DIVERSITY OF LIFE: CHAPTER-3 PLANT KINGDOM

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Salient features and classification of plants into major groups - Algae, Bryophyta, Pteridophyta, Gymnospermae and Angiospermae (three to five salient and distinguishing features and at least two examples of each category); Angiosperms - classification upto class, characteristic features and examples.

Chapter-3:

Plant Kingdom

3.0 INTRODUCTION

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Earliest system of classification was Artificial.

The artificial system of classification used only superficial morphological characters such as habit, colour, number and shape of leaves etc. They were mainly based on few vegetative characters.

The artificial systems gave equal weightage to vegetative and sexual characteristics; this is not acceptable, because the vegetative characteristics are more easily affected by environment.

Later Natural Classification System was developed which were based on natural affinities among the organisms, and considered not only the external features but also internal features like ultra-structure, anatomy, embryology and phytochemistry.

Such a classification for flowering plants was given by **George Bentham and J.D. Hooker.Eichler proposed phylogentic** classification system based on evolutionary relationships between various groups.

This assumes that organisms belonging to the same taxa have a common ancestor. To resolve difficulties in classification where there is no supporting fossil evidence, information from various sources are used by taxonomists like

1. NUMERICAL TAXONOMY

Is now easily carried out by using computers. It is based on observable characteristics. Number and codes are assigned to all the characters and the data are then processed. In *this way each character is given equal weightage and simultaneously hundreds of characters can be considered.*

2. CYTOTAXONOMY

It is based on cytological information like chromosome number, structure and behavior.

3. CHEMOTAXONOMY

It uses chemical constituents of the plant to resolve confusion. Taxonomy is the Science of classification which makes the study of wide variety of organisms easy and helps us to understand the interrelationships among different groups of organisms.

3.1 CLASSIFICATION OF PLANT KINGDOM

In Plant Kingdom the first level of classification depends whether plant body is differentiated, have special tissues for transportation, ability to bear seeds and whether the seeds are enclosed within fruits or not.

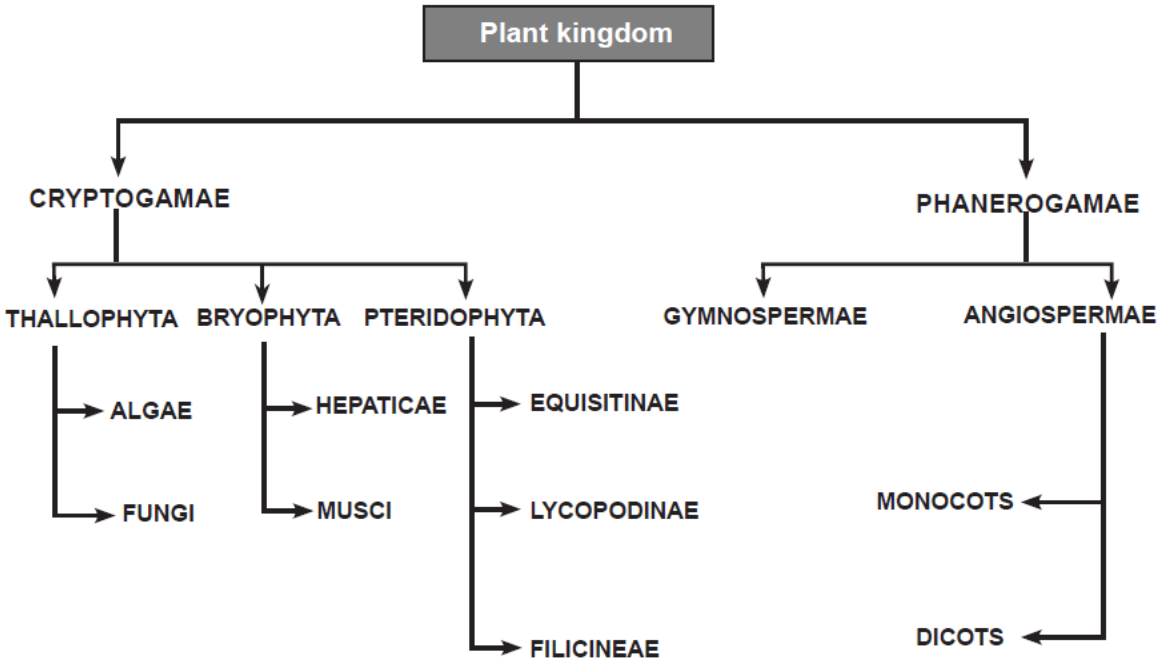

Fig . 1

3.1.1 Thallophyta:

Various types of microorganisms like algae, fungi and bacteria have been kept under it. Algae are classified in to three categories: Red, Brown and Green algae.

