CHAPTER-8
DIVERSITY AMONG PLANTS

Q1. Explain the geographic occurrence of plants.

Ans: The kingdom **plantae** or **plant kingdom** comprises hundreds of thousands of different species. They live in every type of habitat, from frozen Arctic tundra to tropical rain forests and deserts.

Q2. Point out the emergence of plants?

Ans: In the beginning the plants were restricted only to aquatic conditions. The migration started towards land nearly 400 million years ago.

Q3. Write down the division of plants and describe Non-Vascular Plants.

Ans: **Division of plants:** Plants are currently divided into two main groups.

(i) Nonvascular or bryophytes.

(ii) Vascular plants or tracheophytes.

Non-Vascular Plants:

The nonvascular plants lack vascular tissues. These plants do not have true roots, stems, and leaves. Therefore, the nonvascular plants are said to have root like, stem like, and leaf like structures.

Science Titbits

The name moss is often commonly used for plants that are not truly mosses. For example reindeer moss is lichen that is a dominant form of vegetation in the Arctic tundra. Spanish moss is a flowering plant and club moss is relative to ferns.

Science, Technology and Society Connections

♦ **Describe the formation and importance of peat bogs.**

The moss *Sphagnum* grows in bogy places that are low-lying, wet, spongy places forming dense and deep masses called peat bog. One of the distinctive features of this moss is a presence of large empty cells in the leaves, which apparently function to hold water. This feature makes peat moss particularly beneficial as a soil conditioner. When added to sandy soils, for example, peat moss helps to hold and retain moisture. In some areas as bogs, the dead *Sphagnum* accumulates and do not decay. This accumulated moss called **peat** can be used as fuel.



Peat bog



Pear mosses Sphagnum

Q4. How can you categorize seed plants?

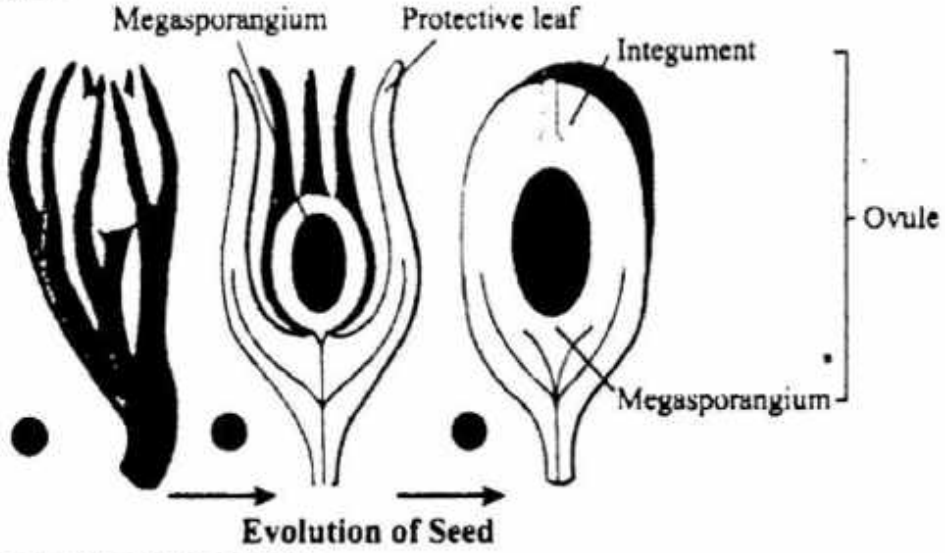
Ans: The two groups of seed bearing vascular plants are the gymnosperms and angiosperms.

The seeds of gymnosperm are produced exposed on the surface of the sporophylls that make up cones. The seeds of angiosperms are usually enclosed by a fruit produced from a flower.

Q5. Describe the events involve in evolution of seed.

Ans: Evolution of seed:

A seed may be considered as a fertilized megasporanguim. It has integument around the embryo. During evolution the seed has passed through the following stages.



Evolution of Seed

Development of heterospory.

All seed plants are heterosporous i.e., produce microspore and megaspore in microsporangia and megasporangia respectively. The megaspore grows into a female gametophyte and microspore grows into a male gametophyte. The megaspores of the seed plants are retained inside the sporangium, where the **megaspore develops into a tiny female gametophyte.**

Evolution of Pollen Tube:

The evolution of pollen tube parallels the evolution of seeds. The egg produced inside an ovule is very well protected in the sporangium. It is so well protected that flagellated sperm would not have the slightest chance of ever reaching an egg. This obstacle has been overcome by the development of **pollen tubes.** Once the pollen grain reaches the cone or flower, it germinates.

The germinated pollen grain is a tiny male gametophyte. It produces a long pollen tube, which grows to the ovule and then digests its way through the protecting layers to the enclosed egg.

Evolution of Integument around the Megasporangium and Seed:

In carboniferous period (geological period 280-350 million years ago), fern like plants were present. The sporophyte of these plants had little protective branch like outgrowths, surrounding the megasporangium. During evolution the outgrowths fused together forming integument, enclosing the megasporangium. Megaspore is retained in the megasporangium. This modified structure is called an **ovule.** The fertilized ovule evolved into seed because of retention of developing embryo.

Science Titbits

There are four groups of gymnosperms. Conifers, Cycads, Ginkgo and Gnetophytes. In gymnosperms, the seeds are not covered. Instead they are exposed on the surface of the sporophyll, leaves that bear sporangia. Reproductive organs are usually borne in the cones on which sporophylls are spirally arranged. Other than these features, the four groups of gymnosperms have little in common.

Teacher's Point

Teachers would guide the students that how do the life cycles of seedless plants and seed plants differ? In what fundamental way are they alike?

Science, Technology and Society Connections

♦ **Justify plants as a medical treasure.**

Herbalism (also herbal **medicine** or phytotherapy) is the **study** of botany and use of **plants** intended for medicinal purposes or for supplementing a diet **Plants** have been the basis for **medical** treatments through much of human history, and such traditional **medicine** is still widely practiced today.

Also a large number of **drugs** are obtained from flowering plants. Some of the drugs are aconite, belladonna, quinine, malathi, santonin, digitalis, asgandh, etc.

Activity

1. Identification of the vegetative and reproductive structures of *Marchantia* and *Funaria* by examining the fresh or preserved material
2. Identification of the vegetative and reproductive structures of a local fern and a *Pinus* and relate them with the concerned life cycles
3. Study of different types of inflorescence of *Cassia, Brassica, Achyranthus, Morus, Candytuft, Helianthus* and *Avena sativa*
4. Describing the flowers of Rose, *Cassia fistula*, *Solanum nigrum* and *Avena sativa*

EXERCISE

MCQs

1. Select the correct answer.

(i) Plants are thought to have descended from a common protistan ancestor ancient

(A) freshwater algae (B) archaea
(C) cyanobacteria (D) brown alga

(ii) Gametophyte in bryophytes is

(A) haploid (B) diploid
(C) triploid (D) pentaploid

(iii) Whisk ferns belong to the group

(A) pteropsida (B) lycopsida
(C) psilopsida (D) annelid

(iv) Sago grains are obtained from

(A) cycas (B) pinus
(C) moss (D) fern

(v) These are highly evolved of all the plants on the earth

(A) bryophytes (B) pteridophytes
(C) gymnosperms (D) angiosperms

(vi) Moss plants develop from

(A) oospore (B) protonema
(C) antherozoids (D) diploid spores

(vii) Fern plant is

(A) diploid sporophyte (B) diploid gametophyte
(C) haploid sporophyte (D) haploid gametohyte

(viii) Gymnosperms are characterised by

(A) multiflagellate sperms (B) naked seeds
(C) winged seeds (D) seeds inside fruits

(ix) Where a megasporangium is present in an angiosperm?

(A) in the style of a flower (B) within an ovule
(C) in the stigma of a flower (D) packed into pollen sacs

(x) Gametophyte generation is dominant in

(A) pteridophytes (B) gymnosperms
(C) bryophytes (D) angiospersms

Answers

(i) A	(ii) A	(iii) C	(iv) A	(v) D
(vi) B	(vii) A	(viii) B	(ix) B	(x) C

SHORT QUESTIONS

2. What are the features shared by algae and plants?

Ans: Following are the features shared by algae and plants

(i) Plants are multicellular, eukaryotic, photosynthetic, autotrophs, as are brown, red and certain green algae.

(ii) Plants have cell wall made of cellulose. Likewise green algae, dinoflagellates and brown algae have also cellulose in their cell walls.

(iii) Chloroplasts with chlorophylls a and b are present in plants as well as in green algae.

3. What are the features shared by the green algae 'Charophyceans' and plants?

Ans: Following are the features shared by the green algae 'Charophyceans' and plants

(i) Both contain a higher percentage of cellulose than cell walls of non charophycean algae

(ii) The peroxisomes of both contain enzymes that help to minimize the loss of organic products as a result of photorespiration.

(iii) The flagellated sperm of plants closely resembles that of charophycean sperm.

(iv) In both the synthesis of new cross-walls during cell division involves the formation of phragmoplast.

(v) Comparisons of both nuclear and chloroplast genes agree that charophyceans as the closest relatives of land plants.

Note: It does not mean that these algae are the ancestors of plants however, they do offer a glimpse of what those ancestors might have been like

4. What are the diagnostic features shared by all plants.

Ans: Plants are multicellular eukaryotes with well-developed tissue and have autotrophic nutrition.

