
(D) before pollen discharge

4. Endosperm in Angiosperm is
(A) haploid (B) diploid
(C) triploid (D) polyploid

5. Endosperm nucleus is **[WB JEEM 2015]**
(A) n (B) 2n (C) 3n (D) 4n

6. **Assertion:** Angiospermic endosperm is a triploid tissue.
Reason: Endosperm is formed by the fusion of male gamete (n) and two haploid polar nuclei.
(A) Both assertion and reason are true and reason is the correct explanation of assertion.
(B) Both assertion and reason are true but reason is not the correct explanation of assertion.
(C) Assertion is true but reason is false.
(D) Both assertion and reason are false.

7. Real function of the 'endosperm' is to
(A) supply nutrition to the growing embryo
(B) form integuments of ovule
(C) form funicle of ovule
(D) form radicle of seed

8. In angiosperms, free nuclear divisions occur during
(A) gamete formation
(B) embryo formation
(C) endosperm formation
(D) flower formation

9. Triploid plants can be obtained from culture of
(A) pollen (B) endosperm
(C) ovule (D) megaspore

10. The storage tissue of cereal grains is
(A) fruit (B) seed
(C) endosperm (D) embryo

11. The endosperm where there is no wall formation around nucleus is called _____ endosperm.
(A) free nuclear (B) cellular
(C) binuclear (D) locular

12. The coconut water from tender coconut represents **[NEET (UG) P-I 2016]**
(A) Free nuclear proembryo
(B) Free nuclear endosperm
(C) Endocarp
(D) Fleshy mesocarp

13. Coconut water from a tender coconut is **[AIPMT Re-test 2015]**
(A) Degenerated nucellus
(B) Immature embryo
(C) Free nuclear endosperm
(D) Innermost layers of the seed coat

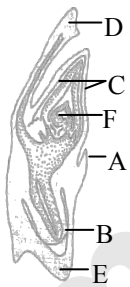
14. The dicotyledonous seeds usually store reserve food materials in
(A) cotyledons (B) perisperm
(C) coleoptile (D) coleorhiza

15. Fully developed embryo ultimately becomes
(A) globular shaped
(B) heart shaped
(C) horse–shoe shaped
(D) kidney shaped

16. In the embryos of a typical dicot and a grass, true homologous structures are
[NCERT Exemplar]
(A) coleorhiza and coleoptiles
(B) coleoptile and scutellum
(C) cotyledons and scutellum
(D) hypocotyl and radical

17. In a seed of maize, scutellum is considered as cotyledon because it
(A) protects the embryo
(B) contains free nuclear endosperm
(C) absorbs food materials and supplies them to the embryo
(D) converts itself into a monocot leaf

18. In this diagram showing the L.S. of an embryo of grass, identify the answer having the correct combination of alphabets with the right part:



[KCET 2014]
(A) A – Root cap, B – Coleoptile, C – Scutellum, D – Coleorhiza, E – Epiblast, F – Shoot apex
(B) A – Shoot apex, B – Epiblast, C – Coleorhiza, D – Scutellum, E – Coleoptile, F – Radicle
(C) A – Epiblast, B – Scutellum, C – Coleoptile, D – Radicle, E – Coleorhiza, F – Shoot apex
(D) A – Epiblast, B – Radicle, C – Coleoptile, D – Scutellum, E – Coleorhiza, F – Shoot apex

19. A seed develops from
(A) ovule (B) ovary
(C) embryo (D) embryo sac

20. Which of the following is an endospermic seed?
(A) Pea (B) Bean
(C) Groundnut (D) Castor

21. Which one of the following is a non-endospermic seed?
(A) Maize (B) Rice
(C) Groundnut (D) Castor

22. Non-albuminous seed is produced in
[NEET (UG) 2014]
(A) maize (B) castor
(C) wheat (D) pea

23. Morphologically the white fluffy edible mass in maize is
(A) seed coat (B) seed
(C) endosperm (D) pericarp

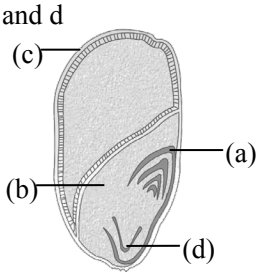
24. What is the cotyledon of maize embryo called?
(A) Aleurone layer (B) Scutellum
(C) Plumule (D) Radicle