CHIEF CHARACTERISTICS OF ALGAE ARE:

- Cell wall of algae is made up of cellulose.

- Sex organs of algae are unicellular.

- Algae store their food in the form of starch.

Reproduction: Vegetative, Asexual and Sexual reproduction.

Economic Utilities: It is useful in the form of food stuffs, agriculture, in trade and business, in biological research, as the fodder of domestic animals, in the form of medicines and in the formation of land. But there are many algae which act like pollutants and contaminate the drinking water. Also, watery equipment's are rottened by the algae.

1. Celphaleuros algae produce a disease called **red rust in the tea plants.**
2. Algae are chlorophyll-bearing, simple, thalloid, autotrophic and largely aquatic (both fresh water and marine) organisms.
3. They occur in a variety of other habitats: moist stones, soils and wood.
4. Some of them also occur in association with fungi (lichen) and animals (e.g., on sloth bear). The form and size of algae is highly variable.

1. The size ranges from the microscopic unicellular forms like Chlamydomonas, to colonial forms like Volvox and to the filamentous forms like Ulothrix and Spirogyra.
2. A few of the marine forms such as kelps, form massive plant bodies. The algae reproduce by vegetative, asexual and sexual methods. Vegetative reproduction is by fragmentation.
3. Each fragment develops into a thallus. Asexual reproduction is by the production of different types of spores, the most common being the zoospores.
4. They are flagellated (motile) and on germination gives rise to new plants. Sexual reproduction takes place through fusion of two gametes.
5. These gametes can be flagellated and similar in size (as in Chlamydomonas) or non-flagellated (non-motile) but similar in size (as in Spirogyra).

Such reproduction is called isogamous.

6. Fusion of two gametes dissimilar in size, as in some species of Chlamydomonas is termed as anisogamous.
7. Fusion between one large, non-motile (static) female gamete and a smaller, motile male gamete is termed oogamous, e.g., Volvox, Fucus.
8. Algae are useful to man in a variety of ways. At least a half of the total carbon dioxide fixation on earth is carried out by algae through photosynthesis.
9. Being photosynthetic they increase the level of dissolved oxygen in their immediate environment.
10. They are of paramount importance as primary producers of energy-rich compounds which form the basis of the food cycles of all aquatic animals. Many species of Porphyra, Laminaria and Sargassum are among the 70 species of marine algae used as food.
11. Certain marine brown and red algae produce large amounts of hydrocolloids (water holding substances), e.g., algin (brown algae) and carrageen (red algae) are used commercially.
12. Agar, one of the commercial products obtained from Gelidium and Gracilaria are used to grow microbes and in preparations of ice-creams and jellies.
13. Chlorella and Spirullina are unicellular algae, rich in proteins and are used as food supplements even by space travelers.
14. The algae are divided into three main classes: Chlorophyceae, Phaeophyceae and Rhodophyceae.

3.1.2 CHLOROPHYCEAE

The members of chlorophyceae are commonly called green algae. The plant body may be unicellular, colonial or filamentous. They are usually grass green due to the dominance of pigments chlorophyll a and b.

1. The pigments are localised in definite chloroplasts. The chloroplasts may be discoid, plate-like, reticulate, cup-shaped, spiral or ribbon-shaped in different species.
2. Most of the members have one or more storage bodies called pyrenoids located in the chloroplasts. Pyrenoids contain protein besides starch.
3. Some algae may store food in the form of oil droplets. Green algae usually have a rigid cell wall made of an inner layer of cellulose and an outer layer of pectose.
4. Vegetative reproduction usually takes place by fragmentation or by formation of different types of spores. Asexual reproduction is by flagellated zoospores produced in zoosporangia.
5. The sexual reproduction shows considerable variation in the type and formation of sex cells and it may be isogamous, anisogamous or oogamous. Some commonly found green algae are: Chlamydomonas, Volvox, Ulothrix, Spirogyra and Chara.