Plants are well protected from being dried up in air by their cuticle, formed from a waxy substance called cutin The plant body has root, stems and leaves having vascular tissue xylem, phloem and cellulose rich cell **walls.**

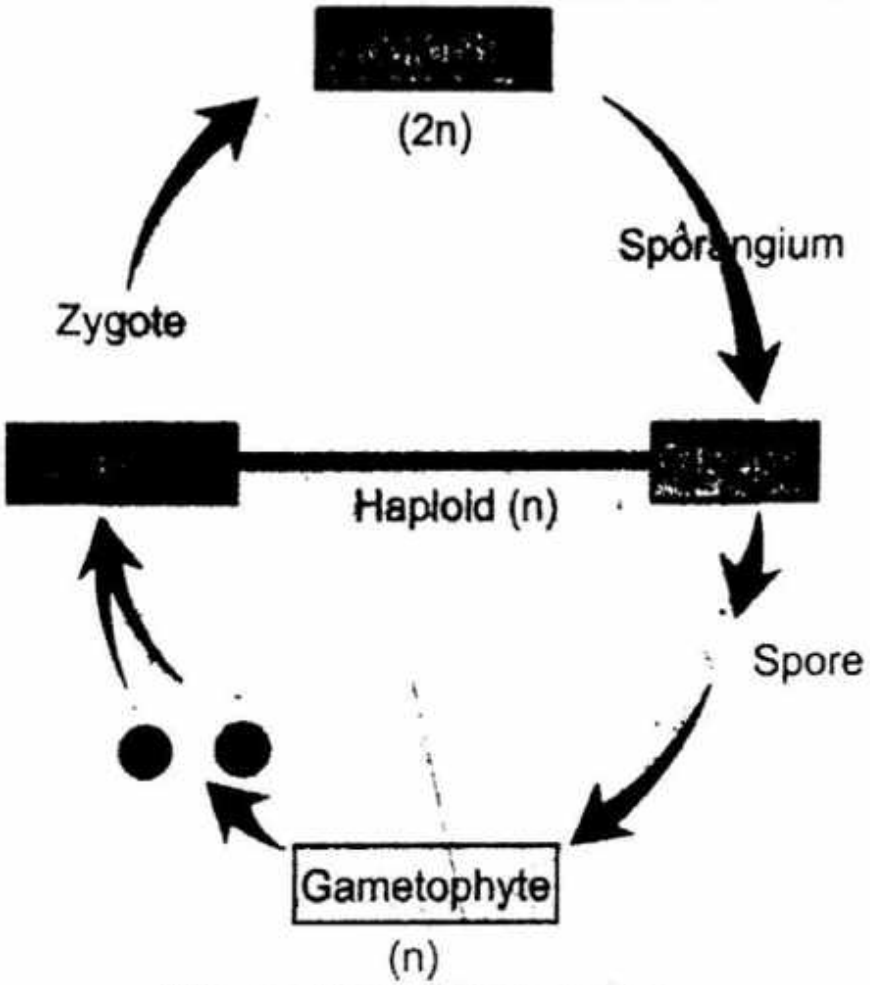
Plants show alternation of generation. It consists of the sporophyte ,the diploid generation that produces haploid spores by meiosis. Spores develop into a haploid generation. The gametophyte is the haploid generation, which produces gametes that unite to form a diploid zygote. The plants are oogamous the gametes are eggs and sperms.

5. What is alternation of generation? Write its importance.

Ans: Plants show alternation of generation. It consists of the sporophyte the diploid generation that produces haploid spores by meiosis. Spores develop into a haploid generation. The gametophyte is the haploid generation, which produces gametes that unite to form a diploid zygote. The plants are oogamous the gametes are eggs and sperms.

Importance:

Alternation of generation is an important aspect in terrestrial plant life which helps them to accommodate and adapt in land environment. The alternating sporophyte and gametophyte generation helps in the production of best plants which stand the favorable and unfavorable environmental conditions.



Alternation of Generation

6. Why bryophytes are called 'amphibious plants'.

Ans: The bryophyta is a group of plants comprising of liverworts, hornworts and mosses are the only nonvascular plants.

Bryophytes are typically quite small and a few exceed 2 centimetres in length. They generally require a moist environment for active growth and reproduction, but some bryophytes tolerate dry areas. Bryophytes are also called amphibious **plants** because they need water for development, existence and reproduction.

7. Write the main four features of bryophytes?

Ans: The four main features of bryophytes are:

(1) They lack specialized vascular tissues.

(2) Multicellular sex organs produce embryo.

(3) Sporophytes are always smaller and obtain their food from the gametophyte.

(4) Their life cycles are similar to seed plants. Bryophytes are also called amphibious **plants** because they need water for development, existence and reproduction.

8. Name the land adaptation features of bryophytes.

Ans: Following are the land adaptation features of bryophytes

(1) The Multicellular plant body and conservation of water

(2) Absorption of carbon dioxide

(3) Absorption of water

(4) Heterogamy.

(5) Protection of reproductive cells.

(6) Embryo Formation.

(7) Alternation of Generations.

9. What is the importance of bryophytes?

Ans: Importance of Bryophytes:

(i) Mosses play an important role in their environment. They hold the soil in place and help prevent erosion.

(ii) Mosses provide food for animals, especially birds and small mammals.

(iii) Commercially the most important mosses are the **peat mosses.** Their leaves hold water and are beneficial as a soil conditioner.

(iv) When added to sandy soils peat moss helps to hold and retain moisture.

10. Write the features of seedless vascular plants.

Ans: Following are the features of seedless vascular plants.

The **seedless vascular plants** (ferns and their allies) disperse the species by producing windblown **spores.** When the spores germinate, a relatively **large gametophyte** is formed which is independent of the sporophyte for its nutrition.

In these plants, **flagellated sperms** are released by **antheridia** and swim in a film of external water to the **archegonia,** where fertilization occurs.

11. Describe the development of heterospory.

Ans: All seed plants are heterosporous i.e., produce microspore and megaspore in microsporangia and megasporangia respectively. The megaspore grows into a female gametophyte and microspore grows into a male gametophyte. The megaspores of the seed plants are retained inside the sporangium, where the megaspore develops into a tiny female gametophyte.

12. What is the importance of seedless vascular plants?

Ans: Following are the importance of seedless vascular plants.

(i) *Lycopodium* and *Selaginella* are chiefly grown as **ornamental plants** and are utilized in the preparation of Christmas wreaths.

(ii) Ducks and other aquatic animals feed upon the corm of *Isoetes.*

(iii) The **ferns** are mostly ornamental plants of gardens and greenhouses. Some of them are used in the preparation of bouquets. Stems and leaves of tree ferns are used for **building purposes.**

(iv) Some genera, like *Pteris, Ceratopteris* and *Marsilea,* are edible.

(v) The rhizome of the male fern yields a drug, which is utilized for removing the intestinal parasites.

(vi) Practically all the members of the seedless vascular plants have contributed extensively to coal formation.

13. Write the features of vascular plants.

Ans: Vascular plants (L. *vasculum,* dim. of *vas,* vessel) include ferns and their allies, gymnosperms, and angiosperms

Features of vascular plants:

(i) Vascular tissue consists of **xylem** (Gk. *xylon*, wood), and **phloem** (Gk. *phloios*, bark).

(ii) The vascular plants have true roots, stems, and leaves. Xylem, with its strong-walled cells, supports the body of the plant against the pull of gravity.

(iii) The leaves are covered by a waxy **cuticle.**

(iv) Leaves have small pores called stomata.

(v) The **sporophyte generation** is diploid and dominant in vascular plants.

(vi) The vascular plants are widely distributed.

14. Describe the evolution of pollen tube.

Ans: Evolution of Pollen Tube:

The evolution of pollen tube parallels the evolution of seeds. The egg produced inside an ovule is very well protected in the sporangium. It is so well protected that flagellated sperm would not have the slightest chance of ever reaching an egg. This obstacle has been overcome by the development of **pollen tubes.** Once the pollen grain reaches the cone or flower, it germinates.

The germinated pollen grain is a tiny male gametophyte. It produces a long pollen tube, which grows to the ovule and then digests its way through the protecting layers to the enclosed egg.

15. What is the importance of pollen tube?

Ans: The evolution of pollen tube parallels the evolution of seeds.

(i) It helps to transport flagellated sperm to the ovule

(ii) It digests the protective layers enclosing the egg

(iii) It is the main component of the male gametophyte.

(iv) It is the main adaptation of the terrestrial plants.

(v) It prevents the loss of plant reproductive structures that is flagellated sperm.

(vi) It indirectly helps in fertilization of sperm and egg.

16. What are the uses of gymnosperms?

Ans: Uses of gymnosperms:

(i) Pine seeds like chilghoza are eaten as dry fruits.

(ii) Ephedrine, a drug from *Ephedra* is used for the relief of asthma and other respiratory ailments.

(iii) Conifers are a source of soft wood for construction, packing, plywood, board and for making paper.

(iv) **Cycads** are grown as ornamental plants.

(v) *Cycas circinalis*, which grows as a wild cycad, serves as a source of "sago". It is pure starch extracted in liquid state and then solidifies to form small granules.

(vi) Resins, terpentine, tar and many oils are obtained from conifers.

17. What are angiospefms?

Ans: Angiosperms are the flowering plants. Their seeds are enclosed by fruits. The term angiosperms literary means **"enclosed seed"** (*angio*: closed, *sperm* seed).

The leaves bearing ovules are folded and joined at the margins to form ovaries. The ovary after fertilization is changed into fruit. This is exceptionally a large and successful group of plants which is divided into Dicots and Monocots.

They have common characters, like, vascular tissues, differentiated plant body, flowers, fruits and seeds

18. What is the advantage of the seed?

Ans: Advantage of the seed:

(i) Safer crop emergence and earlier establishment of final populations

(ii) More uniform rate of emergence and earlier and bigger plants

(iii) Root shapes and sizes are improved

(iv) Increased yield of an average 4% compared to unprimed sugar beet seed

19. Describe the three types of inflorescence with examples.

Ans: Inflorescence:

Flowers are borne either single or in clusters. A flower is said to be **solitary** when occurring singly, e.g., *Hibiscus rosasinensis*.

Flowers borne in clusters along with the stem and associated whorls constitute **inflorescence.**

Depending upon the arrangement of flowers, inflorescence is classified into:

(a) Racemose **(b)** Cymose **(c)** Compound

(a) Racemose Inflorescence:

Here the main axis of inflorescence does not end in a flower but it continues to grow and give off flowers laterally.

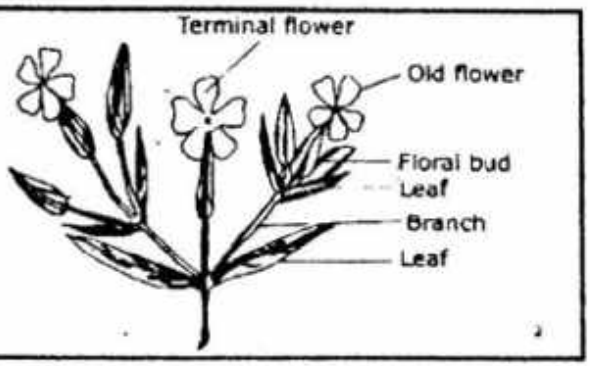
Examples: Radish and mustard *(Brassica)*.

