Chapter = 08

Diversity Among Plants

DIVERSITY AMONG PLANTS:

Plants are multi cellular, photosynthetic having cell wall, vacuole, and photosynthetic pigments. Development involve embryo and heteromorphic alternation of generation. Plants can reproduce both asexually and sexually.

Evolutionary Relations in Plants:

- In the beginning plants were restricted to aquatic conditions.
- Started migration to land nearly 350 MYA.
- Gradually adapted to terrestrial habitat but can live in every habitat.
- Show enormous diversity in size and form due to Cuticle, Protective sheath around sex organ.

Transport tissues xylem and phloem, Leaves and roots, Woody tissues, Transport of male gametes to female reproductive
organ.

- Earliest vascular plants were small and restricted to swampy areas

Characters of Plants:

i. Plants are Multicellular eukaryotes.
ii. Nutrition-photosynthetic autotroph having pigments especially chlorophyll.
iii. Cell wall - Rigid Cell Wall present made up of cellulose.
iv. Life cycle-shows heteromorphic alternation of generation.
V. Zygote retained and develop into embryo.
vi. Waxy protective layer-made up of cuticle, prevent loss of water.
vii. Sporopollenin - tough made up of carotenoids, protects plants from grazing and microorganism, also protects spore from biodegradation .
viii. Lignin - a class of complex organic polymers that form key structural materials in the supporting tissues.
ix. Stomata and lenticels - for gaseous exchange.

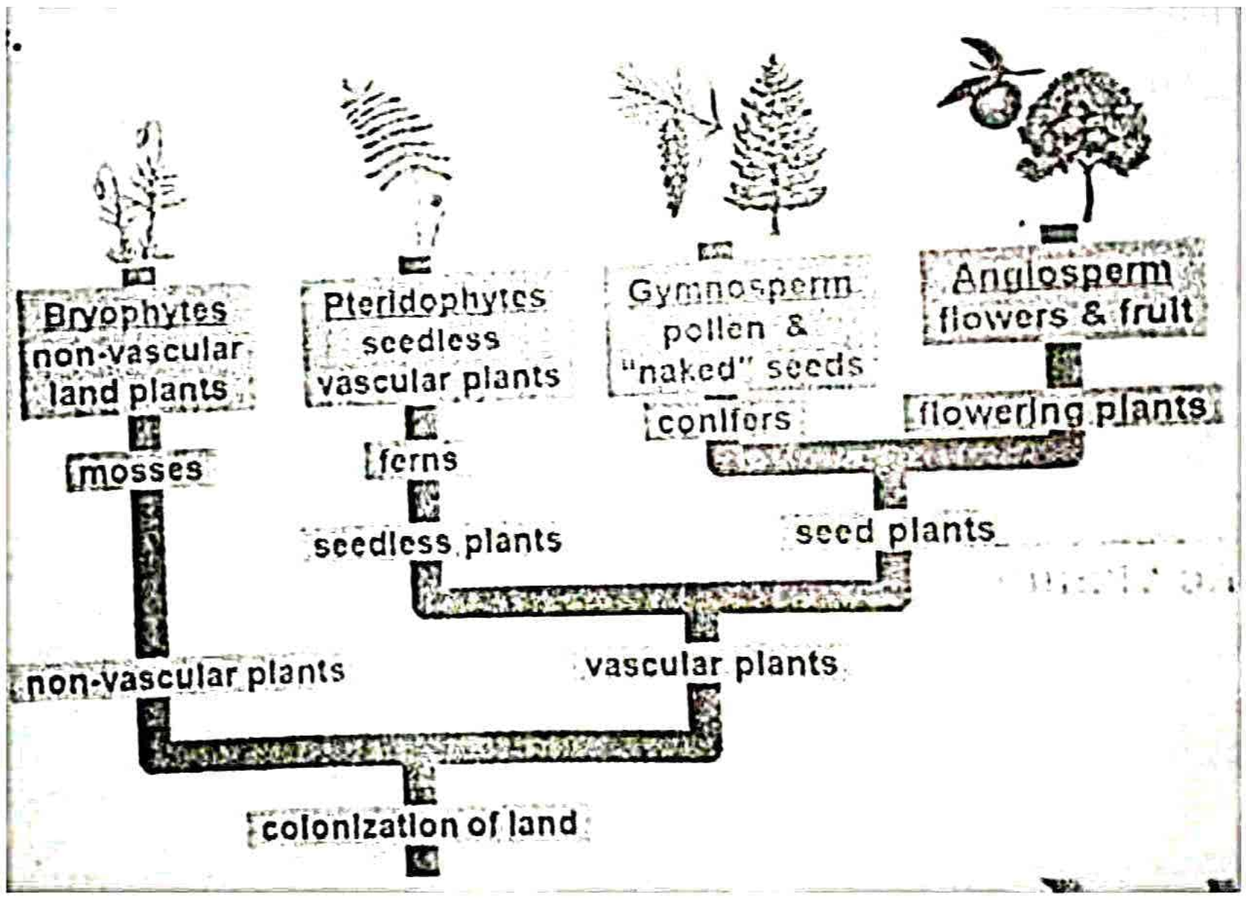
Kingdom Plantae is divided into two sub-kingdoms on the basis of presence or absence of vascular tissue (xylem and phloem).
A) Sub-Division - Bryophyta (Non-Vascular plants).
B) Sub-Division Tracheophytes (Vascular plants).

Vascular supply and lignin transport support:

In vascular plants conducting tissues are present which are supported by lignin.

Alternation of generation and sexual Reproduction:

- Haploid gametophyte produce sporophyte generation by sexual reproduction while diploid sporophyte produces gametophyte generation by asexual reproduction.
- Gametophyte and sporophyte are heteromorphic differ in size and shape.
- Gametophyte generation produce male and female gametes that fuse together and form zygote which grow into sporophyte.
- Diploid Sporophyte produce spores by meiosis that germinate and develop into gametophyte.



NON VASCULAR AND VASCULAR PLANTS:

Non vascular plants:

- Without conducting tissues - xylem and phloem.
- Gametophyte is dominant plant,
- They need aquatic habitat to reproduce because they have flagellated sperm.

Example: Liverwort, Hornwort and Mosses.

Bryophytes:

Bryophytes are simple non vascular plants appeared before 450 mya. In bryophytes strengthening tissues are absent.

General Characters Of Non Vascular Plants:

i. They show alternation of generation present with gametophyte dominant.
ii. Gametophyte is chlorophyllous, thalloid, differentiated into rhizoids, pseudo stem and leaves.
iii. Male gametangia known as antheridium, produces motile male gamete (antherozoid or spermatozoids).
iv. Female gametangia known as archegonia, produces non motile female gamete (ovum).
v. Sporophyte is semi parasite on gametophyte and differentiated into foot, seta, and capsule.
vi. They live mainly in damp, shady places.
vii. Amphibious in nature, need water to reproduce because sperms are flagellated but some tolerate dry environment.

LIFE CYCLE OF BRYOPHYTES (MOSS):

Life cycle is completed into two stages i.e. gametophyte and sporophyte stage.

1. Gametophyte stage:

- Haploid and consists of pseudo leaf, stem and rhizoids.
- Gametophyte of moss is either unisexual or bisexual.
- In this stage, male (antheridia) and female sex organs (archegonia) are produced.

Antheridia:

- Antheridia of moss are club shaped.

• Inside the antheridium motile bi flagellate antherzoides (male gamete) are produced.

Archegonia:

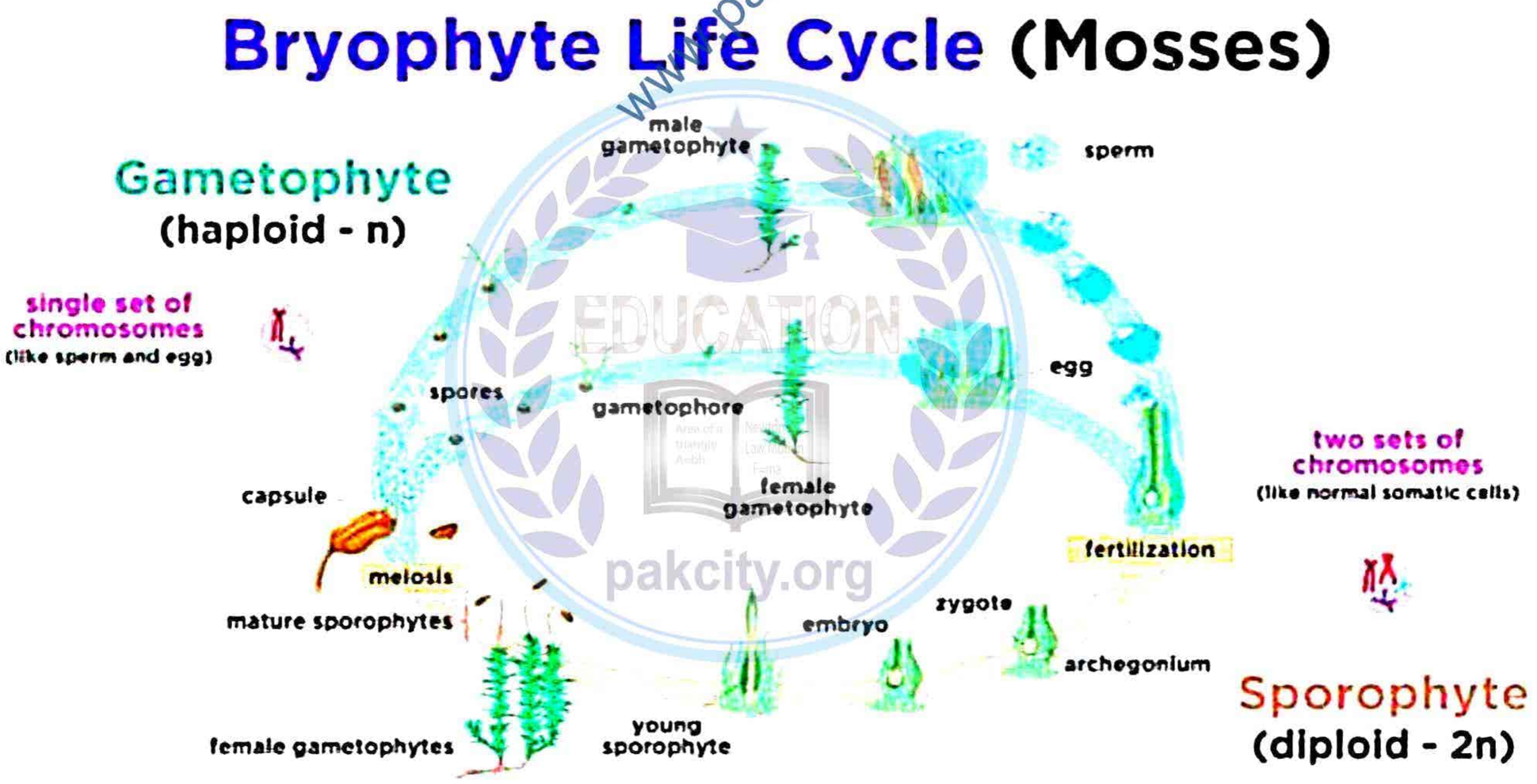
• Each archegonium is flask shaped.
• It consists of stalk, venter and neck.
• The stalk helps in the attachment of archegonium.
• Venter is the middle swollen part, contains a large egg cell and smaller venter canal cell.
• Neck is the upper elongated tube like part. It contains neck canal cells.