25. 'Coleorhiza' is a cap–like covering over
(A) plumule in a dicot
(B) radicle in dicot
(C) plumule in a monocot
(D) radicle in a monocot

26. In maize grain, plumule is covered by
(A) coleorhiza (B) coleoptile
(C) caruncle (D) tigellum

27. The wheat grain has an embryo with one large, shield-shaped cotyledon known as
[AIPMT Re-test 2015]
(A) Coleoptile (B) Epiblast
(C) Coleorrhiza (D) Scutellum

28. In the given diagram identify the parts labelled as a, b, c and d



[KCET 2021]
(A) a → Coleoptile, b → Scutellum, c → Pericarp, d → Coleorrhiza
(B) a → Coleoptile, b → Scutellum, c → Coleorrhiza, d → Pericarp
(C) a → Pericarp, b → Coleorrhiza, c → Scutellum, d → Coleoptile
(D) a → Coleorrhiza, b → Coleoptile, c → Scutellum, d → Pericarp

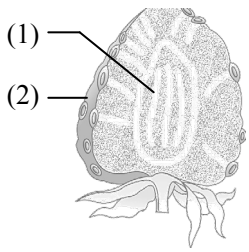
29. Developing embryo digests the endosperms; that seed at maturity is
(A) non-endospermic (B) albuminous
(C) ex - albuminous (D) both (A) and (C)

30. Fruit wall is called
(A) pericarp (B) epicarp
(C) mesocarp (D) endocarp

31. Which one of the following fruits is parthenocarpic? **[AIPMT Re-test 2015]**
(A) Banana (B) Brinjal
(C) Apple (D) Jackfruit

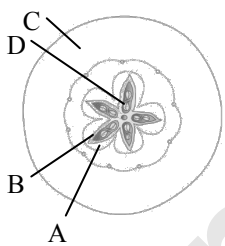
32. In some plants, the female gamete develops into embryo without fertilization. This phenomenon is known as: **[NEET (UG) 2019]**
(A) syngamy (B) parthenogenesis
(C) autogamy (D) parthenocarpy

33. The diagram of strawberry fruit is given below. Identify (1) and (2).



(A) 1 – Endocarp; 2 – Seed
(B) 1 – Thalamus; 2 – Ovary
(C) 1 – Achene; 2 – Thalamus
(D) 1 – Thalamus; 2 – Achene

34. Which part of the fruit, labelled in the given figure makes it a false fruit? **[NEET (UG) 2022]**



(A) C → Thalamus (B) D → Seed
(C) A → Mesocarp (D) B → Endocarp

35. Banana is an example of **[WB JEEM 2015]**
(A) parthenocarpy (B) apomixis
(C) parthenogenesis (D) polyembryony

36. In apple, the edible portion is **[WB JEEM 2014]**
(A) Mesocarp (B) Epicarp
(C) Endocarp (D) Thalamus

37. **Assertion (A):** All the fruits that we eat are not real fruits.
Reason (R): In few plants floral parts like thalamus or pedicel also contribute to the fruit formation. Such fruits are called false fruits. **[EAMCET 2016]**
(A) A and R are true and R is the correct explanation of A.
(B) A and R are true and R is not the correct explanation of A.
(C) A is true, R is false.
(D) A is false, R is true

38. The name 'perisperm' is given to the
(A) peripheral endosperm
(B) remnant of the nucellus
(C) disintegrated synergids
(D) disintegrated antipodals