Racemose Inflorescence in mustard	

(b) Cymose Inflorescence:

Here the primary axis terminates in a flower but the growth continues through the lateral buds. These buds give rise to lateral branches which bear flowers. The flowers are arranged in basipetal succession, i.e., the outer or basal flowers are younger and the upper flowers are older,

Example: *Dianthus* (pink).

Cymose inflorescence in Dianthus (Pink)	

(c) Compound Inflorescence:

In a compound inflorescence the peduncle or main axis of the inflorescence branches repeatedly in racemose or cymose manner and the ultimate branches bear flowers in a racemose or cymose manner

Examples: Compound racemose, e.g. Goldmohur *(Delonix regia)*, Amaltas *(Cassia fistula)*, etc. Compound Spike, e.g., rice *(Oryza sativa)*.

The three main types of inflorescence also include various sub types of inflorescence.

Compound Inflorescence in Amaltas	

20. Give one example of: Whisk ferns, club mosses, horsetails and ferns.

Ans:
(i) Examples of Whisk ferns are Rhynia , Psilotum
(ii) Examples of club mosses are *Lycopodium* and *Selaginella*.
(iii) Example of horsetails is *Equisetum*
(iv) Examples of ferns is Osmunda claytoniana

21. Define/Describe/Explain briefly:
cutin, gametophyte, sporophyte, archegonium, antheridium, rhizoids, microgametophye, macrogametophyte, strobilus, homosporous, heterosporous, pollen tube, double fertilization, raceme inflorescence, cymose inflorescence, compound inflorescence.

Ans: Cutin:

Plants are well protected from being dried up in air by their cuticle, formed from a waxy substance called cutin

Gametophyte:

The gametophyte is the haploid generation, which produces gametes that unite to form a diploid zygote.

Sporophyte:

A sporophyte is the diploid multicellular stage in the life cycle of a plant or alga. It develops from the zygote produced when a haploid egg cell is fertilized by a haploid sperm and each sporophyte cell therefore has a double set of chromosomes, one set from each parent.

OR

It is the diploid multicellular individual or generation of a plant with alternation of generations that begins from a diploid zygote and produces haploid spores by meiotic division.

Archegonium:

An archegonium is a multicellular structure or organ of the gametophyte phase of certain plants, producing and containing the ovum or female gamete.

Antheridium:

An antheridium is a haploid structure or organ producing and containing male gametes. It is the male reproductive organ of some cryptogamous plants.

Rhizoids:

The structures for absorption of water in moss and liverworts are **rhizoids.** These are present on the lower surface of the *Marchantia* thallus. Rhizoids are long filamentous structures. They are unicellular and are extensions of the cell of the lower epidermis. Rhizoids increase the surface area for absorption of water from the soil and also help in anchorage.

Microgametophye:

The male gametophyte that develops from the microspores of heterosporous plants. The pollen grains of gymnosperms and angiosperms are microgametophytes. In seed plants, the microgametophyte is contained in the pollen grain.

Macrogametophyte:

Macrogametophyte is the female gametophyte of plant it consist of an embryo sac which has eight nuclei than wall formation takes place these are converted into cells these cells are antipodal cells, polar nuclei , synergids and egg.

Strobilus:

In club mosses the sporangia are born on terminal clusters of leaves called **strobili** (sing, *strobilus)* which are club shaped. They are only living plants to have microphylls.

Homosporous:

Homosporous produce only one type of spore that contains both male and female parts The resulting gametophyte is monoecious that is both antheridia and archegonia are present on the same plant

Example: *Lycopodium. Equlsetum*

Heterosporous:

Produce two types of spores or distinct male and female spores or microspore and megaspores. The resulting gametophyte is dioecious. Microspore germinate to form male gametophyte that bears antheridia. Megaspore germinate to form female gametophyte that bears archegonia

Example: *Setaginella, Marsella*

Pollen tube:

It is a slender tube that is formed by a pollen grain of a seed plant and penetrates the ovule, where it releases the male gametes.

OR

It is a hollow tube which develops from a pollen grain when deposited on the stigma of a flower. It penetrates the style and conveys the male gametes to the ovule.

Double fertilization:

Union of one sperm with the egg and the second sperm with the fusion nucleus is called **double fertilization.** It only occurs in the flowering plants.

Racemose Inflorescence:

Here the main axis of inflorescence does not end in a flower but it continues to grow and give off flowers laterally

Examples: Radish and mustard *(Brassica)*.

Cymose Inflorescence:

Here the primary axis terminates in a flower but the growth continues through the lateral buds. These buds give rise to lateral branches which bear flowers. The flowers are arranged in basipetal succession, i.e., the outer or basal flowers are younger and the upper flowers are older.

Example: *Dianthus* (pink).

Compound Inflorescence:

In a compound inflorescence the peduncle or main axis of the inflorescence branches repeatedly in racemose or cymose manner and the ultimate branches bear flowers in a racemose or cymose manner.

Examples: Compound racemose, e.g., Goldmohur *(Delonix regia)*, Amaltas *(Cassia fistula)*, etc. Compound Spike, e.g., rice *(Oryza sativa)*.

22. Write the differences between:

(a) gametophyte and sporophyte
(b) antheridium and archegonium
(c) monoecious and dioecious
(d) cutin and cuticle
(e) mosses and liverworts
(f) roots and rhizoids
(g) homosporous and heterosporous
(h) antherozoids and sperms
(i) angiosperms and gymnosperms
(j) polar nuclei and fusion nuclei
(k) generative nucleus and pollen tube nucleus
(l) antipodal cells and synergids
(m) fertilization and double fertilization
(n) diploid and triploid
(o) racemose inflorescence and cymose inflorescence

Ans: (a) gametophyte and sporophyte:

Gametophyte	Sporophyte
It is haploid phase of life cycle.	It is diploid phase of life cycle.
It is specialized to produce gametes.	It produces spores.
All divisions are mitotic.	Meiosis occurs during formation of spores.
It is sexual generation.	It is asexual generation.
It is formed by germination of a meiospore.	It is formed by growth of a zygote.

(b) antheridium and archegonium:

Antheridium	Archegonium
Antheridium is the male part of seedless plants.	Archegonium is the female part of seedless plants
It is globular structure.	It is flask shape.
They consist of jacket cells.	They have a venter and a neck.

	Venter contains egg while neck contains neck canal cells
It produces flagellated antherozoids.	They produce egg.

(c) monoecious and dioecious:

Monoecious	Dioecious
Monoecious organisms have both male and female reproductive parts.	Dioecious organisms consist of both male and female in separate individuals.
Bisexual.	Unisexual maybe either male or female.
Exhibit uni-parental reproduction.	Exhibit bi-parental reproduction.
Plants are able to use both self and cross pollination.	Plants are able to use only cross pollination.
Examples: Earth worms, jelly fish Planaria and slugs.	**Examples:** Mammals, birds, reptiles and insects.

(d) cutin and cuticle:

Epidermal cells have covering of **cutin,** which is a wax like substance. It reduces the evaporation of water in plants. The layer of cutin is called **cuticle.**

(e) mosses and liverworts:

Mosses	Liverworts
The plant body has a radial symmetry.	The plant body is dorsiventral.
The plants are always leafy.	The plants may be thallose or foliose.
The leaves generally have a midrib.	Leaves, when present, are without a midrib.
Branching is lateral and extra-axillary.	Branching is generally dichotomous.
Rhizoids are multicellular.	Rhizoids are unicellular.
A filamentous protonema occurs.	A protonema stage is absent.
Seta grows slowly over a long period and fully developed before the spores mature.	Seta develops rapidly towards the maturity of spores.

(f) roots and rhizoids:

Roots	Rhizoids
Roots are present in vascular plants.	Rhizoids are present in non vascular plants.
Roots are much more complicated.	Rhizoids are very simple.
They are always multicellular.	They are unicellular and sometimes multicellular.
They possess xylem and phloem	They lack xylem and phloem
Roots have sophisticated structures containing different layers.	Rhizoids are filamentous in structure.

(g) homosporous and heterosporous:

Homosporous	Heterosporous
It produces bisexual gametophyte.	It produces unisexual gametophyte.

In the homosporous, Spores germinate in soil.	In the heterosporous, Spores germinate within sporangia.
They produce independent gametophyte.	They produce dependent gametophyte.
Examples of Homosporous pteridophytes are Lycopodium.	Examples of Heterosporous pteridophytes are Selaginella and Salvinia.

(h) antherozoids and sperms:

Sperms are the male gametes cells and antherozoids are flagellated sperms produced in the antheridia of Adiantum hence they can not be distinguished as different terms.

(i) angiosperms and gymnosperms:

Characteristic	Angiosperms	Gymnosperms
Definition	Seed-producing flowering plants whose seeds are enclosed within an ovary.	Seed-producing non-flowering plants whose seeds are unenclosed or "naked."
Seeds	Enclosed inside an ovary usually in a fruit.	Bare, not enclosed; found on scales, leaves or as cones.
Life Cycle	Seasonal	Evergreen
Reproductive system	Present in flowers; can be unisexual or bisexual	Cones; unisexual
Leaves	Flat	scalelike , needle-like
Reproduction	Mostly rely on animals.	Mostly rely on wind.
Uses	Medications, food, clothing, etc.	Paper, Lumber , etc.
Wood	Hardwood	Softwood
Cotyledons	Present	Absent

(j) polar nuclei and fusion nuclei:

Polar nuclei is the component of embryo sac formed by the mitosis in the mega spores followed by further division resulting into set of eight nuclei one of which is polar nuclei, they are two in number, placed in the centre. By the time egg has been fertilized, the two polar nuclei have combined to form a single **fusion nucleus.**

(k) generative nucleus and pollen tube nucleus:

As the pollen tube develops, the two nuclei of the pollen grain move into it. The two nuclei are called **generative nucleus** and the **pollen tube nucleus.** Generative nucleus divides again to form two somewhat elongated **sperms.** The tube nucleus is located near the tip of the pollen tube with two sperms following behind. The pollen tube, containing tube nucleus and the two sperms (male gametes), is the **male gametophyte** (microgametophyte).