Fertilization:

• Motile antherozoides move towards the archegonia in the presence of water.
• They enter archegonia through its open mouth and one spermatozoid fuses with the egg cell with the result the zygote (2n) are formed.

2- Sporophyte stage:

• The zygote develops into sporophyte.
• Sporophyte grows upon gametophyte.
• Sporophyte consists of three parts.
• **Foot:** It helps in the attachment of sporophyte and in the absorption of food from the tissues of gametophyte.
• **Seta:** is the stalk of capsule.
• **Capsule:** Produces spore mother cell which is diploid and divide by meiosis and form haploid spore. Each spore can germinate into new gametophyte.



ADAPTATION OF BRYOPHYTES TO LAND HABITAT:

All Bryophytes show amphibious form of land plants. Following are main adaptations exhibited by them.

a) Rhizoids for water absorption:

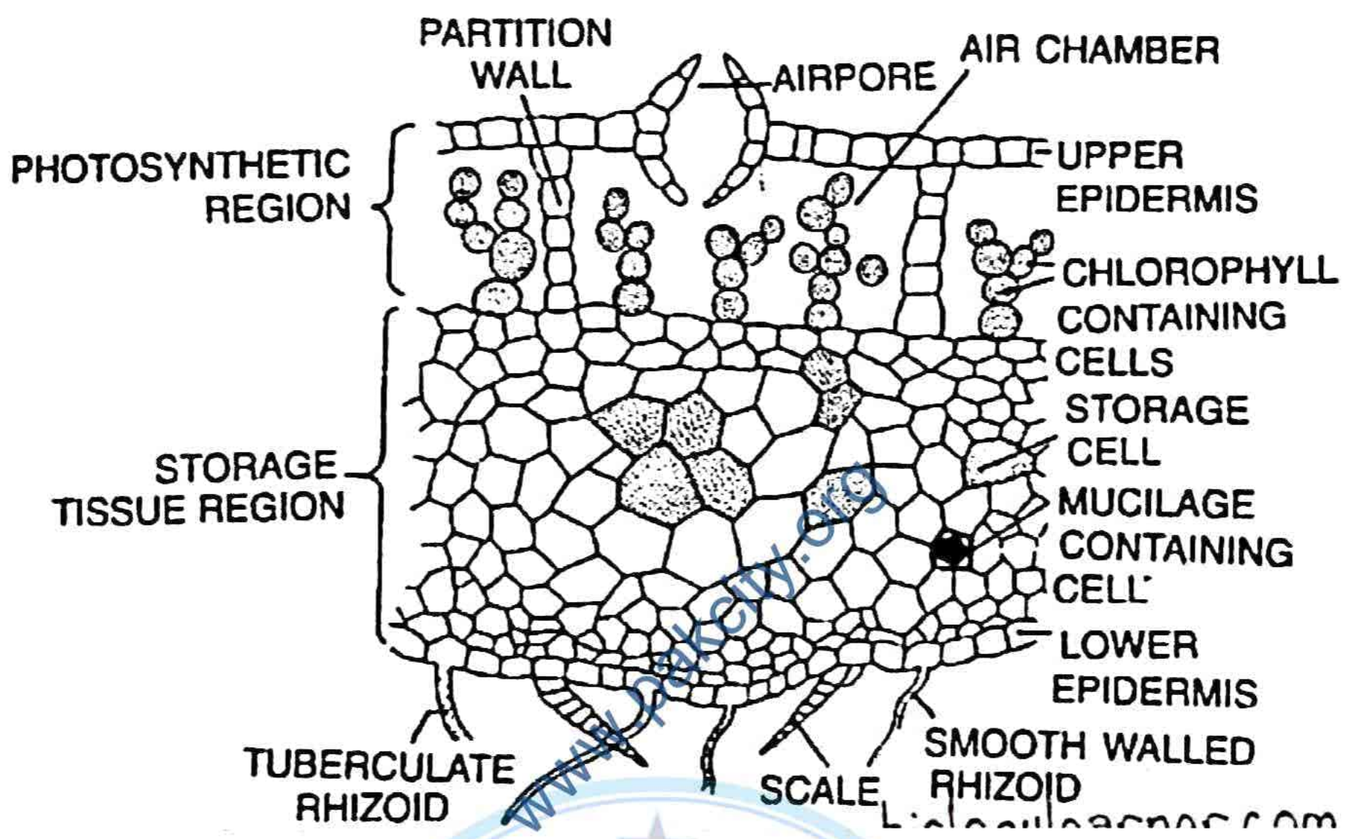
• Bryophytes have rhizoids for water absorption.
• Rhizoids are long filamentous extensions of the lower surface cells of the thallus.

b) Conservation of water:

- Bryophytes body is multilayered and covered by cuticle which is non cellular and wax life.
- Cuticle reduces the rate of evaporation.

c) Absorption of CO_2:

- Bryophytes thallus bears aerating pores.
- Each pore leads inside into an air chamber.
- Air chamber consists of branch filaments of photosynthetic cells.
- CO_2 enter through these pores and absorbed by the wet surface of the photosynthetic cells in the air chambers and diffuse into cytoplasm of the cell.



d) Heterogamy:

- Heterogamy means difference in structure and size of gametes.
- Bryophytes develop two different types of gametes.
- The one is male (motile) and the other one is female (non motile) full of stored food.

e) Protection of reproductive cells:

- Male and female gametes are protected in antheridia and archegonia.
- Protection is required for land habitat.
- In addition to it "paraphyses" (a sterile hair like filament present among the reproductive organ in lower plants that provide protection) are also present which helps to prevent drying out sex cells.

f) Formation of embryo:

- In bryophytes the fertilized egg called oospore (zygote) is formed inside the archegonia.
- Oospore develops into embryo inside the protective coverings of archegonia protects the embryo from drying out and mechanical injury.

Advantages of bryophytes:

- Maintaining ecosystem.
- Initiate soil formation.
- Maintain soil moisture.
- Recycling nutrients Bioindicators.

Used as meddicines:

- Marchantia used in liyer disorders
- Polytrichum used in fever, trauma injuries, pneumonia, lymphocytic leukemia.
- Insecticidal activities.

VASCULAR PLANTS:

- Conducting tissues xylem and phloem are present.
- Lignin is deposited on xylem that provide strength and rigidity.
- A protective jacket of sterile cells is present around reproductive organ.

- Multicellular embryo retained within the archegonia.
- On aerial parts, protective covering the cuticle is present.
- In life cycle Sporophyte stage is dominant.
- Gametophyte small in size, short lived.

TRACHEOPHYTES CLASSIFICATION:

Tracheophytes are further subdivided on the bases of presence or absence of flower.

a) Seedless Vascular Plant (Pteridophytes):

- Non-flowering plants are placed into the group Pteridophyta, includes

Psilopsida
Lycopsida
Sphenopsida
Pteropsida

b) Flowering plants (Seed):

- Flowering plants grouped into Spermatophyte/phanerogam.
- They have only one subdivision spermopsida.
- Spermatophyte further divided into gymnosperm and angiosperm.

Pteridophyta (Non-Flowering/Seedless Plants):

Fern allies and Ferns:

- Fern allies refer loosely attached spore producing vascular plants.
- These are further divided into four sub divisions.

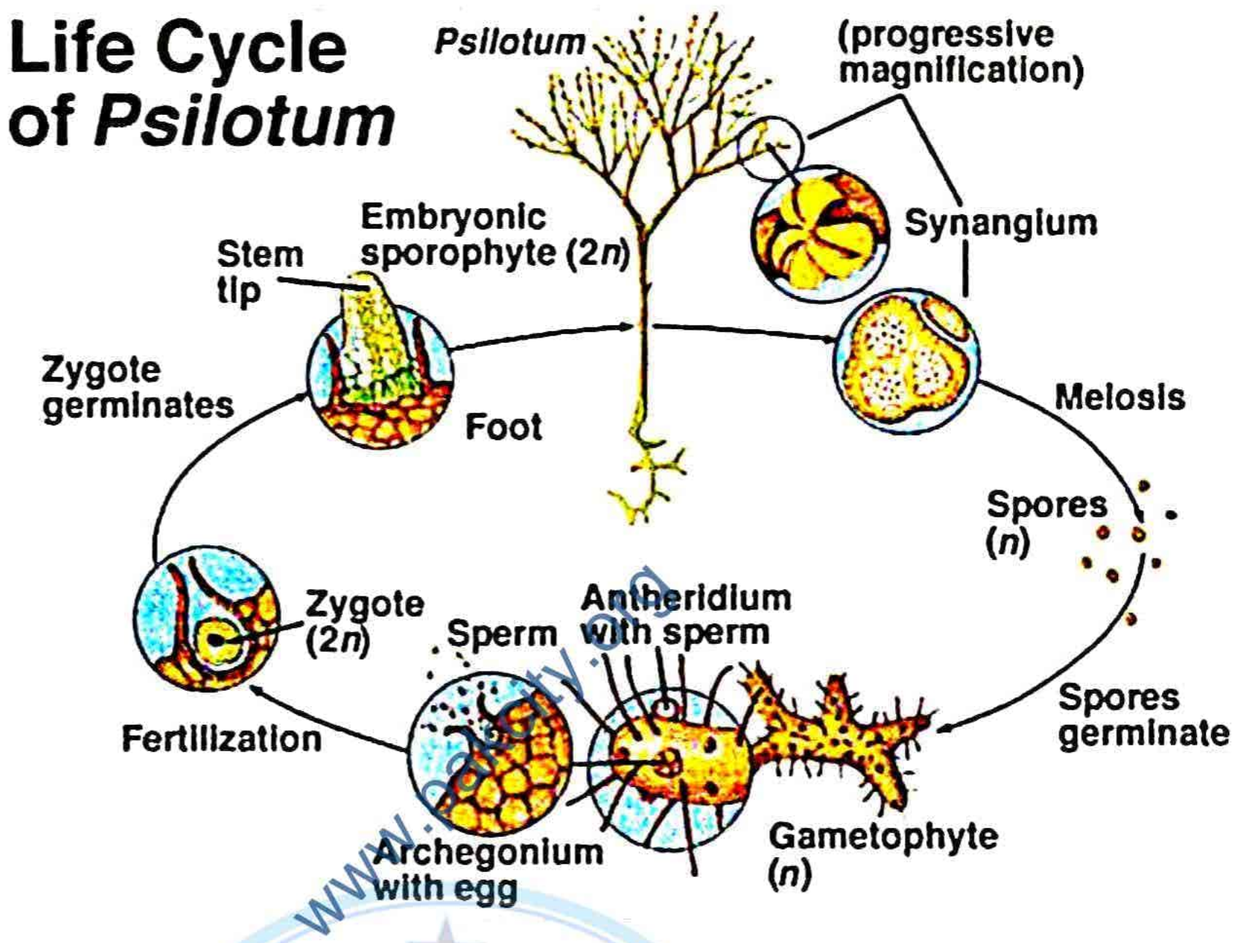
1) Psilopsida.
2) Lycopsida.
3) Sphenopsida.
4) Pteropsida.