3.1.3 PHAEOPHYCEAE

1. The members of phaeophyceae or brown algae are found primarily in marine habitats.
2. They show great variation in size and form.
3. They range from simple branched, filamentous forms (Ectocarpus) to profusely branched forms as represented by kelps, which may reach a height of 100 meters.
4. They possess chlorophyll a, c, carotenoids and xanthophylls. They vary in colour from olive green to various shades of brown depending upon the amount of the xanthophyll pigment, fucoxanthin present in them.
5. Food is stored as complex carbohydrates, which may be in the form of laminarin or mannitol.
6. The vegetative cells have a cellulosic wall usually covered on the outside by a gelatinous coating of algin.
7. The protoplast contains, in addition to plastids, a centrally located vacuole and nucleus.
8. The plant body is usually attached to the substratum by a holdfast, and has a stalk, the stipe and leaf like photosynthetic organ – the frond.
9. Vegetative reproduction takes place by fragmentation.

Asexual reproduction in most brown algae is by biflagellate zoospores that are pear-shaped and have two unequal laterally attached flagella. Sexual reproduction may be isogamous, anisogamous or oogamous. Union of gametes may take place in water or within the oogonium (oogamous species). The gametes are pyriform (pear-shaped) and bear two laterally attached flagella. The common forms are Ectocarpus, Dictyota, Laminaria, Sargassum and Fucus.

3.1.4 RHODOPHYCEAE

Rhodophyta are commonly called red algae because of the predominance of the red pigment, rphycoerythrin in their body.

Majority of the red algae are marine with greater concentrations found in the warmer areas.

They occur in both well-lighted regions close to the surface of water and also at great depths in oceans where relatively little light penetrates. The red thalli of most of the red algae are multicellular.

Some of them have complex body organisation. The food is stored as floridean starch which is very similar to amylopectin and glycogen in structure.

The red algae usually reproduce vegetatively by fragmentation. They reproduce asexually by nonmotile spores and sexually by non-motile gametes.

Sexual reproduction is oogamous and accompanied by complex post fertilisation developments. The common members are: Polysiphonia, Porphyra Gracilaria and Gelidium

3.2 BRYOPHYTA:

Plants are found at land and water but are amphibians like Liver warts, Horn warts, Moss etc. These plants are also autotrophic as chloroplasts are present.

1. Bryophytes are also called **amphibians** of the plant kingdom because these plants can live in soil but are dependent on water for sexual reproduction.
2. They usually occur in damp, humid and shaded localities.
3. They play an important role in plant succession on bare rocks/soil.
4. The plant body of bryophytes is more **differentiated than that of algae.**
5. It is thallus-like and prostrate or erect, and attached to the substratum by unicellular or multicellular rhizoids.
6. They lack true roots, stem or leaves.
7. They may possess root-like, leaf-like or stem-like structures.
8. **The main plant body of the bryophyte is haploid.** It produces gametes, hence is called a gametophyte. The sex organs in bryophytes are multicellular. The male sex organ is called antheridium.
9. They produce biflagellate antherozoids. The female sex organ called archegonium is flask-shaped and produces a single egg.
10. The antherozoids are released into water where they come in contact with archegonium.
11. An antherozoid fuses with the egg to produce the zygote.
12. Zygotes do not undergo reduction division immediately. They produce a multicellular body called a sporophyte.
13. The sporophyte is not free-living but attached to the photosynthetic gametophyte and derives nourishment from it.
14. **Some cells of the sporophyte undergo reduction division (meiosis) to produce haploid spores.** These spores germinate to produce gametophyte.
15. Bryophytes in general are of little economic importance but some mosses provide food for herbaceous mammals, birds and other animals.
16. Species of Sphagnum, a moss, provide peat that have long been used as fuel, and because of their capacity to hold water as packing material for trans-shipment of living material.
17. **Mosses along with lichens are the first organisms to colonise rocks** and hence, are of great ecological importance. They decompose rocks making the substrate suitable for the growth of higher plants.
18. Since mosses form dense mats on the soil, they reduce the impact of falling rain and prevent soil erosion. The bryophytes are divided into liverworts and mosses.