(l) antipodal cells and synergids:

Antipodal cells and synergids are the components of embryo sac forming the female gametophyte along with polar nuclei and egg. **Antipodal cells** are three in number and are present at the opposite end of the micropyle, and have no function and sooner or later get disorganized. **Synergids** are two in number at the micropyler end. These help in fertilization by guiding the pollen tube and as soon as their function is over these get disorganized.

(m) fertilization and double fertilization:

Fertilization	Double fertilization
It is union of two compatible gametes.	It is union of one male gamete with egg and the other male gamete with secondary nucleus of the same embryo sac.
It occurs in almost all eukaryotes.	It is restricted to angiosperms only
Fertilization produces a diploid zygote.	Double fertilization produces a diploid zygote and a triploid primary endosperm cell.

(n) diploid and triploid:

Diploid	Triploid
Diploid is that carrying two sets of chromosome in genome in nucleus.	Triploid consist of three sets of haploid number of chromosome

(o) racemose inflorescence and cymose inflorescence:

racemose inflorescence	cymose inflorescence
The growth of the inflorescence is indefinite.	The growth of the inflorescence is definite.
The main axis does not terminate in a flower and continuous to grow and forms flowers laterally.	The main axis and its branches terminate in a flower.
The floral axis is monopodial.	The floral axis is multipodia
Young fruits are not protected by flowers	Young fruits are protected by flowers
Flowers develop from all sides	Flowers develop from one or two sides.
Examples: Raddish, Brassica	**Example:** Diantheus (pink)

EXTENSIVE QUESTIONS

23. Describe the general characteristics of bryophytes.

Ans: General characteristics of bryophytes:

The bryophyta is a group of plants comprising of liverworts, hornworts and mosses are the only nonvascular plants.

Size:

Bryophytes are typically quite small and a few exceed 2 centimetres in length.

(l) antipodal cells and synergids:

Antipodal cells and synergids are the components of embryo sac forming the female gametophyte along with polar nuclei and egg. **Antipodal cells** are three in number and are present at the opposite end of the micropyle, and have no function and sooner or later get disorganized. **Synergids** are two in number at the micropyler end. These help in fertilization by guiding the pollen tube and as soon as their function is over these get disorganized.

(m) fertilization and double fertilization:

Fertilization	Double fertilization
It is union of two compatible gametes.	It is union of one male gamete with egg and the other male gamete with secondary nucleus of the same embryo sac.
It occurs in almost all eukaryotes.	It is restricted to angiosperms only
Fertilization produces a diploid zygote.	Double fertilization produces a diploid zygote and a triploid primary endosperm cell.

(n) diploid and triploid:

Diploid	Triploid
Diploid is that carrying two sets of chromosome in genome in nucleus.	Triploid consist of three sets of haploid number of chromosome

(o) racemose inflorescence and cymose inflorescence:

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The bryophyta is a group of plants comprising of liverworts, hornworts and mosses are the only nonvascular plants.

Size:

Bryophytes are typically quite small and a few exceed 2 centimetres in length.

Aquatic:

They generally require a moist environment for active growth and reproduction, but some bryophytes tolerate dry areas.

Gametophytes and sporophytes generations:

The gametophytes of bryophytes are green and manufacture their own food. They are relatively large and evident as compared to sporophytes. Some of their sporophytes are completely enclosed within gametophyte tissue, others that are not enclosed; turn brownish or straw coloured at maturity.

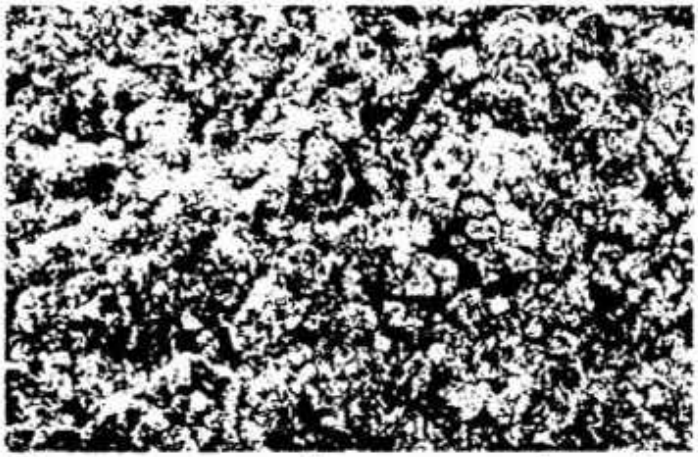
Features: The four main features of bryophytes are:

(1) They lack specialized vascular tissues.

(2) Multicellular sex organs produce embryo.

(3) Sporophytes are always smaller and obtain their food from the gametophyte.

(4) Their life cycles are similar to seed plants. Bryophytes are also called amphibious **plants** because they need water for development, existence and reproduction.



Mosses covering several rocks

24. Describe the life cycle of moss with diagram.

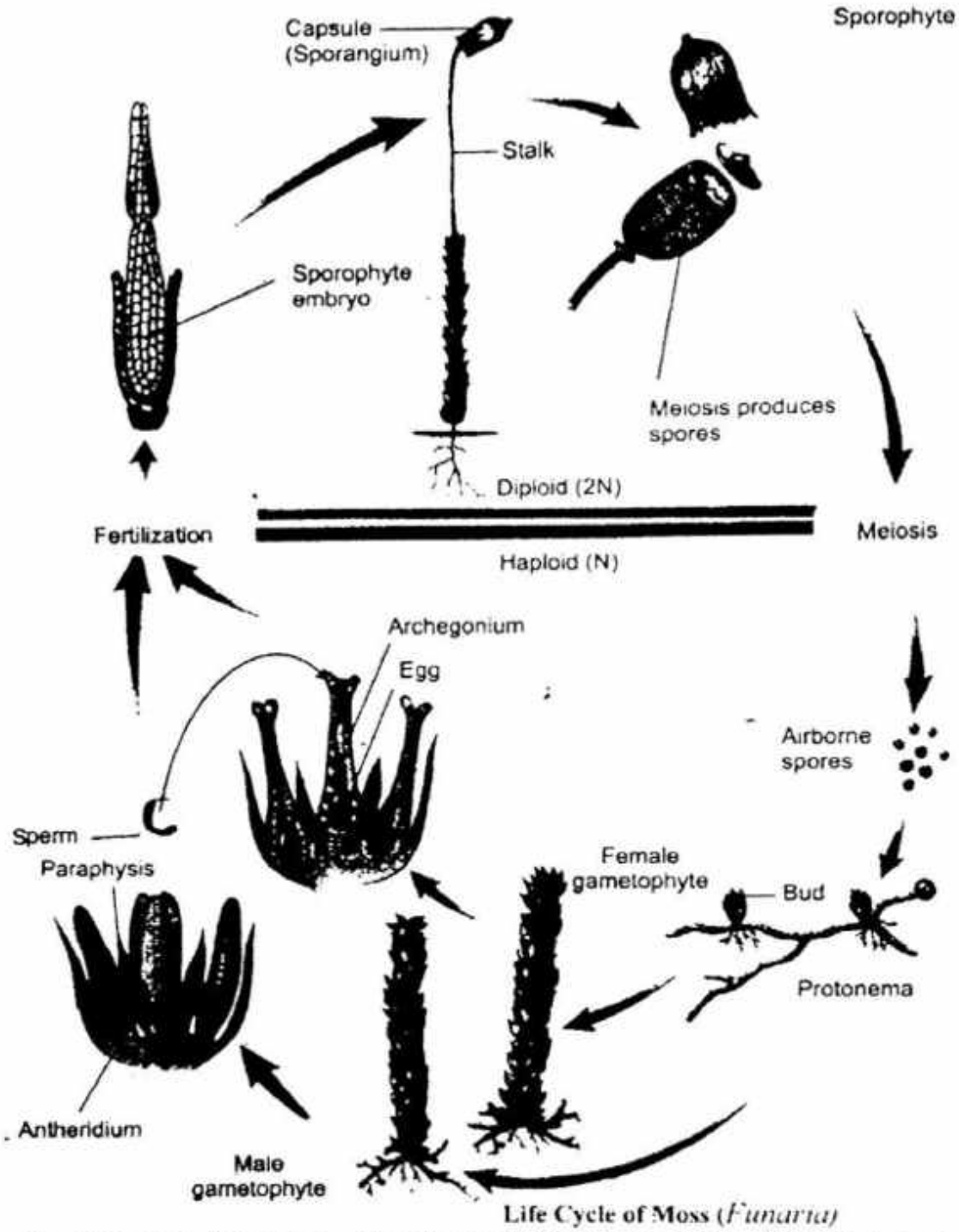
Ans: Life Cycle of Moss:

Alternation of generation:

The moss plants show two generations the sporophyte and the gametophyte, which regularly alternate with each other. It is known as **alternation of generation.** The life cycle is completed when the plant passes through these two generations.

Life Cycle:

The matured green shoot is the **gametophyte.** It produces gametes and reproduces by sexual method. The sex organ is at the apex of the shoot. The male sex organ is known as **antheridium** and the female sex organ as **archegonium** *(ar-keh-gonium).* The sex organs are intermixed with some multicellular hair like structures, known as **paraphyses.** The two sex organs may occur on the same plant i.e., **monoecious** or on two separate plants, i.e., **dioecious.** The **sporophyte** consists of a foot which is embedded in the tissue of the gametophyte and a **stalk** with a **sporangium.**



Life Cycle of Moss (*Funaria*)

Spores are formed in the sporophyte by meiosis, thus the spores are haploid. The spore germinates into alga like structure called **protonema,** having bud and branches. The bud gives rise to gametophyte. In the antheridium the sperms are produced. In the **archegonium** the egg is produced. The flagellated sperms swim through the film of water to the egg. Fertilization is internal. The diploid zygote divides and forms the embryo. The embryo develops into a diploid sporophyte.