1. Sub division Psilopsida (Whisk ferns) Living fossils:

- Fossils representative of vascular plants.
- Psilotum is the only living species of this group.
- True leaves and roots are absent.
- Small outgrowth produce on stem (enation).
- Lack flowers and reproduce asexually by spores.
- Sporophyte of psilopsids is diploid, simple and dichotomous (divide into two parts).
- Underground stem contains unicellular rhizoids (root hairs).
- Stem is green and carryout photosynthesis.

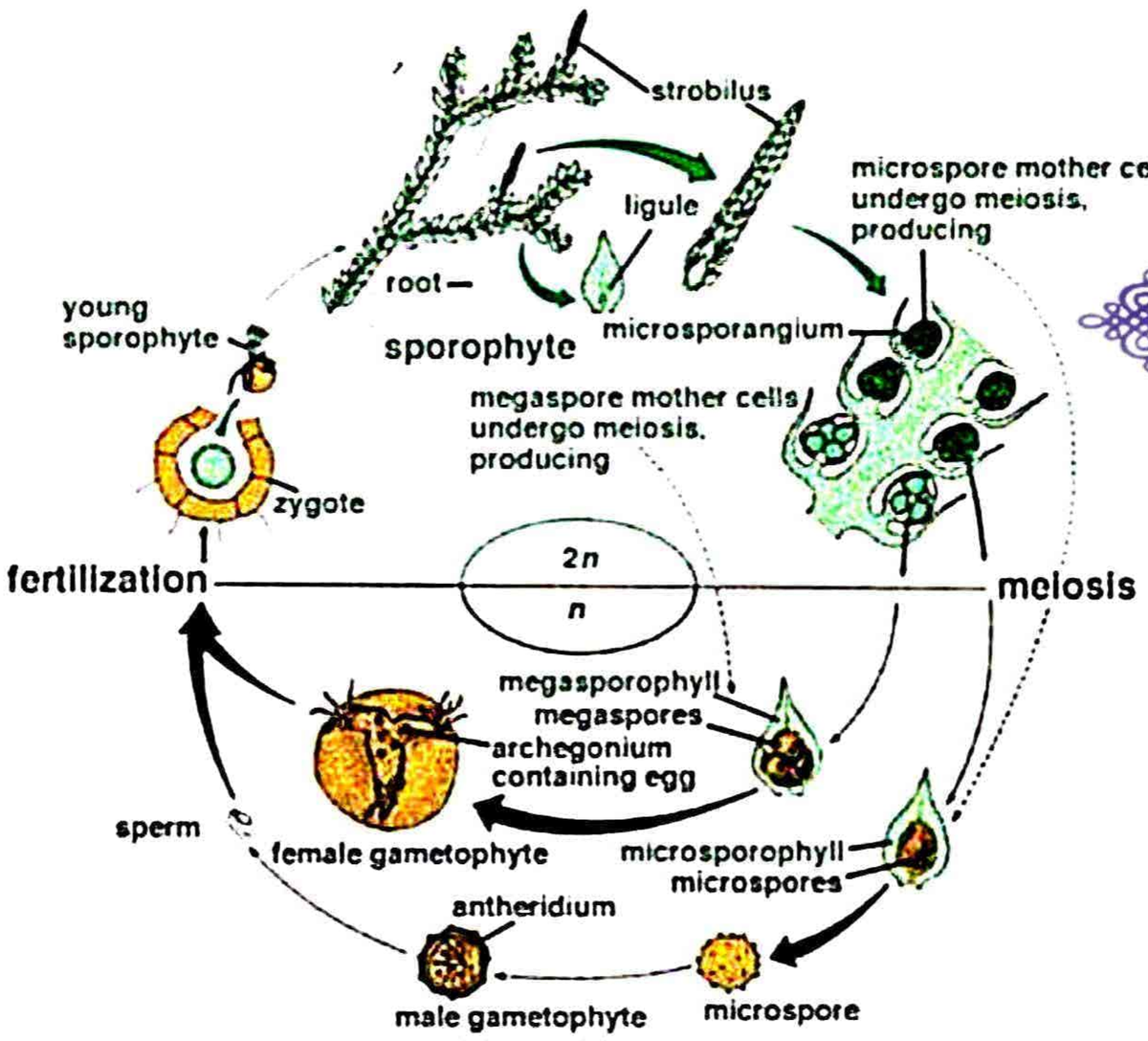
- Reproductive structures sporangia develop on the tip of some branches.
- Meiosis produces haploid spore within the sporangia which are similar (homospory).
- Each spore germinate into gametophyte which is called prothallus.
- Prothallus/gametophyte is monoecious.
- Both sex organ produce near the growing tip.

E.g. Psilotum.



2. Sub division Lycopsida:

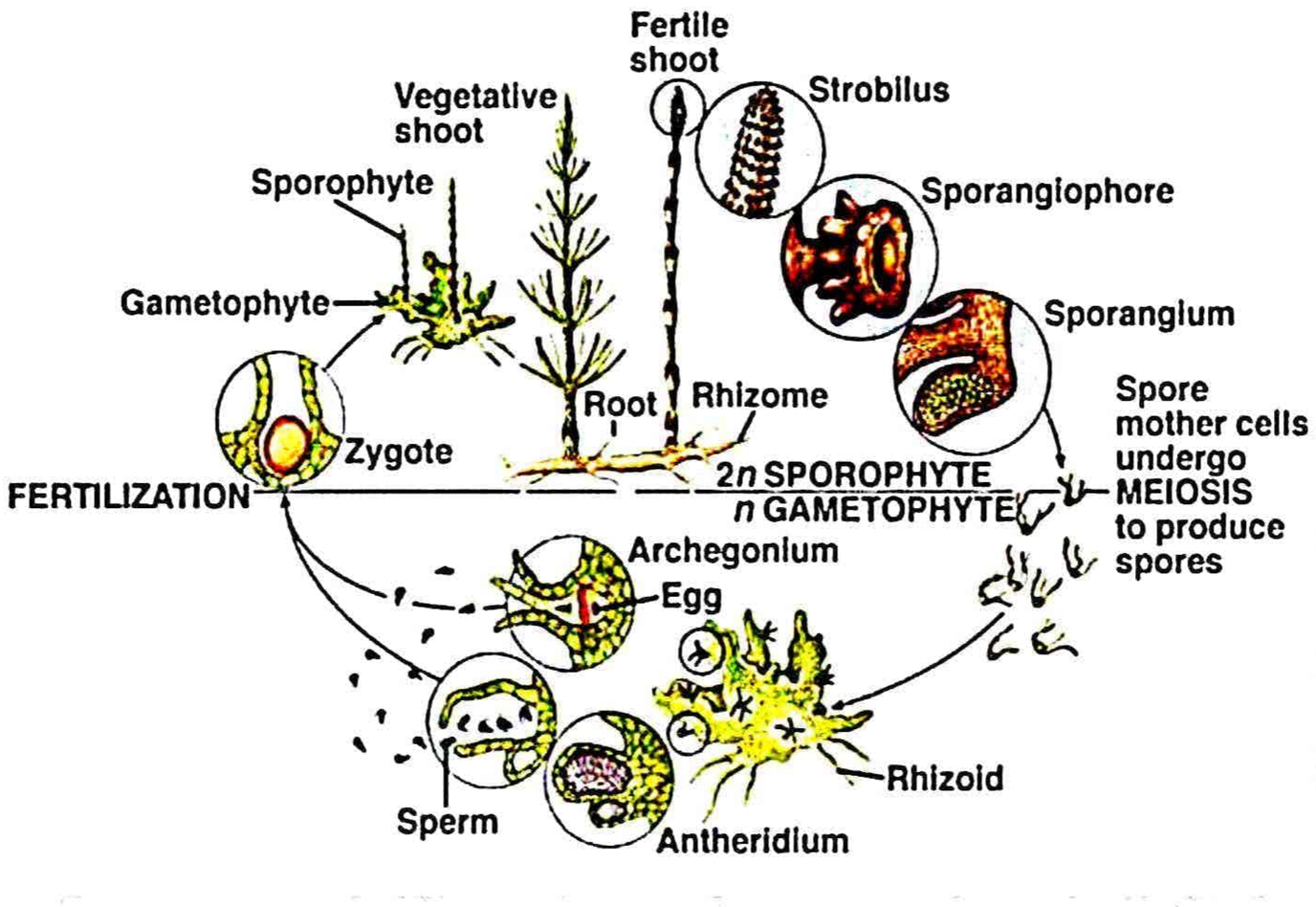
- Tropical areas (warm all years, 25-28 C°).
- Large trees formed the first forest.
- Have true roots and leaves.
- Sporophyte is dichotomously branched shoot, having specialized spike like leaves with sporangia.
- Such modified leaves are called sporophylls.
- Sporophylls are grouped into cone like structure called strobilus.
- Strobilus is club shaped hence named as club mosses.
- Spores are alike in Lycopodium and different in Selaginella kraussiana.
- Homospory in lycopodium produce monoecious gametophyte.
- Heterosory in selaginella produce dioecious gametophyte.
- one sporangia produce large spore (mega spore) develop into female gametophyte and other sporangia produce small spore (micro spore) develop into male gametophyte (antheridia).