3.2.1 LIVERWORTS

1. The liverworts grow usually in moist, shady habitats such as banks of streams, marshy ground, damp soil, bark of trees and deep in the woods.
2. The plant body of a liverwort is thalloid, e.g., Marchantia. The thallus is dorsiventral and closely appressed to the substrate.
3. The leafy members have tiny leaf-like appendages in two rows on the stem-like structures.
4. Asexual reproduction in liverworts takes place by fragmentation of thalli, or by the formation of specialised structures called gemmae (sing. gemma).
5. Gemmae are green, multicellular, asexual buds, which develop in small receptacles called gemma cups located on the thalli.
6. The gemmae become detached from the parent body and germinate to form new individuals. During sexual reproduction, male and female sex organs are produced either on the same or on different thalli.
7. The sporophyte is differentiated into a foot, seta and capsule. After meiosis, spores are produced within the capsule. These spores germinate to form free-living gametophytes.

3.2.2 MOSSES

1. The predominant stage of the life cycle of a moss is the gametophyte which consists of two stages.
2. The first stage is the protonema stage, which develops directly from a spore.
3. It is a creeping, green, branched and frequently filamentous stage. The second stage is the leafy stage, which develops from the secondary protonema as a lateral bud.
4. They consist of upright, slender axes bearing spirally arranged leaves. They are attached to the soil through multicellular and branched rhizoids.
5. This stage bears the sex organs.
6. Vegetative reproduction in mosses is by fragmentation and budding in the secondary protonema.
7. In sexual reproduction, the sex organs antheridia and archegonia are produced at the apex of the leafy shoots.
8. After fertilisation, the zygote develops into a sporophyte, consisting of a foot, seta and capsule. The sporophyte in mosses is more elaborate than that in liverworts.
9. The capsule contains spores. Spores are formed after meiosis.
10. The mosses have an elaborate mechanism of spore dispersal. Common examples of mosses are Funaria, Polytrichum and Sphagnum .

<u>Economic Utilities:</u> These plants have good absorption capacity of water and thus can be used as flood preventive measure. Also used in stopping soil erosion. Moss plant is used as a fuel called peat energy and as antiseptics.

3.3 TRACHEOPHYTA:

These plants have well developed vascular tissues and divided in to xylem and phloem. Further it is divided in to three subgroups: Pteridophyta, Gymnosperms and Angiosperm.

3.3.1 PTERIDOPHYTA:

In these plants there are lack of seeds and flowers.

Examples: Club Mosses, horsetails, ferns etc.

Characteristics:

- These plants are sporophyte. As spores of these plants are produced in sporangia.

- The leaves in which sporangia produces is called sporophyll.

- On Gametophyte there exist male and female sex organ.

- Alternation of genes is also appeared.

- Zygospores are formed through zygote.

Utilities: This plant is used as fodders for the domestic animals, while the seed is used as medicines.

Algae	Fungi
1. They contain photosynthetic pigments. 2. Autotrophic. 3. Most of them are aquatic in habitat. 4. The cell wall is made up of Cellulose. 5. It contains starch as a stored food material.	1. Photosynthetic pigments are absent. 2. Heterotrophic. 3. Most of them are terrestrial. 4. The cell wall is made up of chitin. 5. It contains glycogen and oil as the stored food material.

1. The Pteridophytes include horsetails and ferns.
2. Pteridophytes are used for medicinal purposes and as soil-binders.
3. They are also frequently grown as ornamentals.
4. Evolutionarily, they are the first terrestrial plants to possess vascular tissues – xylem and phloem.
5. The pteridophytes are found in cool, damp, shady places though some may flourish well in sandy-soil conditions.
6. You may recall that in bryophytes the dominant phase in the life cycle is the gametophytic plant body. However, in pteridophytes, the main plant body is a sporophyte which is differentiated into true root, stem and leaves.
7. These organs possess well-differentiated vascular tissues. The leaves in pteridophyta are small (microphylls) as in Selaginella or large (macrophylls) as in ferns.
8. The sporophytes bear sporangia that are subtended by leaf-like appendages called sporophylls.