39. Perisperm differs from endosperm in **[NEET (UG) 2013]**
(A) being a haploid tissue
(B) having no reserve food
(C) being a diploid tissue
(D) its formation by fusion of secondary nucleus with several sperms

40. **Assertion (A):** Unlike coconut, groundnut consumes endosperm completely during embryo development.
Reason (R): Though the embryogeny is similar in groundnut and coconut, perisperm is seen in coconut. **[AP EAM CET 2019]**
(A) Both (A) and (R) are true and (R) is the correct explanation of (A).
(B) Both (A) and (R) are true and (R) is not correct explanation of (A).
(C) (A) is true but (R) is false.
(D) (A) is false but (R) is true.

41. After fertilization, the seed coat of seeds develop from
(A) integuments (B) chalaza
(C) embryo sac (D) ovule

42. Identify the INCORRECT statements from the following.
i. Arboreal rodents act as pollinating agents.
ii. Endosperm is persistent in rice.
iii. Cashew is a true fruit.
iv. Sexual reproduction leads to variations.
(A) i and ii (B) i and iii
(C) Only iii (D) iii and iv

43. Seeds are called products of sexual reproduction because they
(A) are formed by fusion of gametes
(B) give rise to new plants
(C) can be stored for long time
(D) are formed by fusion of pollen tubes

44. A pome fruit is said to be false, because
(A) the pericarp is inconspicuous
(B) the endocarp is cartilaginous
(C) the edible part of fruit is fleshy thalamus
(D) the fruit is derived from inferior ovary

45. Formation of fruits without fertilization is known as
(A) parthenocarpy (B) parthenogenesis
(C) polyembryony (D) polygamy

46. The phenomenon wherein, the ovary develops into a fruit without fertilization is called **[NCERT Exemplar]**
(A) parthenocarpy
(B) apomixis
(C) asexual reproduction
(D) sexual reproduction

47. Seedless fruits in grapes are formed due to
(A) sterility
(B) double fertilization
(C) syngamy
(D) parthenocarpy

48. The ability of seeds to retain the power of germination over a period of time is called
(A) dormancy of seed (B) viability of seed
(C) drying of seed (D) totipotency

49. Persistent nucellus in the seed is known as: **[NEET (UG) 2019]**
(A) Hilum (B) Tegmen
(C) Chalaza (D) Perisperm

50. The hilum is a scar on the **[AIPMT 2015]**
(A) Seed, where funicle was attached
(B) Fruit, where it was attached to pedicel
(C) Fruit, where style was present
(D) Seed, where micropyle was present

51. Match the following ovular structure with post fertilization structure and select the correct alternative.

	Column I		Column II
i.	Ovule	a.	Endosperm
ii.	Ovary	b.	Fruit
iii.	Nucellus	c.	Seed
iv.	Polar nuclei	d.	Perisperm

(A) i – b, ii – c, iii – d, iv – a
(B) i – b, ii – c, iii – a, iv – d
(C) i – c, ii – b, iii – d, iv – a
(D) i – c, ii – b, iii – a, iv – d

52. Which character of angiosperms helped in their dominance on earth? **[MHT CET 2018]**
(A) Formation of seeds
(B) Formation of endosperm
(C) Double fertilization
(D) Presence of xylem vessels

53. Temporary suspension of growth is called
(A) dormancy (B) viability
(C) dispersal (D) desiccation

54. Loss of viability of seeds is due to
(A) damage of embryo
(B) denaturation of enzymes
(C) exhaustion of food
(D) all of the above

55. In some members of which of the following pairs of families, pollen grains retain their viability for months after release? **[NEET (UG) 2021]**
(A) Rosaceae ; Leguminosae
(B) Poaceae ; Rosaceae
(C) Poaceae ; Leguminosae
(D) Poaceae ; Solanaceae

Apomixis and Polyemembryony

1. What is Apomixis? **[TS EAMCET 2020]**
(A) Production of fruit without fertilization
(B) Production of seeds without pollination
(C) Production of fruit without pollination
(D) Production of seeds without fertilization