25. Explain the land adaptive characteristics exhibited by bryophytes.

Ans: The Land Adaptations of Bryophytes:

The land adaptive characteristics exhibited by nonvascular plants are:

(1) The Multicellular plant body and conservation of water:

The plant body of liverworts called thallus is multicellular consists of hundreds of cells e.g., *Marchantia (Mar-kan-shia).* Only the cells of the upper layer are exposed to the atmosphere. Some cells are photosynthetic and some are

storage cells. Water cannot evaporate from these inner cells because the upper epidermis has covering of **cutin,** which is a wax like substance. It reduces the evaporation of water in some mosses and liverworts. The layer of cutin is called **cuticle.**



Marchantia thallus

(2) Absorption of carbon dioxide:

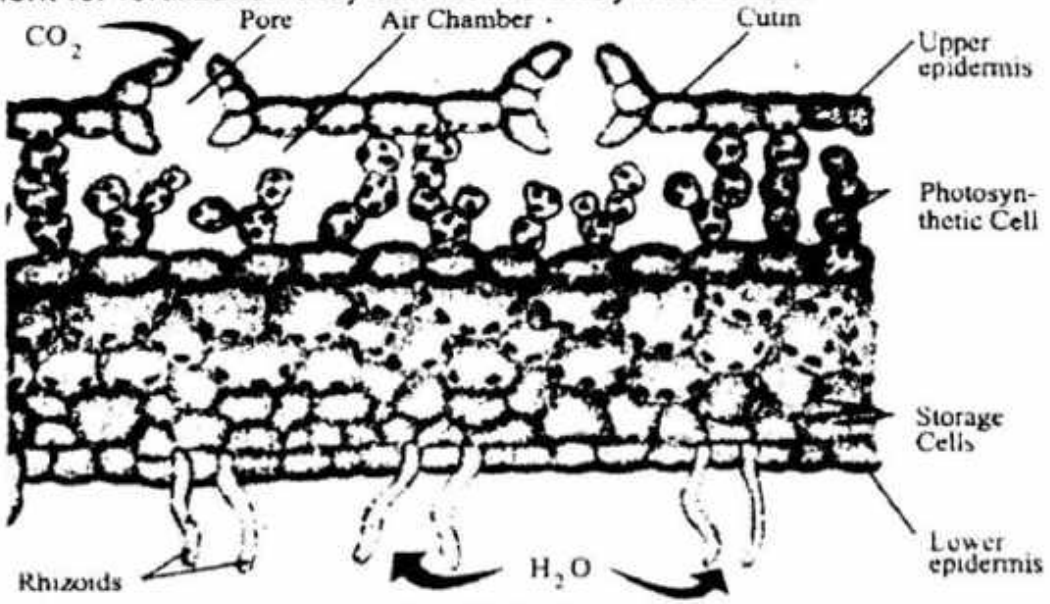
The upper epidermis in *Marchantia* has many **pores,** which open into the air chamber. The air chamber is surrounded with photosynthetic cells. CO_2 is absorbed by large amount of wet surfaces of the photosynthetic cells of the air chambers. CO_2 then diffuses into the cytoplasm. When CO_2 is being absorbed, evaporation of water may occur through the pores.

(3) Absorption of water:

The structures for absorption of water in moss and liverworts are **rhizoids.** These are present on the lower surface of the *Marchantia* thallus. Rhizoids are long filamentous structures. They are unicellular and are extensions of the cell of the lower epidermis. Rhizoids increase the surface area for absorption of water from the soil and also help in anchorage.

(4) Heterogamy:

When two types of gametes are produced, it is called heterogamy. Sperms and ova are produced by the nonvascular plants, e.g., Moss, *Marchantia* etc. The **sperms** are flagellated and motile, require water for reaching egg. The **egg** is large and nonmotile. It contains large amount of food, which is used to nourish the early stages of the developing embryo after the fertilization of egg. Due to the water requirement for fertilization they cannot live away from water.



Transverse Section of Marchantia Thallus



(a) Disk shaped structures that bear antherida in *Marchantia*



(b) Umbrella shaped structures that bear archegoniain in *Marchantia*

(5) Protection of reproductive cells:

The moss *Marchantia* etc. can be distinguished as male and female plants. The sex organs are multicellular and are covered by sterile hairs to prevent the drying of the sex organs. Most of the cells of the sex organs are sterile which form a protective coat around the egg and sperms. Protection of spore is performed by sporangium.

(6) Embryo Formation:

Fertilization is inside the archegonium. The zygote divides to form the embryo and is retained inside the archegonium. The chances of survival of embryo are increased as it is protected by the wall of the archegonium. Embryo is present in all bryophytes and vascular plants.

(7) Alternation of Generations:

The mosses and liverworts have a life cycle with alternating gametophyte and sporophyte generations. It increases the chances of survival of the plants on land

26. Give a brief account of: (a) Psilopsida (b) Lycopsida (c) Sphenopsida (d) Pteropsida with examples.

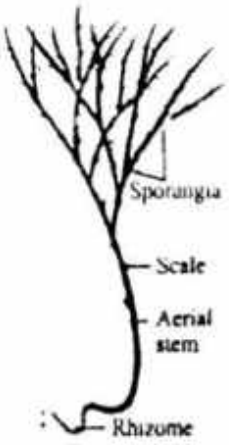
Ans: (a) Psilopsida

The group psilopsida includes the simplest known vascular plants known as **whisk ferns,** named for their resemblance to whiskbrooms. The whisk fern lack true roots but bear underground stems called rhizomes that bear **rhizoids.**

Aerial stems have no leaves, they have only tiny scales fork repeatedly and carry on photosynthesis. **Sporangia** are present at the tips of the branches. Most members of this group are extinct

Examples: Example of extinct group are *Rhynia*. *Psilotum* is the most common living genus.





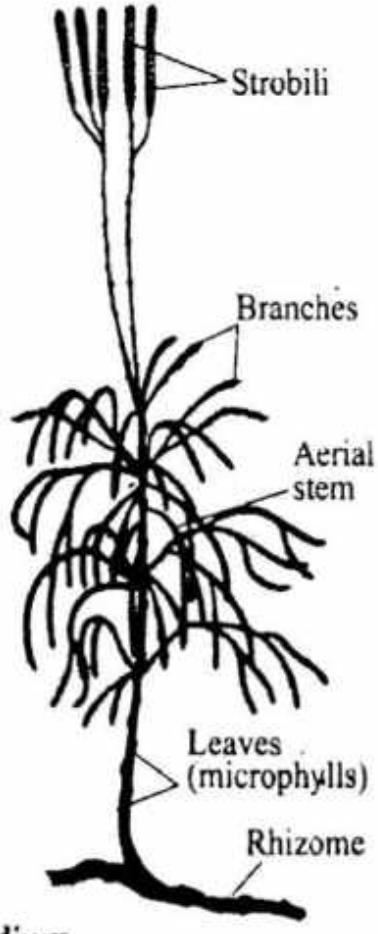
Whisk Fern, *Psilotum*

(b) Lycopsida:

Lycopsida includes the **club mosses, spike mosses** and **quillwort.** The plant body consists of a branching **rhizome** which sends up aerial stems less than 30 cm tall. Tightly packed scale like leaves cover the stem and branches of the plants. The leaves are **microphylls,** having only one strand of vascular tissue. In club mosses the sporangia are born on terminal clusters of leaves called **strobili** (sing. *strobilus)* which are club shaped. They are only living plants to have microphylls.

Examples: The familiar members of this group belong to genera *Lycopodium* and *Selaginella*.





Club Moss, *Lycopodium*

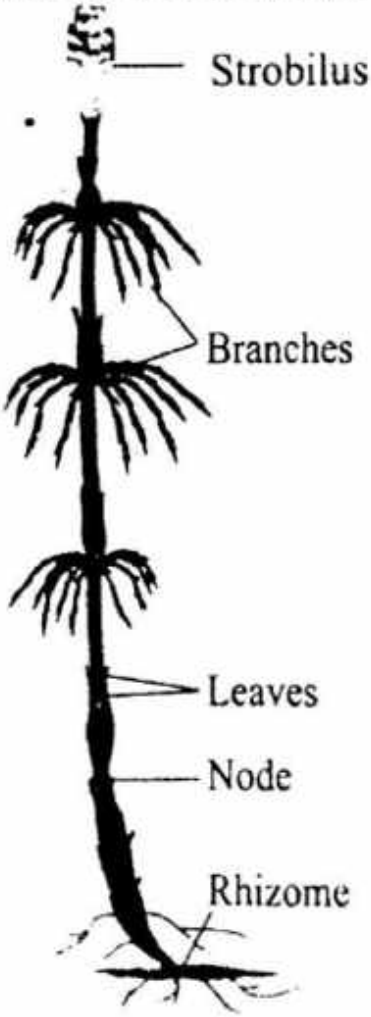
(c) Sphenopsida:

Sphenopsida commonly known as horsetails, are found in waste and wet places all over the world. Sphenopsida includes more fossil plants than living one. Today there is only one surviving genus *Equisetum*.

A rhizome produces aerial stem. The stems are slender, green, hollow structure, and appear jointed as slender green side branches are present at the nodes. The small and scale like leaves also form whorls at the **nodes,** the nodes are separated by **internodes.** Many horsetails have strobilus at the tips of the stem.



Horsetail, *Equisetum*



(d) Pteropsida:

Ferns belong to the group pteropsida, subgroup or class **filicinae,** which are most abundant group of seedless vascular plants in warm and moist tropical regions.

Size:

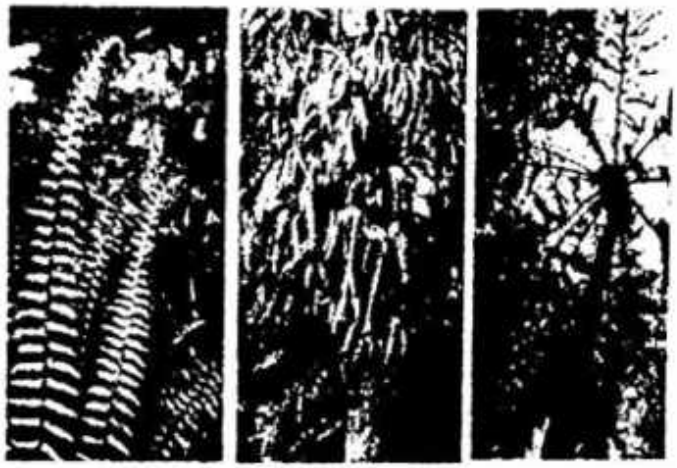
Ferns range in size from reduced aquatic forms less than a centimetre, to a tree fern that may have trunks more than 24 metres tall, with leaves up to 5 metres or more in length.

Reproductive characteristics:

Except few all the ferns are **homosporous.** Sporophyte generation is much larger, more conspicuous, and more complex than the gametophyte. Sporophyte is completely independent. Sporangia are foliar, i.e., attached to leaves or fronds. When the frond is young and immature, it is coiled.