3. Sub division Sphenopsida (Horse Tails):

- These plants abundant in Carboniferous period.
- Only one living member Equisetum commonly called "Horse-tail" exists today.
- Possess true roots, stems and leaves.
- Have Rhizome, also called creeping rootstalk, horizontal underground stem capable of producing the shoot and root systems of a new plant.
- Stem is green, hollow, jointed and photosynthetic.

- Ring of leaves present at each joint or node.
- Spore are born after meiosis in terminal cones (Strobili) and all are alike (homosporous).
- Outer layer of spore wall form 4 sporopollenin thread called Elators that help in dispersal.
- When spore land on moist place elator coil and germinates.
- Give rise to small gametophytes up to 3 cm, that bear both archegonia and antheridia (monoecious/bisexual).
- Unicellular rhizoid arised from basal cells.
- Gametophyte is dorsiventral (having dissimilar dorsal and ventral surfaces).



4. Sub division Filicinophyta (Ferns):

- well-developed plants having vascular system with true roots, stem and leaves.
- Found in tropical region but also found in temperate region.
- Range in size from small delicate, filmy, aquatic to tall trees.
- Sporophyte is large and dominant, having true leaves. stem and roots.
- Leaves are large and known as frond.
- Sporangia are found in clusters called sorus in which spores are produced.
- Vascular tissues present in sporophyte.
- Gametophyte is small and simple prothalus.
- In prothalus, male and female reproductive organs present.

Example: Dryopteris.

Temperate: environments with moderate rainfall with irregular drought, mild to warm summers and cool to cold winters.

a) Evolution Of One veined leaf:

Enation theory:

- A thorn like outgrowth arises from the necked stem which is known as "enation".
- In this vascular tissues are also formed for the supply of water.
- Later this thorn like outgrowth forms single veined leaf,

Reduction theory:

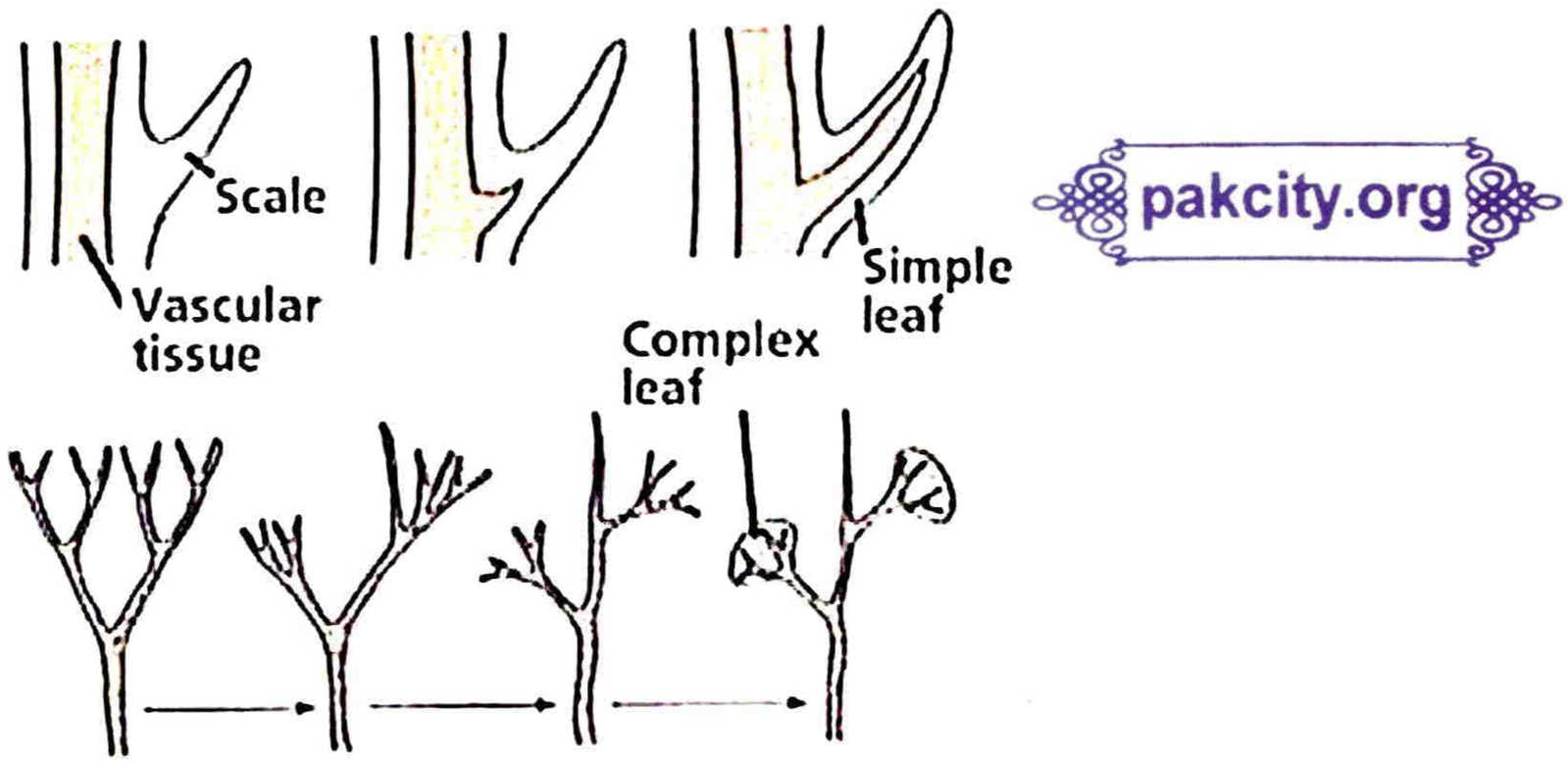
- The single veined leaf may be evolved as the leafless branches of the primitive vascular plants reduced in size.
- E.g. club moss (lycopodium) and horse tail (equisetum).

b) Evolution of Many veined leaf:

Webbed theory:

- Many veined leaf evolved from the modification of forked branches of primitive plants.
- These forked branches lie in the single plant. In first step: forked branches unite together and restricted to a single plane and became flat body.
- **In second step:** vascular tissues fill the spaces between these branches.

- The evolved leaf looks like the web foot of a duck.



LIFE CYCLE OF THE FERN:

- The life cycle of the fern has two different stages; sporophyte, which releases spores, and gametophyte, which releases gametes.
- Gametophyte plants are haploid while sporophyte plants are diploid.
- This type of life cycle is called alternation of generations.

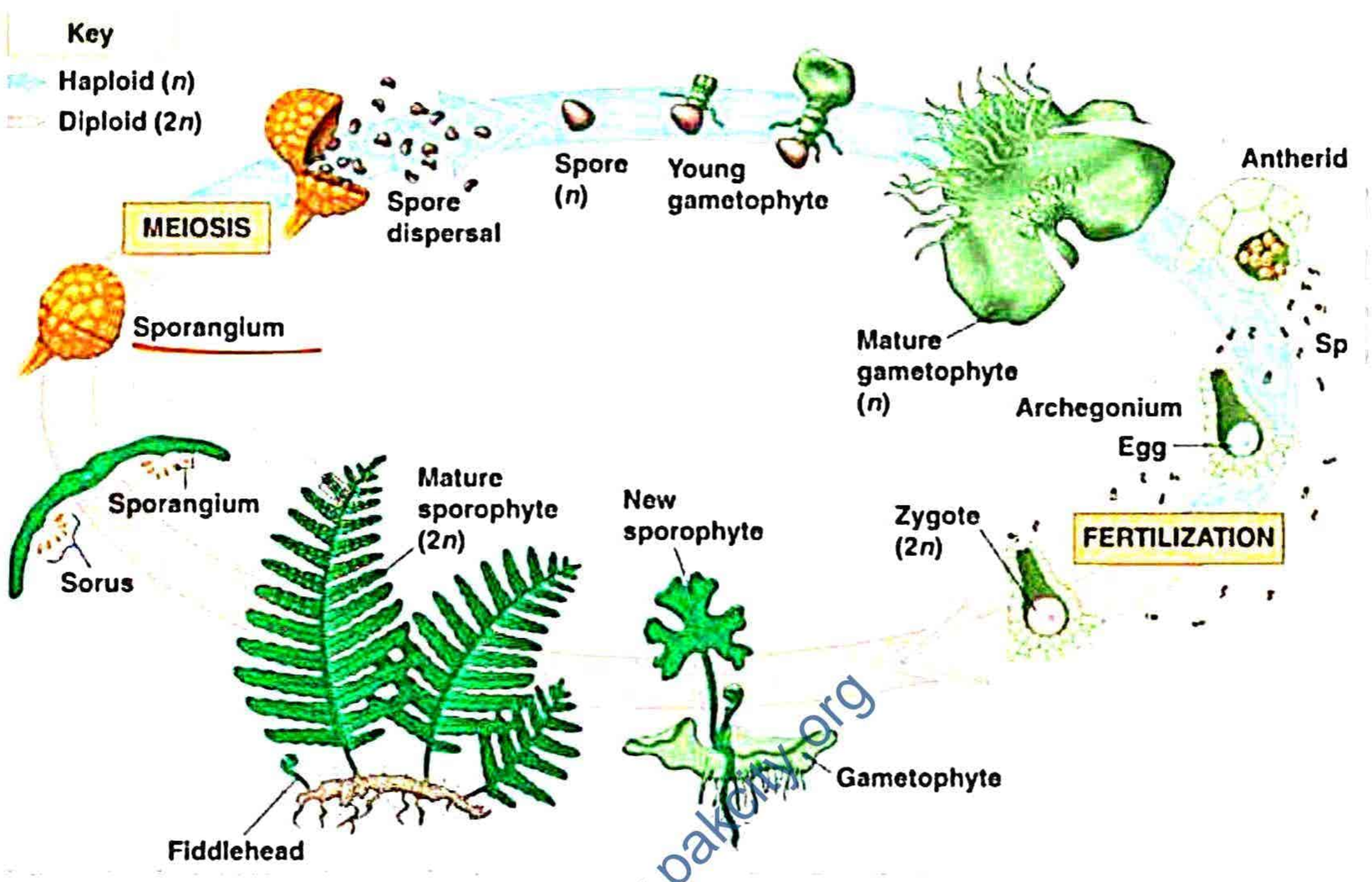
Sporophyte stage:

- Sporophyte consist of adventitious roots, rhizome and pinnately compound leaves.
- Some leaves modified for reproduction known as sporophylls.
- On the underside of sporophylls sori are formed.
- Sori are green but later become brown.
- Sori are cluster of sporangia.
- Sporangium is consist of capsule made up of annulus and stomium.
- Annular cells are thick walled while stomial cells are thin walled.
- Within sporangium spore mother cells divide by meiosis produce 4 haploid spores.
- Spore released through stomium into environment.
- Each spore after germination produce small gametophyte (prothallus).