2. Seeds without fertilization is obtained from **[KCET 2015]**
(A) Polyembryony (B) Parthenocarpy
(C) Dormancy (D) Apomixis

3. The phenomenon of replacement of sexual reproduction with asexual reproduction is called **[TS EAMCET 2017]**
(A) Vivipary (B) Apomixis
(C) Karyogamy (D) Syngamy

4. Seed formation without fertilization in flowering plants involves the process of **[NEET (UG) P-I 2016]**
(A) Somatic hybridization
(B) Apomixis
(C) Sporulation
(D) Budding

5. Despite high level of heterozygosity, the progeny derived from seed of a cross pollinated plant was found to be completely uniform. One reason for this may be the phenomenon of
(A) parthenocarpy
(B) apomixis
(C) induced mutation
(D) polyploidy

6. In some species of family Asteraceae seeds are produced without fertilization. It is called as _____ **[MHT CET 2017]**
(A) apomixis (B) amphimixis
(C) parthenocarpy (D) vivipary

7. Occurrence of two or more embryos in one ovule is called
(A) polyembryony
(B) parthenocarpy
(C) apogamy
(D) adventive embryony

8. The best example of polyembryony is
(A) Banana (B) Pea
(C) Coconut (D) Orange

9. Identify the INCORRECT statement.
(A) Production of hybrid seeds is costly.
(B) Hybrid seeds have to be produced every year.
(C) Hybrid seeds are too expensive for the farmers.
(D) If seeds collected from hybrids are kept for many years and then sown, the progeny plants still maintain the hybrid characters.

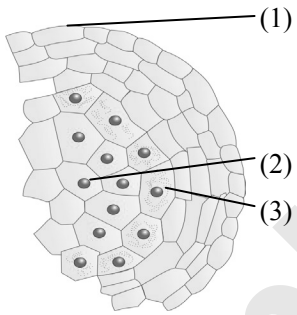
10. Which one of the following generates new genetic combinations leading to variation?
[NEET (UG) P-II 2016]
(A) Nucellar polyembryony
(B) Vegetative reproduction
(C) Parthenogenesis
(D) Sexual reproduction

Topic Test

1. Pollen grains measure about _____ micrometers in diameter.
(A) 5–10 (B) 10–20
(C) 50–60 (D) 25–50

2. Complete the given analogy with respect to number of ovules in an ovary.
Wheat : One ovule :: _____ : Many ovules
(A) Paddy (B) Mango
(C) Orchid (D) Both (A) and (B)

3. The diagram given below shows one microsporangium. Identify (1), (2) and (3).



(A) 1–Endothecium; 2–MMCs; 3–Tapetum
(B) 1–Epidermis; 2–MMCs; 3–Tapetum
(C) 1–Middle layer; 2– MMCs; 3–Tapetum
(D) 1–Endothecium; 2–Middle layers; 3–Tapetum

4. Perisperm can be found occasionally in the seeds of
(A) black pepper (B) ground nut
(C) pea (D) none of these

5. Identify the ODD one out.
(A) Antipodals
(B) Generative cell
(C) Synergids
(D) Filiform apparatus

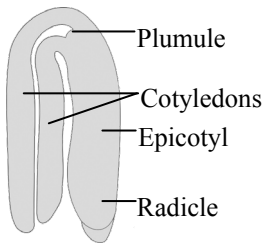
6. Match Column I and Column II and choose the correct option.