Circinate vernation:

This pattern of development is called **circinate vernation.** It is an important feature of ferns.



Ferns

27. Describe evolution of leaf.

Ans: Evolution of leaf:

Leaves are present in higher vascular plants. They have evolved from the primitive vascular plants. There are two main types of leaves in vascular plants:

(a) One veined leaves. **(b) Many veined leaves.**

(a) One veined leaves:

One veined leaves are small and scale like. They have single vascular bundle and vein. Therefore they are called single or one veined leaves or microphyllous leaves.

Example:

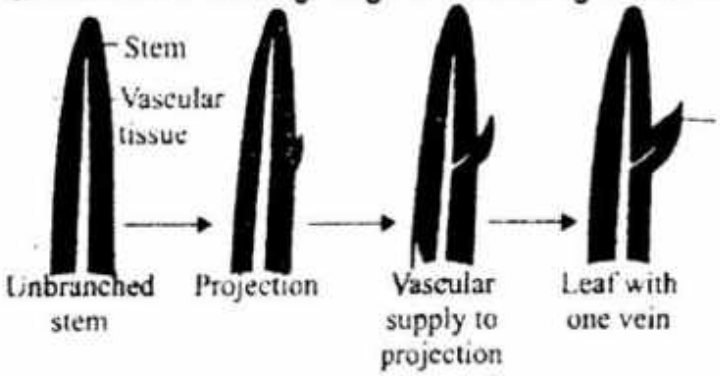
Club mosses *(Lycopodium).*

There is no fossil record showing the evolution of **single veined leaves.** However two hypotheses (singular: *hypothesis)* have been proposed to explain their origin:

(i) Outgrowth hypothesis **(ii) Reduction hypothesis**

(i) Outgrowth hypothesis:

According to **out-growth hypothesis** single veined leaf originated as simple outgrowth from the naked branches of the primitive plant. The outgrowths had no vascular tissues. With the increase in size, vascular tissues were needed for the transportation of food, water etc. and support. Thus vascular supply was extended from main vascular bundle of stem giving rise to a single veined leaf.



Evolution of Single Veined Leaf, Outgrowth Hypothesis

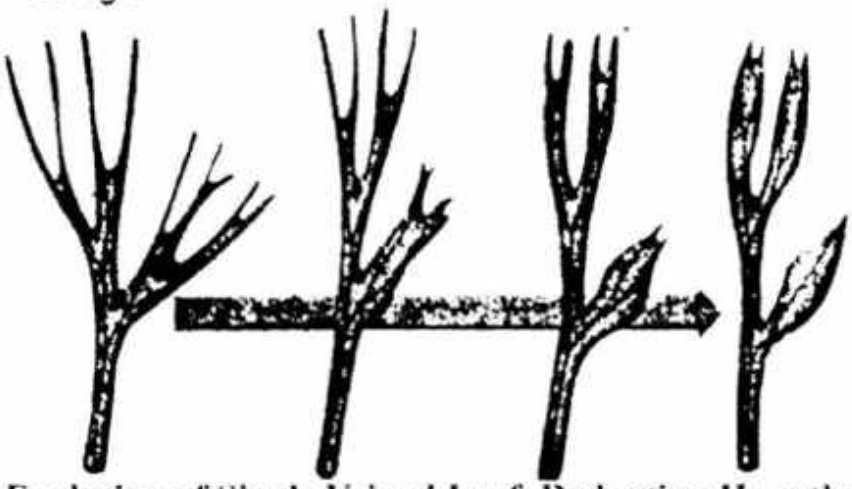
(ii) Reduction hypothesis:

The **reduction hypothesis** states that the early vascular plants had leafless branches These branches were gradually reduced in size. Thus by simplification and reduction in size and flattening of the leafless branches the single veined leaves were evolved

(b) Many veined leaves:

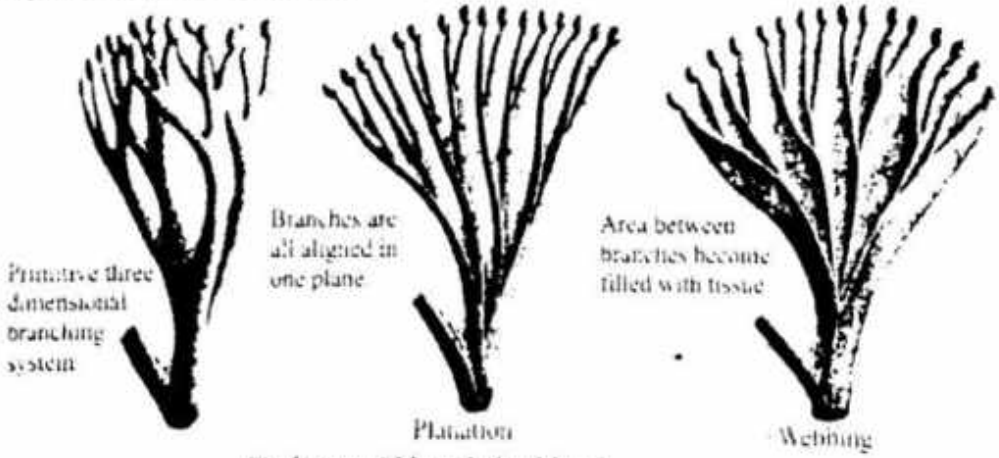
Many veined leaves are large leaves having prominent blade As many veins and vascular bundles are present so they are called many veined leaves or megaphyllous leaves

Example: Ginkgo



Evolution of Single Veined Leaf, Reduction Hypothesis

It is evident from fossil record that **many veined leaves** have evolved through modification of the forked branches found in early vascular plants e g *Rhynia*. According to this view the forked branches were changed to a single plane known as **planation**. The branches became flat The spaces between the bundles and branches of vascular tissues became filled with photosynthetic tissues called **webbing**. The structure resembles superficially to the webbed foot of the duck and thus a many veined leaf evolved

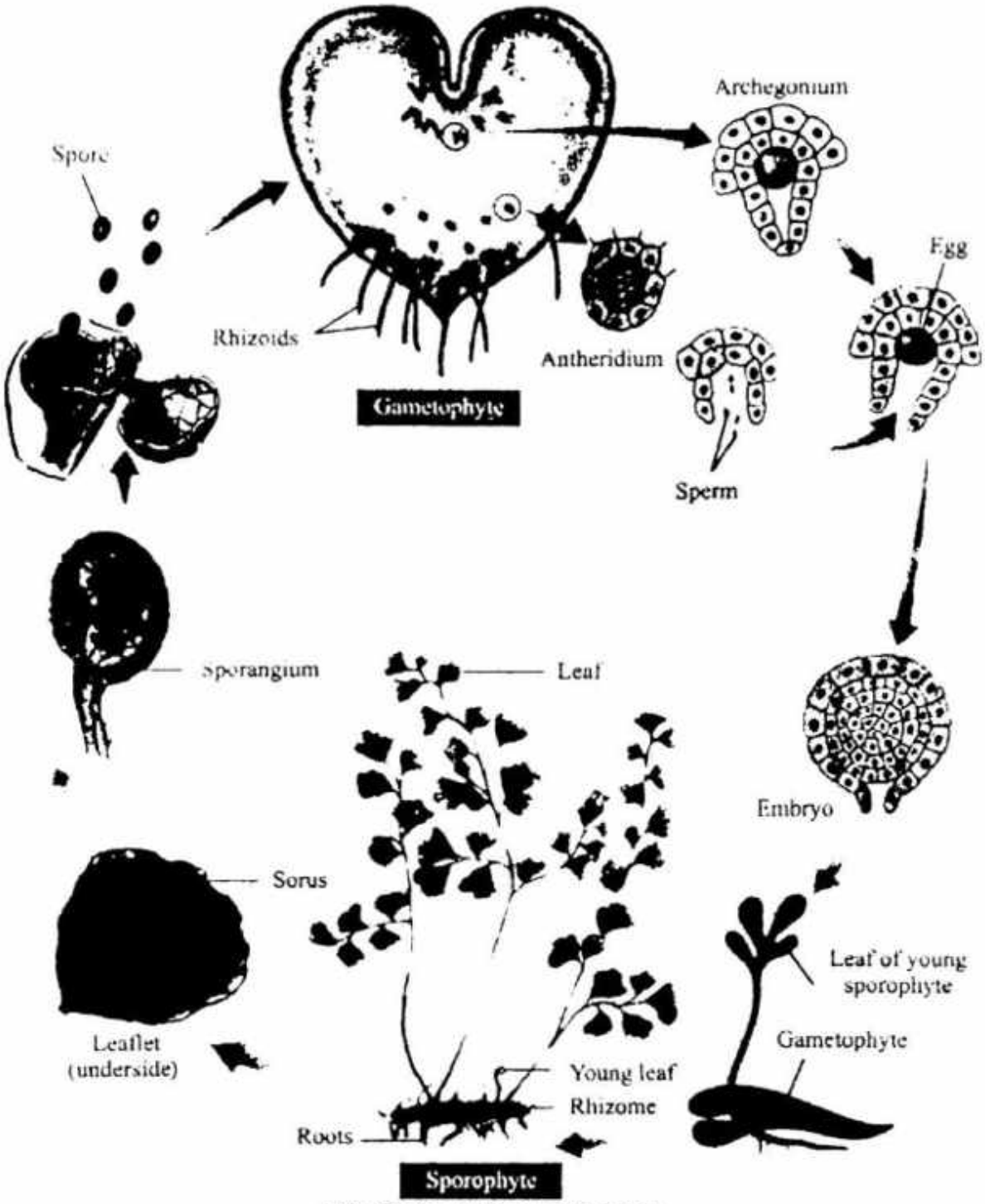


Evolution of Many Veined Leaf

28. Describe the life cycle of fern (Adiantum).

Ans: Life Cycle of Fern *(Adiantum):*

Life cycle of *Adiantum* (Maidenhair fern) contains two generations i e sporophyte and gametophyte Both of these generations are independent



Life Cycle of Fern (*Adiantum*)

Sporophyte generation:

Sporophyte *of Adiantum* produces vegetative leaves at start. At later stages, fertile leaves also start producing along with vegetative leaves. Fertile leaves produce sori (singular: *sows)* on their underside. Sori are group of sporangia. These sori are covered with a flap of tissue called **false indusium.**

Sporangium:

A mature sporangium is flattened, spherical or ellipsoidal. It consists of a stalk and upper swollen portion called **capsule.** Capsule is covered with single layered wall. Wall consists of two portions **annulus** and **stomium.** Annulus portion contains cells with thick radial and inner tangential cell walls

Stomium consists of cell with thin cell walls. This is the site for bursting of sporangia. Inside sporangia spores are produced by meiosis of spore mother cells. Many spores are produced inside sporangia. Spore wall contains two layers **exine** and **intine.**

When spores get mature, the wall of sporangia burst. Sporangium becomes dry, so the cells of annulus region contracts which exerts pressure on stomium cells. Stomium is weak region of wall of sporangia, so sporangia get burst from this region.