Gametophyte stage:

- Each spore grows into a photosynthetic prothallus (gametophyte) via mitosis.
- Gametophyte or prothallus is much smaller than sporophyte, heart shaped, dorsoventrally flattened.
- It has rhizoids which absorb water and minerals.
- Each prothallus produces gametes via mitosis.
- Prothallus mono ious, produces both sperm and eggs on the same plantlet.
- Within the gametophyte, sperm is produced within a structure called an antheridium.
- The egg is produced within a similar structure called an archegonium.
- While the sporophyte consisted of fronds and rhizomes, the gametophyte has leaflets and rhizoids.
- Sperm showed chemotactic movement towards archegonium.
- One sperm fuse with egg cell formed oospore (zygote).
- Oospore develop into sporopliyte, gametophyte degenerate later.

- When water is present, sperm use their flagella to swim to an egg and fertilize it.
- The fertilized egg remains attached to the prothallus.
- The egg is a diploid zygote formed by the combination of DNA from the egg and sperm.
- The zygote grows via mitosis into the diploid sporophyte, completing the life cycle.



VASCULAR PLANTS AS SUCCESSFUL LAND PLANTS:

Vascular plants become successful land plants due to four adaptations.

i. Sterile jacket around gametangia.
ii. Embryo retained in the archegonia.
iii. Cuticle present on aerial parts.
iv. Xylem developed that transport water and minerals and provide support as well.

Importance of seedless vascular plants:

- Food: use as a food such as Pteris, Ceratopteris, Marsilea, Polypodium.
- Medicines: use as a medicínes such as rhizome of Polypodium use for sore throat.
- Coal: use as a fuel and causes global warming.
- Decorative plants: ferns use as decorative plants due to its fronds
- Nitrogen fixing: water ferns genus Azolla form an association with cyanobacteria that recycled the N into aquatic habitat.

SEED PLANTS (SPERMATOPHYTES):

Seed plants are most successful land plants due to following two reasons;

i. Embryo is enclosed within a ovule and can remain dormant for long periods.
ii. Microspores (pollen grains) transported to ovule through different sources.

EVOLUTION OF SEED:

Evolution of seed takes place in three steps.

1) Origin of Heterospory:

• The plant that produces different spores is called heterosporous and the spores are called heterospores.
• These spores on germination give two types of plants.
1. Male spore: produce male gametophyte.
2. Female spore: produce female gametophyte.

2) Development of Integument:
• Integument is formed around the spore.
• This acts as a protective covering and provides food to female gametophyte.

3) Retention of megaspore:
• Mature megaspore retains within the sporangia and develops into female gametophyte.

GROUPS OF SEEDED PLANTS: (Spermatophytes):
Spermosida can be divided into two main sub-groups, which are as follows:
i) Gymnosperms.
ii) Angiosperms.

i) Gymnosperm:
Gymnosperms are successful land plants hence, constitute about 30% of the• land forest.

Characters of Gymnosperms:
• Seeds-naked.
• Ovules-not covered by ovary.
• Ovary – absent.
• Leaves-needle like.
• Size large trees (shrubs) up to 100m and 625000 kg.
• Habitat colder parts.
• Sporophyte-dominant and heterosporous.
• Known as – conifers.
• Ovuliferous - specialized leaves, containing ovule.
• Sporangia- located on ovuliferous leaves.
• Reproductive structure - cone, in most gymnosperms sporangia collectively form cone.
• Megaspore - develop into female gametophyte, housed into megasporangium (ovule) permanently.
• Female gametophyte - contain 2 to 5 archegonia.
• Microspore - develop into male gametophyte, which contain stalk nucleus, tube nucleus, 2 gametes cells, 2 prothalial cells within pollen tube.
• Pollen grains - wind dispersed.
• Gametophyte – reduced.
• Vascular tissues - xylem tracheids and phloem sieve cells present while xylem vessels and phloem companion cells absent.
• Fertilization - occurs within sporophyte.
• Seed-megasporangium develop into seed after fertilization.
• Germination - epigeal, seed develop into sporophyte.
Example: Pinus, Fir, Cedar red wood

1- Which is the largest tree in the world?
Answer: Sequoia gigante belongs to gymnosperms is the largest tree in the world.

2- What are non-flowering seed plants?
Answer: conifers are the non-flowering seed plants.

Uses of Gymnosperms:
- Pines, spruce firs are the source of softwood timber and use in construction.
- Paper is made from the pulp of timber.
- Pulp of timber is also used in the chipboard manufacturing which is use in furniture.
- Pine are source of resins, turpentine and pine oil.
- Cycads, thuja, juniperus, ginkgo are used as ornamentals plants in the gardens.

- Pines are also source of expensive dry fruit called chilgoza (Pinus gerardina).
- They are also important as a drugs source, such as ephedra produce ephedrine used in asthma.

ANGIOSPERMS:
Angiosperms is the large and most diverse group in plants that bear flowers and fruits.

Characters of Angiosperms:
- Seeds - enclosed in fruits.
- Ovules - covered by ovary.
- Ovary – present.
- Leaves-blade like.
- Size - small (duck weeds) to large (mountain ash).
- Habitat - tropic to polar region including frets and salt water.
- Sporophyte - dominant and heterosporous.
- Known as - flowering plants.
- Reproductive structure – flower.
- Flower-colored, having nectaries and scent glands hence attract insects and other pollinators.

Angiosperms further divided into monocotyledon and dicotyledon.

LIFE CYCLE OF FLOWERING PLANT:
- Plants are able to reproduce in two different ways - sexual reproduction and asexual reproduction.
- Sexual reproduction involves pollen grains from one flower fertilizing the egg of another to produce a seed.
- In asexual reproduction, only one parent is needed, and the offsprings are exact copies.
- Life cycle of flowering plants involve alternation of generation.
- Sporophyte stage is dominant plant while gametophyte is reduced in the flowering plants.

SPOROPHYTE GENERATION:
Asexual reproduction in angiosperms
- Sporophyte consist of root, stem, leaves and flowers.
- Reproductive structure is flower in angiosperms.
- Flower has four modified leaves, sepals, petals, stamens and carpels.
- Stamen (microsporophyll) is male part and carpel (megasporophyll) is female part.

Microsporophyll (Stamens):

• Microsporophyll consist of anther and filament.
• Anther is four chambered, these chamber known as pollen sac or microsporangia.
• Inside microsporangia microspore mother cell present, that produce four haploid microspores by meiosis.
• Microspores develop into pollen grains later.

Megasporophyll (Carpels):

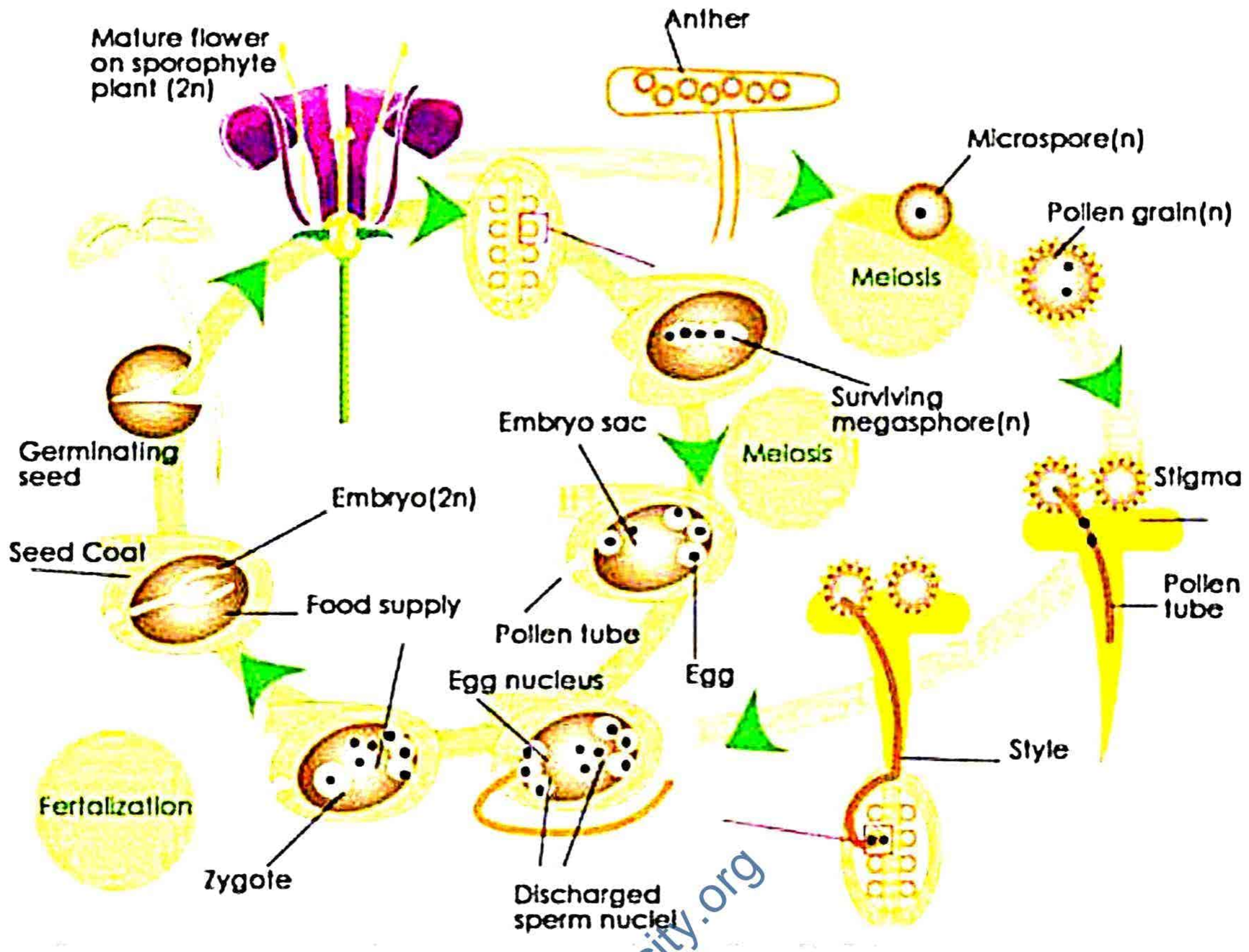
• Megasporophyll consist of stigma, style and ovary.
• Inside ovary, megasporangium (ovule) is present.
• Ovule is protected by integuments.
• Megasporangium (ovule) has small pore called micropyle.
• Inside regasporangium, megaspore mother cell present which produces four megasporc cells.
• Out of these four only one megaspore will develop into female gametophyte, known as embryo sac.