	Column I		Column II
i.	Locule	a.	Pistils free
ii.	Syncarpous	b.	Ovarian cavity
iii.	Apocarpous	c.	Stalk of the ovule
iv.	Funicle	d.	Pistils fused

(A) i – a, ii – c, iii – b, iv – d
(B) i – b, ii – c, iii – a, iv – d
(C) i – b, ii – d, iii – a, iv – c
(D) i – b, ii – a, iii – d, iv – c

7. **Assertion:** Wind pollination is quite common in grasses.
Reason: Majority of plants use biotic agents for pollination.
(A) Both assertion and reason are true and reason is the correct explanation of assertion.
(B) Both assertion and reason are true but reason is not the correct explanation of assertion.
(C) Assertion is true but reason is false.
(D) Both assertion and reason are false

8. In the diagram of typical dicot embryo given below, which of the part is labelled incorrectly?



(A) Plumule (B) Cotyledons
(C) Epicotyl (D) Radicle

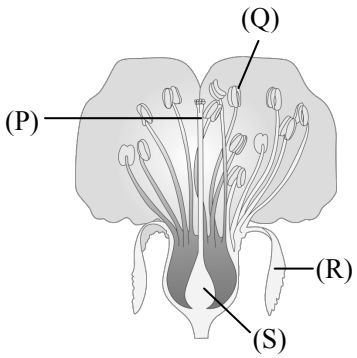
9. The oldest seed is that of _____ excavated from Arctic Tundra.
(A) Ficus
(B) *Phoenix dactylifera*
(C) Orobanche
(D) *Lupinus arcticus*

10. Identify the INCORRECT match.
(A) Apomixis – Fruits develop without fertilization
(B) Pericarp – Fruit wall
(C) Dormancy – State of inactivity of embryo
(D) Perisperm – Residual persistent nucellus

11. If there are 8 microspore mother cells (MMCs) in an anther, how many pollen grains will they produce?
(A) 8 (B) 16 (C) 32 (D) 64

12. Which of the following statement is INCORRECT?
(A) *Parthenium* causes pollen allergy.
(B) Pollen grains of a large number of species can be stored for years in liquid nitrogen (196°C).
(C) Pollen tablets are used as food supplements.
(D) Pollen grains are rich in nutrients.

13. In the diagram of L.S. of flower given below, four parts (P, Q, R, S) are marked. Which of the following part transforms into fruit after fertilization?



(A) P (B) Q (C) R (D) S

14. Given below are some of the steps which are carried out in artificial hybridization programme of crop improvement. From the options, choose the option which gives the correct sequence of steps.
i. Pollen collection from anthers of male parent
ii. Re-bagging
iii. Selection of parents
iv. Bagging
v. Emasculation
vi. Dusting of pollen on stigma
(A) iii → ii → i → v → iv → vi
(B) iii → v → iv → i → vi → ii
(C) iii → iv → v → i → vi → ii
(D) iii → v → iv → i → ii → vi

15. How many meiotic divisions would be required to produce 101 female gametophytes in an angiosperm?
(A) 101 (B) 26
(C) 127 (D) None of these

16. _____ reduction divisions are necessary for the formation of 200 grains of wheat.
(A) 250 (B) 200
(C) 150 (D) 360

17. The function of endothecium is
(A) nutritional
(B) mechanical support
(C) dehiscence
(D) protection

18. Double fertilization is a characteristic of
(A) Gymnosperms (B) Bryophytes
(C) Angiosperms (D) Pteridophytes

19. Match Column I and Column II and choose the correct option.

	Column I		Column II
i.	Ovule	a.	Female reproductive whorl
ii.	PMC	b.	Integumented megasporangium
iii.	Gynoecium	c.	3n
iv.	Endosperm	d.	Microsporogenesis

(A) i – b, ii – d, iii – c, iv – a
(B) i – b, ii – d, iii – a, iv – c
(C) i – b, ii – a, iii – d, iv – c
(D) i – a, ii – b, iii – d, iv – c

20. Sexual reproduction leads to
(A) recombination (B) parthenogenesis
(C) apomixis (D) polyploidy

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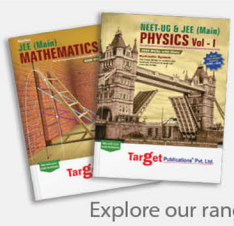

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