Bursting of sporangia caused the dispersal of spores. After falling on suitable place, spore germinates. During germination, exine of spore bursts and intine elongate into a tube like structure. The apical portion of tube gives rise to new generation *of Adiantum* the gametophyte generation.

Gametophyte generation:

The shape of gametophyte *of Adiantum* is heart like. It has a notch, where growing point reside. Gametophyte of *Adiantum* is many cells thick from centre and only one cell thick at margins. **Rhizoids** are produced from underside of gametophyte for anchorage and absorption of water and nutrients. Gametophyte contains chloroplast, so carry out photosynthesis. Gametophyte is independent. Two kinds of organs **antheridia** and **archegonia** are produced on gametophyte.

Archegonia is flask shaped structure with two portions i.e., **ventre** and **neck.** Ventre contain egg while neck contains **neck canal cells.** Antheridia are globose structures, in which many **antherozoids** are produced. Antherozoids when get mature has two flagella for movement in water.

Antherozoids after releasing from antheridia travel through water chemotactically towards archegonia. **Antherozoids** fertilize the egg inside archegonia. Resultant zygote develops into embryo. Embryo starts divisions to form sporophyte. Sporophyte remains dependent on gametophyte at start but soon it becomes independent. The life cycle of *Adiantum* shows heteromorphic alternation of generation.

29. Give an account of vascular plants as successful land plants.

Ans: VASCULAR PLANTS - Successful Land Plants:

The three groups of vascular plants i.e., seedless ferns, naked seeded gymnosperm and covered seeded angiosperms show many adaptations to become the successful group of land plants.

Ferns:

Ferns have true roots, stems and leaves. Leaves are green photosynthetic. Gametophyte lacks vascular tissue. Gametophyte is separated from sporophyte. Flagellated sperms require outside source of water for fertilization.

Some ferns e.g., bracken fern can spread into drier areas by means of vegetative (asexual) reproduction. Fern also spreads by means of rhizome.

Gymnosperms:

Gymnosperms have well developed roots and stem. Many are tall trees that can withstand heat, dryness and cold. **Pollen grains** are transferred by wind, and the growth of the pollen tube delivers a sperm to an egg. Enclosure of the dependent megagametophyte in an ovule protects it during its development and shelters the developing zygote as well.

Finally the **embryo** is protected within the seed. All these factors increase the chance for reproductive success on land

Angiosperms:

Angiosperms have true roots, stems and leaves. The vascular tissue is well developed. **Xylem tissue** contains **xylem vessels** as well as **tracheids. Leaves** are generally broad, expanded blades and are very efficient in absorbing light for photosynthesis. Shedding of leaves during cold or dry spells is also an advantage for survival in harsh environment.

Angiosperms are found in all sorts of habitats, and some have even returned to water. The reproductive organs are the **flowers,** which attract animal pollinators. Flowers are modified in wind pollinated plants.

30. Give an account of gymnosperms.

Ans: Gymnosperms:

General characteristics:

The plant body gymnosperms may be tall, woody, perennial trees or shrubs. The plant body is a sporophyte, differentiated into stem, leaves and root. Stem is branched with the exception of *Cycas*, which is rarely branched.

Types of leaves:

There are two types of leaves. The foliage leaves and the scaler leaves. Foliage leaves may be simple or compound. The leaves are evergreen with thick cuticle. Venation is simple.

Arrangement of leaves:

The arrangement of leaves may be spiral or cyclic.

Xerophytic features:

Leaves exhibit xerophytic features like thick and tough cuticle, stomata sunken in pits, presence of wax on the surface.

Xylem:

Xylem consists of tracheids and xylem parenchyma. Vessels and wood fibres are generally absent with exceptions of Gnetales.

Phloem:

Companion cells are absent in phloem.

Sporophylls:

Cones are unisexual. Male and female sporophylls are arranged on straight axis.

Heterosporous:

Gymnosperms are heterosporous, i.e., produce microspores and megaspores.

Alternation of generation:

There is alternation of generation, i.e., sporopohytic and gametophytic generation.

Polyembryony:

Polyembryony is of common occurrence, but finally a single embryo matures.

Uses of gymnosperms:

(i) Pine seeds like chilghoza are eaten as dry fruits.

(ii) Ephedrine, a drug from *Ephedra* is used for the relief of asthma and other respiratory ailments.

(iii) Conifers are a source of soft wood for construction, packing, plywood, board and for making paper

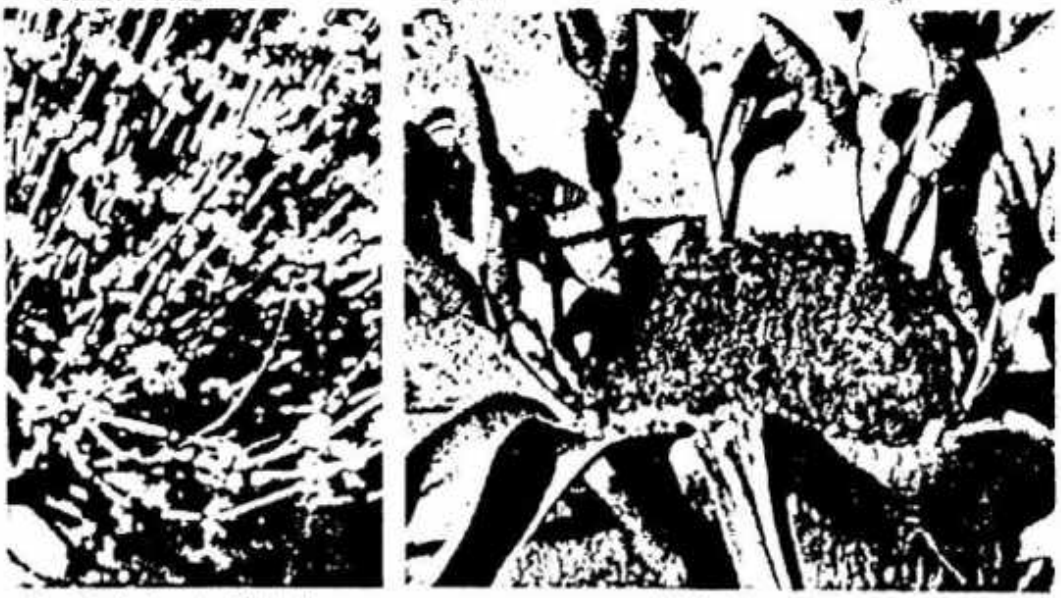
(iv) **Cycads** are grown as ornamental plants

(v) *Cycas circinalis*, which grows as a wild cycad, serves as a source of "sago" It is pure starch extracted in liquid state and then solidifies to form small granules.

(vi) Resins, terpentine, tar and many oils are obtained from conifers



Conifers: *Pinus* *Cycas* *Ginkgo*



Gnetophytes: *(a) Ephedra* *(b) Welwitschia*

Gymnosperms

31. Describe the life cycle of a flowering plant and how it demonstrates an adaptation of angiosperms on land.

Ans: Life Cycle of a Flowering Plant:

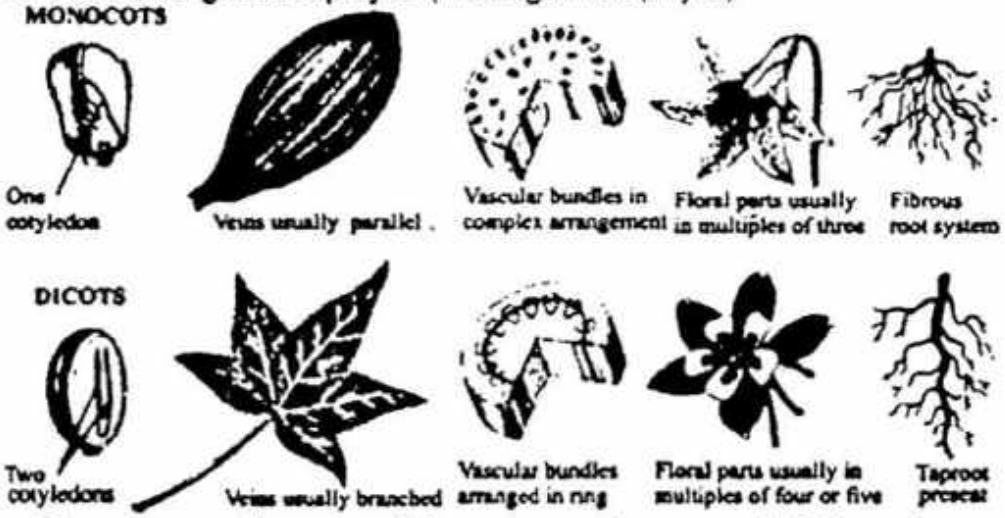
There is an alternation of generations in the flowering plants The sporophyte, a diploid dominant generation alternates with haploid inconspicuous gametophytic generation.

The main plant body is diploid **sporophyte** which produces haploid spores Flower is the reproductive structure which bears anthers and carpels as male and female reproductive parts respectively The anther when fully developed contains 2 to 4 elongated sacs called **pollen sacs.** The pollen sacs contain pollen grains

Formation of pollen grains:

When the anther is developing, mitotic divisions produce local masses called **microspore mother cells** (microsporocyte). Following meiosis in a diploid mother cell, four haploid microspores are produced. A **microspore** divides mitotically into a two celled **pollen grain** (microspore). A tough wall develops around the pollen grain, which protects the contents of the pollen grain from drying out. Cells on the surface of the stigma secrete a sticky nutrient fluid, containing sugar and other substances. After pollination the pollen grains germinate on the stigma. Each pollen grain produces a slender, thin walled **pollen tube.** The pollen tube grows down, through the tissues of the stigma, style and ovary until it reaches the ovule.