Development of female gametophyte:

• Megaspore mother cell go through meiotic division and form four haploid megaspores.
• Out of these four, three degenerate while only one survive that later develop into seven cell (eight-nucleated) female gametophyte or embryo sac.
• The detail of seven cells is given bellow; Antipodal cells: three, found near chalaza.
• **Egg apparatus:** three, towards the micropyle (two synergists and one egg cell).
• **Central cell:** one, found in the center, consist of two nuclei hence called polar nuclei.
Polar nuclei after fusion form secondary nuclei or definitive nuclei.

DOUBLE FERTILIZATION:

• Double fertilization is the characteristic of angiosperms.
• When pollen grains transfer from anther to stigma then pollen tube grows down the style and enter the ovary along with tube nucleus at its tip.
• Pollen tube enters the ovule through micropylar end and discharge two sperms into the embryo sac.
• One sperm fuses with ovum and form zygote while the other one fuse with two polar nuclei and form endosperm.
• Zygote develop into sporophyte while endosperm function in the supply of food.
• After fertilization the mature ovule develop into seed.
• The seed is enclosed by ovary and form fruit.
• The fruit not only protect seed from desiccation during their early development but also facilitate the dispersal of seed by various means such as the wind or animal as it attracts the animals.



ANGIOSPERMS AS SUCCESSFUL GROUP OF LAND PLANTS:

Spermopsids are better adapted to land habitat. There are three main adaptations of spermopsids for living onto land which are given bellow.

- The gametophyte is reduced and it is protected within the sporophyte plant that prevents it from drying out.
- Male gamete lack flagella and non motile, it is transferred from anther to stigma within the pollen grain by wind or animal. Hence not depend on water.
- Fertilized ovum retained within the ovary and develops in seed.

INFLORESCENCE:

- The arrangement of the flowers on a plant OR
- The complete flower head of a plant including stems, stalks, bracts (small modified leaf with undeveloped blade protecting the flower bud) and flowers is called inflorescence.

Types of inflorescence:

There are two types of inflorescence recemose and cymosé inflorescence.

1) Racemose Inflorescence:

- It is indefinite inflorescence. In racemose inflorescence, the man axis called peduncle continues to grow. The flower develops in acropetal succession, means the old flowers are at the base while young flowers are at the tip of floral axis. The opening of the flower is centripetal (tending to move towards the center).

Acropetal succession: development of plant's parts or organ in succession towards the apex i.e. oldest are at the base and youngest are at tip.

i)- Peduncle Elongated:

a) Raceme: It is an inflorescence in which flowers are pedicellated (with thin stem, or stalk) and bisexual, E.g. Brasica

b) Spike: It is an inflorescence having stalk less (sessile) flowers on main axis and bisexual.
E.g. Amaranthus,

c) Catkin: It is an inflorescence in which flowers are sessile (stalk less) and unisexual on main axis. Eg Mulberry (Morus alba)

d) Spadix: In this case flowers are covered by one or many large bracts called spathes OR having thick fleshy spike of flowers enclosed in brightly colored bracts. E.g. Monocotyledon such as banana and palm.

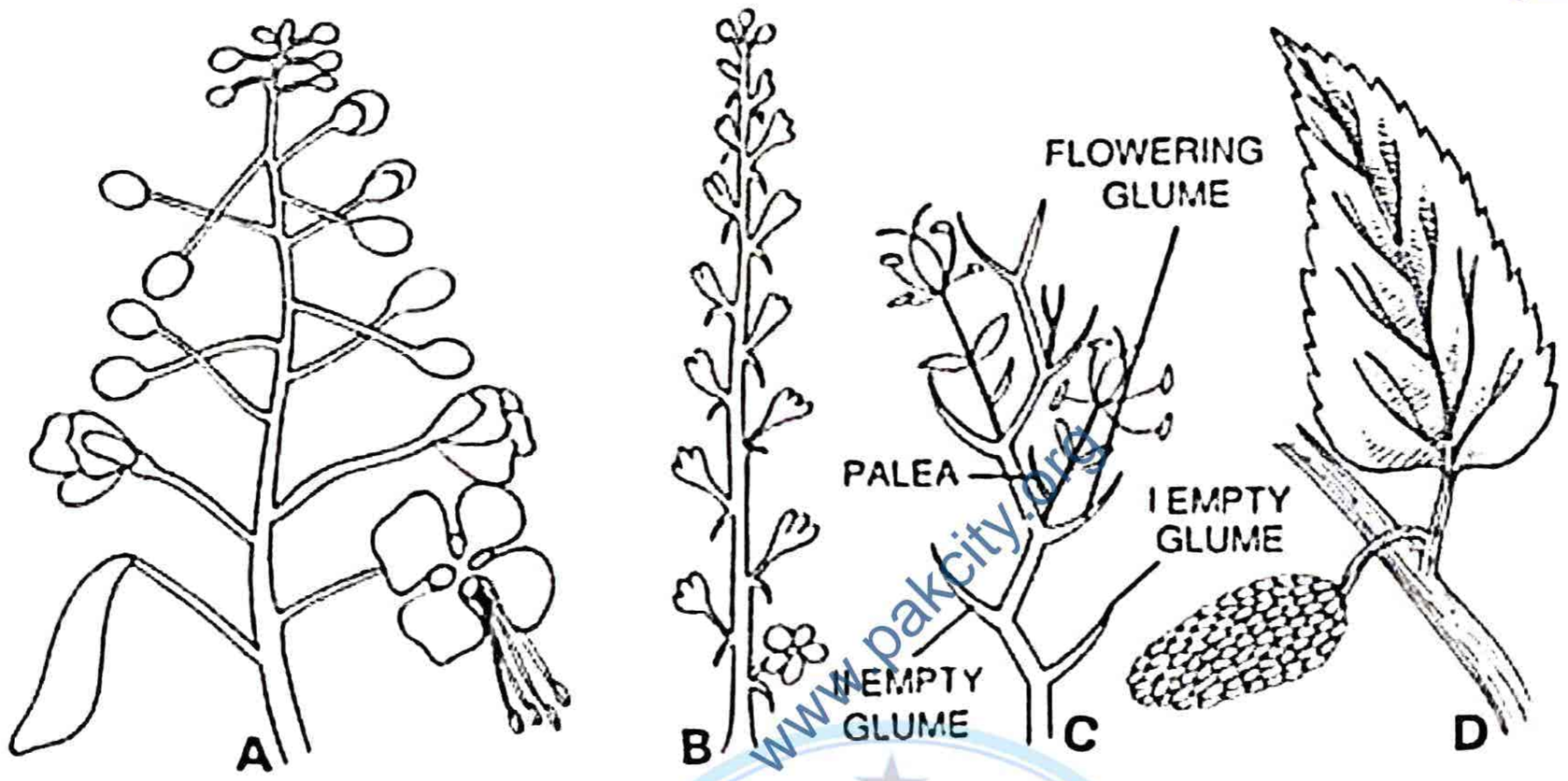


Fig. 34.49. Inflorescence-racemose. A, raceme of **gul-mohar** ; B, spike ; C, spikelet of a grass; D, female catkin of mulberry.

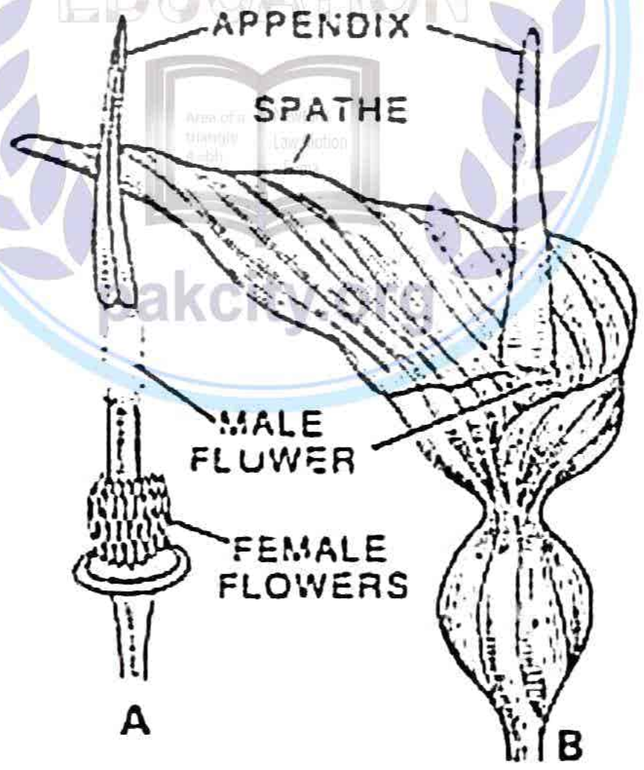
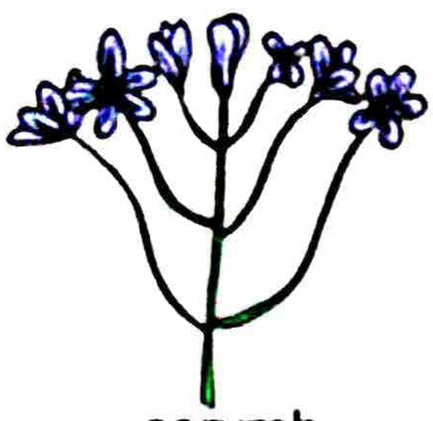


Fig. 34.50. Inflorescence-spadix–A, spadix of an aroid without spatho; B, same with spathe.

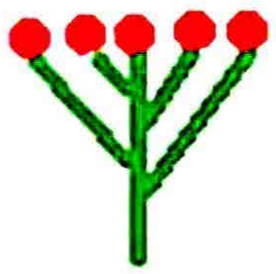
ii)- Peduncle Shortened:

a) Corymb: It is an inflorescence in which flowers have short pedicel. Pedicels are of unequal length in Corymb. In this way, the lower flowers have long pedicel and upper have small pedicel so that all flowers are at the same level. E.g. Iberis (Brasica).

b) Umbel: It is an inflorescence in which all flowers have pedicel of same length; the pedicels appear to arise from common point. E.g. Coriander.



corymb



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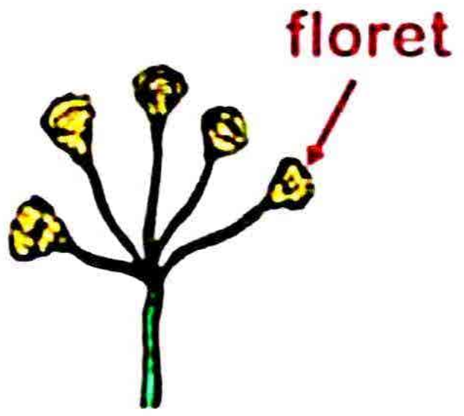
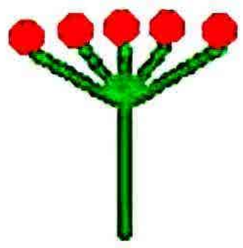


umbel



umbel

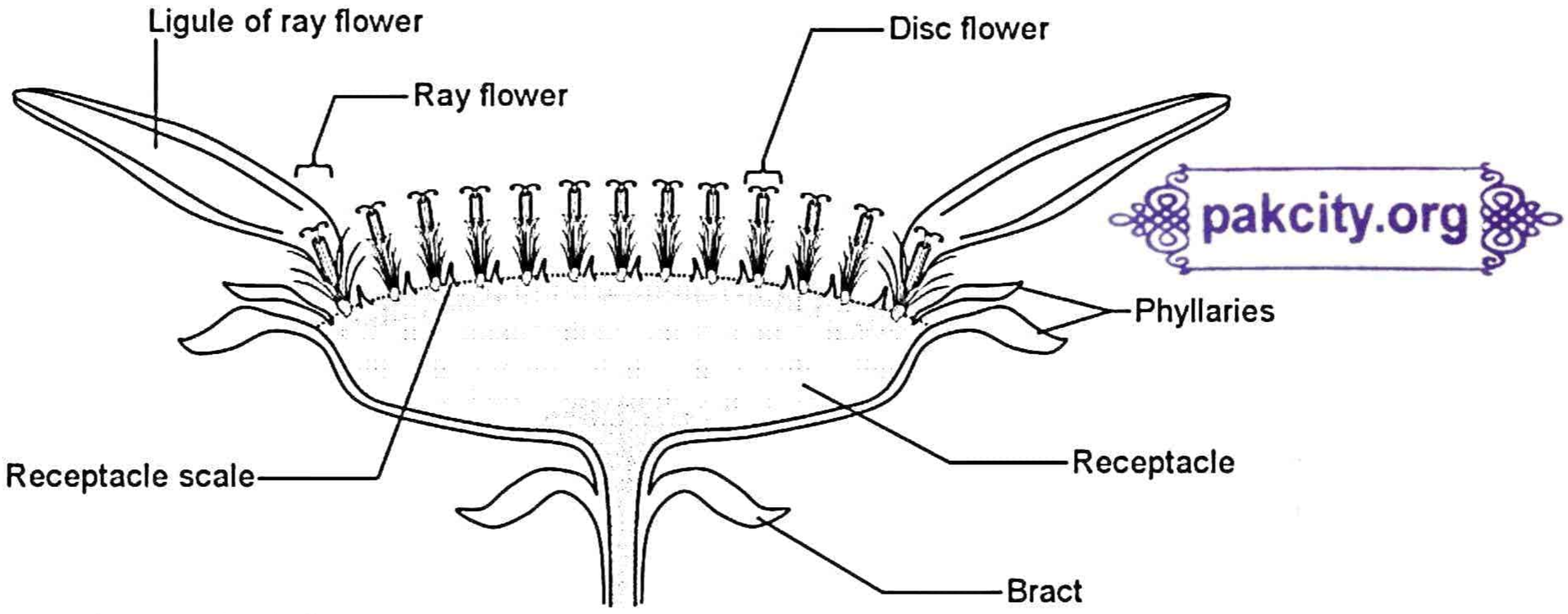
<u>iii)-Peduncle Flattened (Head OR Capitulum):</u>

- It is an inflorescence in which peduncle is flattened laterally expanded, with growing point in center.
- In this inflorescence, main axis forms a disc.
- It has a mass of small sessile flowers called florets (small flower).
- It has one or more circle of bracts at the base forming "involucres" (a series of bracts beneath or around a flower or flower cluster).

<u>Florets are of two types:</u>

a) Ray Florets: These florets are strip shaped and are present at the margin. E.g.

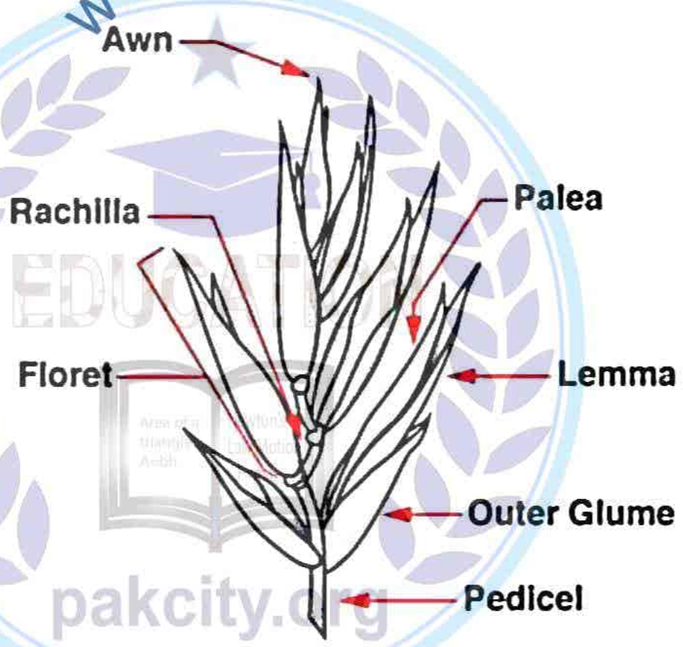
b) Disc-Florets: These florets are tubular and are present in the center. E.g. Sunflower, Zinnia, Marigold etc.



Composite Inflorescence
e.g. *Chrysanthemum*

IV)- Spikelet Inflorescence:

- It is a kind of racemose inflorescence.
- There are three bracts at its base called glumes
- The lower two glumes are without flowers and are called empty glumes while the third glume has flower in its axis and is called lemma.
- Just opposite to lemma there is small "bracteole" called palea.
- Flowers are covered by their lemma and palae e.g. Wheat, rice, Coat etc.



Spikelet

2) CYMOSE INFLORESCENCE:

- In cymose inflorescence main axis (peduncle) soon stops growing i.e. it grow to a certain height.
- The flower develops in "basipetal succession" i.e. oldest flowers are at tip and young flower are at the base.
- The opening of flower is Centrifugal (tending to move away from the center).

Types Of Cymose Inflorescence:

i) Uniparous Cymose:

The main axis soon ends into a flower and producing only one lateral branch at a time which ends in a flower. It has only two types.

a) Scorpoid Cymose:

• If succeeding branches are produced on alternate side is called Scorpoid Cymose e.g. Cotton, Forget-me-not.

b) Helicoid Cymose:

• If the succeeding branches are produced on same side, it is called helicoid è.g. Sundew.

ii) Biparous Cymose:

• The main axis soon ends into a flower and producing two lateral branches which end in a flower.
• This mode is followed by each succeeding flower. E.g. pink-night-jasmine

ii) Multiparous:

• The main axis ends in a flower and more than two lateral flowers are produced from main axis. E.g. calotropis.

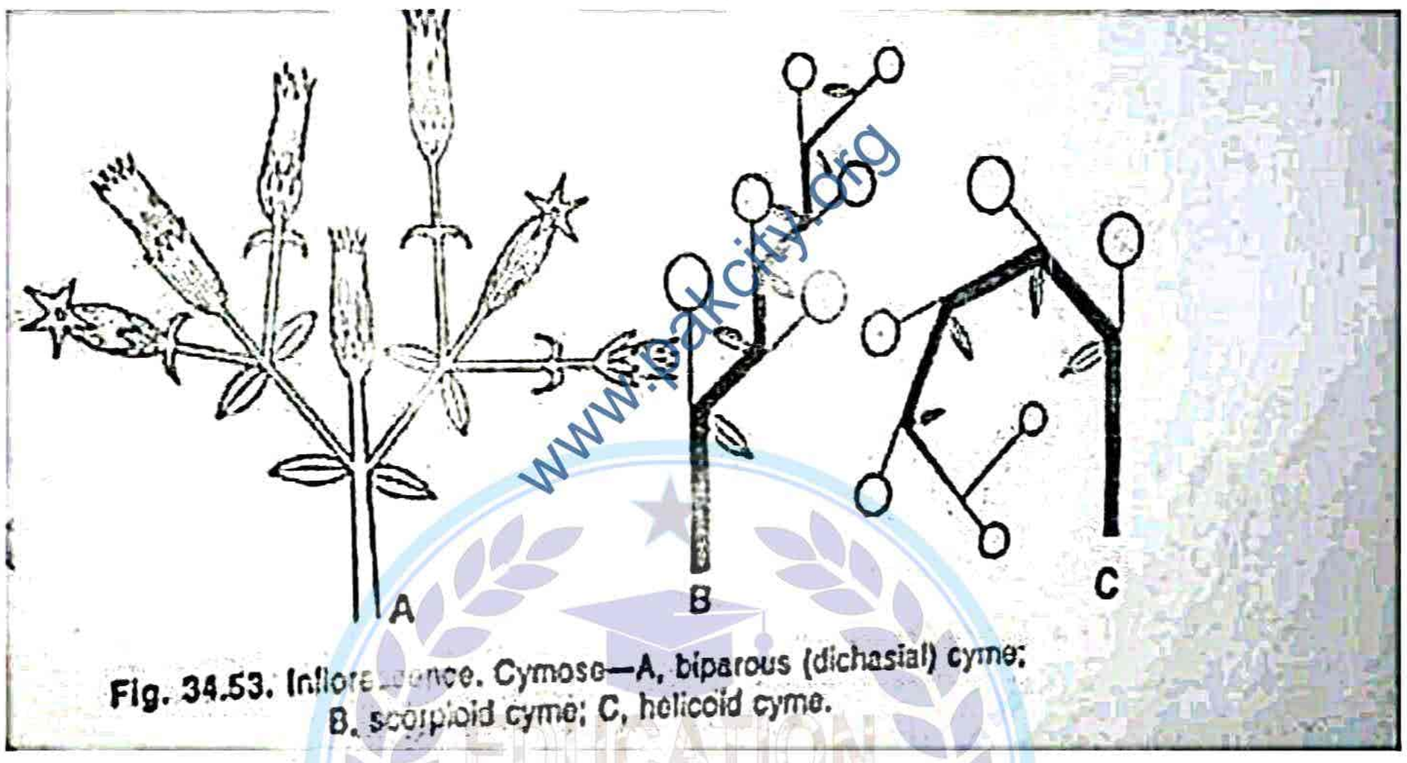


Fig. 34.53. Inflorescence. Cymose—A, biparous (dichasial) cyme; B, scorpioid cyme; C, helicoid cyme.