As the pollen tube develops the two nuclei of the pollen grain move into it. The two nuclei are called **generative nucleus** and the **pollen tube nucleus.** Generative nucleus divides again to form two somewhat elongated **sperms.** The tube nucleus is located near the tip of the pollen tube with two sperms following behind. The pollen tube, containing tube nucleus and the two sperms (male gametes), is the **male gametophyte** (microgametophyte)

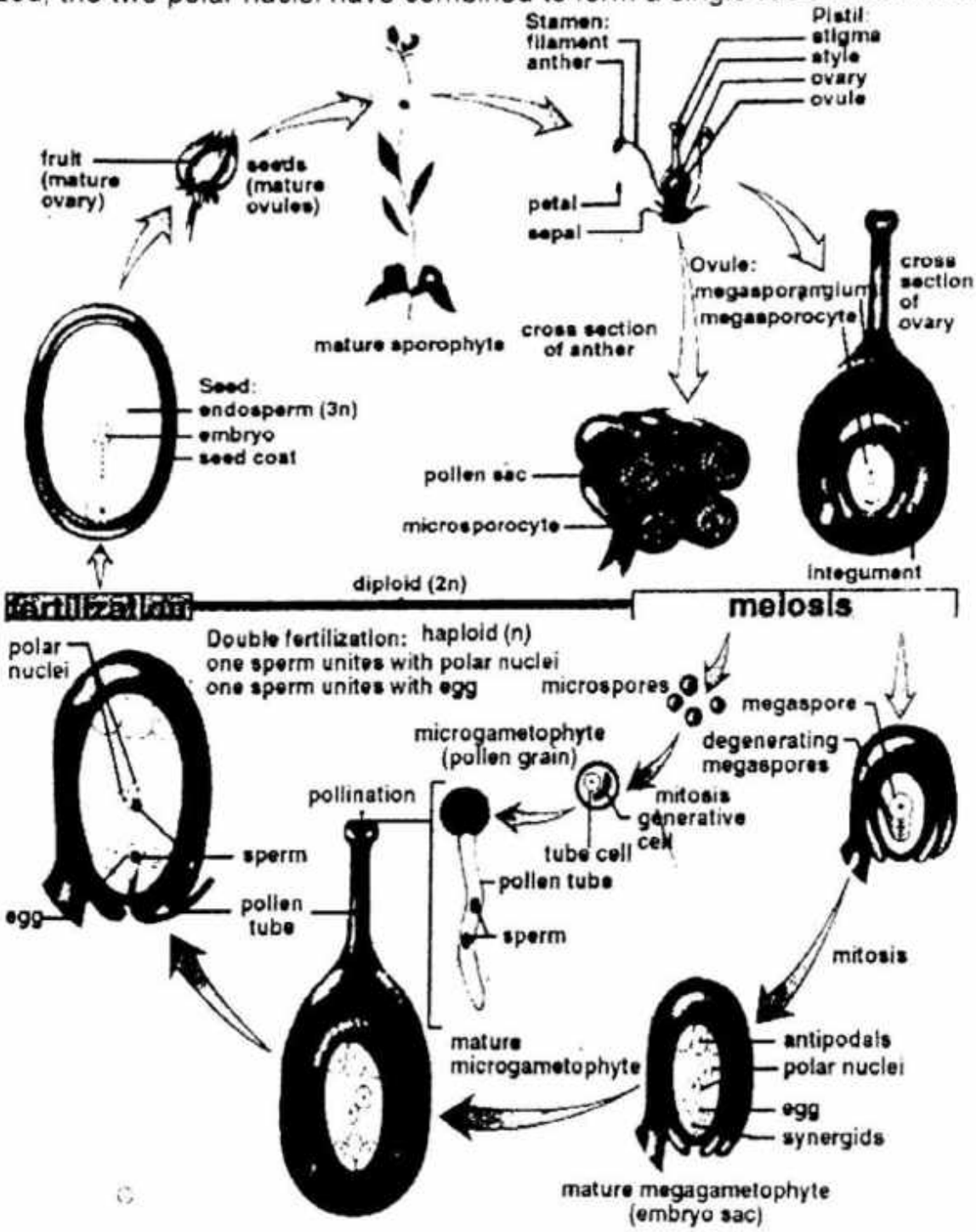


Comparison: Monocots and Dicots

The **ovule** is an egg shaped structure attached by a stalk, to the inside of the ovary. Depending upon the species of the plant involved, an ovary may have one, two, several or even thousands of ovules. The ovule has an opening called **micropyle.** Certain cells (megasporocyte) of the ovule undergo meiosis to produce four monoploid (haploid) cells. Only one of these cells survives. The surviving cell is called the megaspore, which means large spore. The megaspore nucleus divides by mitosis to form two haploid nuclei. Each of these nuclei divides two more times to produce a total of eight haploid nuclei. At the centre of the ovule is the microscopic structure called **embryo sac** having all these eight nuclei. Wall formation takes place and these nuclei are converted into cells. The cells of embryo sac are antipodal cells, polar nuclei, synergids and egg. The embryo sac having these cells are called **female** gametophyte.

Antipodal cells are three in number and are present at the opposite end of the micropyle, and have no function and sooner or later get disorganized. **Synergids** are two in number at the micropyler end. These help in fertilization by guiding the pollen tube and as soon as their function is over these get disorganized

Polar nuclei are two in number, placed in the centre. By the time egg has been fertilized, the two polar nuclei have combined to form a single **fusion nucleus.**



Life cycle of angiosperm

Egg is one in number and is present between the two synergids. Soon after the tip of the pollen tube enters the embryo sac, the end of the tube ruptures and releases the two sperms into the embryo sac. The first sperm fuses with the egg to form a **zygote.**

The zygote develops into an embryonic plant within the ovule. The second sperm deposited in the embryo sac by the pollen tube moves to the centre and unites with the fusion nucleus. Union of one sperm with the egg and the second sperm with the fusion nucleus is called **double fertilization.** It only occurs in the flowering plants.

Formation of seeds and fruits:

Zygote develops into an **embryonic plant** within the ovule. After fertilization fusion nucleus develops into an **endosperm.** It is **triploid,** i.e. consists of three sets of haploid number of chromosomes as two polar nuclei, and one sperm nucleus fuses to form it. Endosperm divides, enlarges and is used as store of food for the young embryo.

After double fertilization the formation of **embryo** and endosperm tissue takes place. As a result the ovule increases in size. The embryo consists of (i) one or two cotyledons (ii) epicotyl (iii) hypocotyl. Both epicotyl and hypocotyl are the parts of the rod like axis attached to the cotyledons. In some plants cotyledons digest and absorb endosperm as the ovule is maturing into **seed.** The ovary wall enlarges and ripens to become the **fruit.**

Adaptations of angiosperms on land:

The life cycle demonstrates adaptations of angiosperms on land. Fertilization takes place through pollen tube independent of external water. Double fertilization increases reproductive success. Following fertilization the ovules located in ovaries develop into seed. An ovary wall is transformed into a fruit. Fruits provide protection for seeds and a mechanism for their wide dispersal.

32. Write in tabular form the difference between dicots and monocots.

Ans: Differences between dicots and monocots:

	Dicots	Monocots
Leaf	Broad, generally bifacial with reticulate venation	Long narrow, lanceolate, monoficial with parallel venation
Stem	Vascular bundle in ring, vascular cambium is present which gives secondary growth	Vascular bundles scattered vascular cambium usually absent so no secondary growth occurs
Root	Primary root is a tap root which develops lateral root 2-8 patches of xylem, vascular cambium present secondary growth occurs	Adventitious roots arise from the base of stem, and give rise to a fibrous root system. Always more than 8 patches of xylem. Vascular cambium absent so no secondary growth.
Seed	Embryo has two cotyledons	It has one cotyledon
Flower	Typically tetra or penta-merous calyx and corolla usually differ from each other. Flowers are usually insect pollinated	Parts usually in three i.e. trimerous. No distinction between calyx and corolla. Flowers are often air pollinated
Example	Rose, pea, buttercup etc	Lilies, orchids grasses, wheat rice

33. Discuss significance of angiosperms to humans.

Ans: Significance of Angiosperms to Humans:

Cereals:

Cereals constitute the staple food of man. Major cereals are wheat rice, maize barley oat etc.

Pulses:

Pulses are seeds of leguminous plants. **These are** rich in proteins. Common pulses are lentil, arhar, urd, pea, gram, **green gram**, soyabean, black gram.

Vegetables:

The main **vegetables** obtained from **angiosperms** include carrot, radish, cabbage, cauliflower, potato, tomato, okra (**lady's fingers**).

Fruits:

The **fruits** are mango, apple, banana, **guava**, grapes, melon, mulberry, pears, etc. Nuts consumed as dry fruits are **cashewnut**, **almonds**, walnut etc.

Edible oils:

Edible oils used for cooking are obtained from groundnut, mustard, cotton seeds, coconut and sunflower.

Spices:

Spices include cinnamon, (vern. dalchini), cloves (vern. laung), chillies, black pepper (vern. kali mirch), caraway (vern. **zeera**), coriander (vern. dhania), fennel (vem saunf). Tea, Coffee and Cocoa **are** important beverages obtained from flowering plants.

Sugar:

Sugar is obtained from sugarcane and **beet roots**.

Fodder:

Many plants yield **fodder** for the cattle. Important fodder giving plants are *Trifolium* (barseem), *Melilotus* (senji), etc.

Drugs:

A large number of **drugs** are obtained from flowering plants. Some of the drugs are aconite, belladonna, quinine, malathi, **santonin**, digitalis, asgandh, etc.

Timber:

Important **timber** yielding plants are **teak**, sal, oak and **sisso** (vern. sheeshum). Commercial cork is obtained from oak.

Fibres:

Many plants provide us **fibres** for various **uses**. Textile fibres are obtained from cotton, rough fibres for making ropes and **gunny bags** are obtained from flax, hemp etc. Jute fibres are obtained from plants in **genus** *Corchorus*, which are used to make ropes, bags, carpets, and mats etc. **The husk** of fruits of coconut is used for making coir brooms and duster etc.

Ornamental plants:

A large number of flowering plants **are** grown in gardens and houses as ornamental plants. Common among them **are bougainvilleas**, roses, petunias, chrysanthemums, crotons, coleus, etc.