SIGNIFICANCE OF ANGIOSPERMS PLANTS FOR HUMAN:

Angiosperms is economically important plants, used as vegetables, fruits, and medicinal plants.

Vegetables:

• Flowers, leaves, shoots, and underground roots and stem of angiosperms are used as vegetables.
• Solanaceae, fabaceae, cucurbitaceae and brassicaceae are important families of angiosperms as vegetables.
• **Solanaceae:** includes potato, tomato, eggplant, chili, pepper.
• **Fabaceae:** includes beans and legumes.
• Cucurbitaceae (squash family): includes pumpkin, melon and ground.
• Brassicaceae (mustard family): includes cabbage, cauliflower, radish and mustard seeds.

Fruits:

• Angiosperms are also used as fruits.
• Rosaceae (rose family): includes almonds, apples, apricots, cherries, peaches, pears, rasberries and strawberries.
• Rutaceae: includes citrus fruits.

- Mucaceae: includes banana.
- Caricaceae: includes papaya.

Medical/Pharmaceutical plants:

- Members of angiosperms have countless importance of pharmaceutical value.
- Citrus fruits: Vitamin C.
- Willows: aspirin.
- Narcotics: such as Opium poppy - opium, cinchona quinone.
- Rose: arq-e-gulab.
- Amaltas (Cassia fistula): act as purgative - tending to stimulate removal of bowels or undigested food.
- Mako (Solanum nigrum): used as pain killer.
- Tulsi (Ocimum tenuiflorum): to treat asthma, bronchitis, cold and flue.
- Mulhethi (Glycyrrhiza glabra): used in repiratory disorders.
- Madagascar periwinkle (Catharanthus roseus): vincristine used in cancer such as leukemia.

SHORT QUESTIONS:

1. How life cycle of plants shows alternation of generations?

Ans: In plants, there are two systems of reproduction. Each is called one generation. There isa rotation between these generations. So, one complete life cycle of a plant includes two generations that alternate with each other. Hence the whole mechanism is called alternation of generations. The two generations are called the sporophyte generation (Di loid) and the gametophyte generation (Haploid). It is the rotation in between the haploid and diploid stages. Sporophyte by asexual reproduction produces gametophyte while gametophyte by sexual reproduction produces sporophyte. And thus the life cycle of a plant will go on.

2. Why bryophytes are called non-vascular plants?

Ans: They are called non-vascular plants because of the absence of vascular tissues (xylem and phloem) that functions for the conduction of food, water, and minerals.

3 . How plants cope when invaded the land from the sea?

Ans: When plant invaded land from sea they adopt some new features such as seeds, stomata, cuticle and vascular tissues. Seeds are evolved for the dispersal and protection of embryo, stomata in aquatic plants present on upper surface while it is on under surface in terrestrial environment, cuticle and vascular tissues are developed to reduce the water loss and circulation of water to all parts of plant. Plants were forced to adapt these traits in order to survive in a terrestrial environment.

4. Why heterogamy is important for plants?

Ans: Heterogamy means different size male and female gametes in plants. It is important for plants because new offspring is formed with diverse genetic makeup and greater adaptations to changing environmental conditions. This can lead to improved survival and reproduction of the offspring, which can result in the long-term survival of the species.

5. Why flower is called a reproductive part of plant?

Ans: Flower is the main reproductive part of an angiospermic plant. It has four structures in whorls, i.e. sepals, petals, stamens, and carpels. Stamens and carpels are the fertile parts of a f

Stamen is the male part produces male gametes and pollen grains. Carpel is the female part which produces female gametophyte. Fusion of male and female gamete (fertilization) takes place in ovary producing zygote which develops into new individual plants. Hence, flower is considered the reproductive part.

6. Why fertilization in angiosperm is called double fertilization?

Ans: Pollination helps the pollen grains to reach stigma via style. The two sperm cells enter the ovule-synergid cell. This proceeds to fertilization. In angiosperms, one sperm fertilizes the egg to form the diploid (2n) zygote, while the other sperm fuses with two polar nuclei to form the triploid (3n) ceil that develop into endosperm. This is called a double fertilization. After fertilization, embryonic development begins.

7. How seeds are evolved?

Ans: The evolution of seeds allowed plants to decrease their dependency upon water for reproduction. Seeds develop from ovules. Ovules consist of a stalk that bears the nucellus (equivalent to the megasporangium; diploid maternal tissue). The nucellus is enveloped by one (gymnosperms) or two (angiosperms) covering layers called the integuments. An ovule is therefore, in a developmental sense, an unfertilized, immature seed precursor and, in a morphological and evolutionary sense, a megasporangium surrounded by integument. These integument develop into the testa (seed coat), of which in mature seeds the outer cell layer of the outer integument usually form a dead covering layer, while inner cell layers may remain alive.

8. Why gymnosperms have naked seeds but not angiosperms?

Ans: The gymnosperms have their ovules freely exposed before and after fertilization. They are not enclosed by any ovary wall. The seeds formed by them lack the seed coat. Hence, due to the absence of ovary wall and seed coat, their seeds are naked.

Difference b/w Sporophyte and Gametophyte:

Sporophyte	Gametophyte
Sporophyte is the plant which shows asexual stage.	Gametophyte is the plant which shows sexual stage.
It produces spores, which may be similar or in few cases of different types.	It produces gametes, which are of two types male and female.
There is no fusion of spores, each spore directly develops into new plant or gametophytic stage.	The male and female gametes fuse together to form zygote. The zygote develops into new plants or sporophytic stage.

Difference b/w Xylem & Pholem

Xylem	Pholem

It is a complex tissue which helps in the conduction of water from roots to the upper.	Pholem is also a complex tisue which helps in the translocation of food from one part to another in the body of plants.
The flow of water in xylem occurs only in one direction i.e. from roots to the upper region, upto leaves.	The flow of water in the xylem occurs in both direction i.e. from upper region to the lower region or from lower to upper region.
Xylem consists of four different types of tissues. 1. Tracheids. 2. Vessel or Tracheae. 3. Wood Parenchyma. 4. wood fibers.	Pholem consists of four different types of tisses. 1. Siere tubes. 2. Campanion cells. 3. Pholem parenchyma or bast parenchyma. 4. Pholem fibres or bast fibres.

Difference b/w Algae & Plants

Algae	Plants
These are simple plant like organisms, their body is called thallus, which can not be divided into root, stem and leaves.	These are well developed organisms, their body is divided into roots, stem and leaves.
These are water living.	These are water living or terrestrial.
They are non-vasular.	They are vascular or sometimes non-vascular.
They are non-flowering and non-seeded.	Higher plants produce flowers and seeds.

Differentiate b/w Vessels & Sieve Tubes

Vessels	Sieve Tubes
These are elongated tube like cells. They are thick walled.	These are also long tube like but thin walled cells.
They are dead cells.	They are living cells.
They do not have transverse walls. They do not have pores.	They have transverse walls which contain pores, so they are called sieve.
They help in the movement of water and dissolved minerals.	They receive prepared food from leaves and supply it to the other parts.
They also provide strength and rigidity.	They do not provide strength and rigidity.

Differnce b/w Bryophyta and Tracheophyta

Bryophyta	Tracheophyta
They are simple plants without vascular tissue.	They are advanced plants with vascular tissues.
They have weak body, some have thallus like structures and some have body with stem and leaves.	They have strong body which consists of root, stem and leaves.
They do not produce flowers and seeds.	Higher plants (Angiosperms) produce flower and seed.
In their life cycle the first stage is called gametophytic stage.	In their life cycle the first stage is called gametophytic-stage.

Difference b/w Homospory & Heterospory

Homospory	Heterospory
The process in which similar types of spores are produced is called homospory.	The process in which two different types of spores are produced is called heterospory. These are microscopes and megaspores..
In homosporous plants only one kind of game-tophyte produces male and female organs.	In heterosporous plants two different kinds of male and female gametophytes are produced.
They produce one type of sporangium.	They produce two types of sporangia.
Homospory do not involve in evolution of seed	Heterospory leads to the evolution of seeds.

Difference between Racemose and Cymose

Racemose	Cymose
The growing point seldom forms in flower.	The growing point always forms in a flower.
The floral axis or peduncle is monopoidal.	The floral axis is sympoidal or multipoidal.
The formation of flowers is indefinite or unrestricted.	The definite or restricted number of flowers are formed.
The arrangement of flowers is acropetal.	The actual arrangement of flower is biseptal.
The arrangement of flower in a group is centripetal i.e. the younger flowers are towards the center and other towards the outside.	The arrangement of flowers is a cyme head and other types of grouping is centrifugal i.c. the older flowers are towards the center and the younger towards the periphery.

Difference b/w Angiosperms & Gymnosperms

Angiosperms	Gymnosperms
These are seed-producing flowering plants whose seeds are enclosed within an ovary.	These are seed-producing non- flowering plants whose seeds are unenclosed.
Their seeds are enclosed inside an ovary, usually in a fruit.	Their seeds are bare and not enclosed, which are found on scales, leaves, or as cones.
The lifecycle of these plants is seasonal because these die during autumn/fall.	These plants are evergreen in nature.
These are present in flowers and can be unisexual or bisexual.	These are present as cones and are unisexual.
The shape of the leaves is flat.	Their leaves are scale-like and needle- like.
Mango, rose plant, etc.	Pinus, fir, larch, cedar, redwood, etc.