9. In some cases sporophylls may form distinct compact structures called strobili or cones (Selaginella, Equisetum).
10. The sporangia produce spores by meiosis in spore mother cells. The spores germinate to give rise to inconspicuous, small but multicellular, the need for water for fertilisation, the spread of living pteridophytes is limited and restricted to narrow geographical regions.
11. The gametophytes bear male and female sex organs called antheridia and archegonia, respectively. Water is required for transfer of antherozoids – the male gametes released from the antheridia, to the mouth of archegonium. Fusion of male gamete with the egg present in the archegonium result in the formation of zygote.
12. Zygote thereafter produces a multicellular well-differentiated sporophyte which is the dominant phase of the pteridophytes.
13. In majority of the pteridophytes all the spores are of similar kinds; such plants are called homosporous.
14. Genera like Selaginella and Salvinia which produce two kinds of spores, macro (large) and micro (small) spores, are known as heterosporous.
15. The megaspores and microspores germinate and give rise to female and male gametophytes, respectively.
16. The female gametophytes in these plants are retained on the parent sporophytes for variable periods.
17. The development of the zygotes into young embryos take place within the female gametophytes.
18. This event is a precursor to the seed habit considered an important step in evolution.
19. The pteridophytes are further classified into four classes: Psilopsida (Psilotum); Lycopsida (Selaginella, Lycopodium), Sphenopsida (Equisetum) and Pteropsida (Dryopteris, Pteris, Adiantum)

3.3.2 GYMNOSPERM:

The plants whose seeds are completely uncoated and there is complete lack of ovary.

Examples: Cycas, Pinus (Pines), Cedrus (Deodar) etc.

Characteristics:

a. These plants are perennial and xerophytic.
b. Have clear cut annual rings.
c. Undergo wind- pollination and have polyembryony- characteristics.
d. One or more cotyledons in an embryo exists with radicle and plumule.

Economic Utilities:

1. *Used in the form of food,*
2. *Timber & medicine.*
3. *For decorative and domestic use.*
4. *In making volatile oils & also used in the form of tanning and resin.*

THE GYMNOSPERMS

(Gymnos : naked, sperma : seeds) are plants in which the ovules are not enclosed by any ovary wall and remain exposed, both before and after fertilization.

1. The seeds that develop post-fertilisation, are not covered, i.e., are naked.
2. Gymnosperms include medium sized trees or tall trees and shrubs.
3. One of the gymnosperms, the giant redwood **tree Sequoia is one of the tallest tree species.**
4. The roots are generally tap roots. Roots in some genera have fungal association in the form of mycorrhiza (Pinus), while in some others (Cycas) small specialised roots called **coralloid roots** are associated with N2- fixing cyanobacteria.
5. The stems are unbranched (Cycas) or branched (Pinus, Cedrus).
6. The leaves may be simple or compound.
7. In Cycas the pinnate leaves persist for a few years. The leaves in gymnosperms are well-adapted to withstand extremes of temperature, humidity and wind.
8. In conifers, the needle-like leaves reduce the surface area. Their thick cuticle and sunken stomata also help to reduce water loss.

The gymnosperms are heterosporous;

1. They produce haploid microspores and megaspores. The two kinds of spores are produced within sporangia that are borne on sporophylls which are arranged spirally along an axis to form lax or compact strobili or cones.
2. The strobili bearing microsporophylls and microsporangia are called microsporangiate or male strobili.
3. The microspores develop into a male gametophytic generation which is highly reduced and is confined to only a limited number of cells.
4. This reduced gametophyte is called a pollen grain. The development of pollen grains take place within the microsporangia.
5. The cones bearing megasporophylls with ovules or megasporangia are called macrosporangiate or female strobili.
6. The male or female cones or strobili may be borne on the same tree (Pinus) or on different trees (Cycas).
7. The megaspore mother cell is differentiated from one of the cells of the nucellus.
8. The nucellus is protected by envelopes and the composite structure is called an ovule.

9. The ovules are borne on megasporophylls which may be clustered to form the female cones. The megaspore mother cell divides meiotically to form four megaspores. One of the megaspores
10. enclosed within the megasporangium (nucellus) develops into a multicellular female gametophyte that bears two or more archegonia or female sex organs.
11. The multicellular female gametophyte is also retained within megasporangium.
12. Unlike bryophytes and pteridophytes, in gymnosperms the male and the female gametophytes do not have an independent free-living existence. They remain within the sporangia retained on the sporophytes.
13. The pollen grain is released from the microsporangium. They are carried in air currents and come in contact with the opening of the ovules borne on megasporophylls.
14. The pollen tube carrying the male gametes grows towards archegonia in the ovules and discharge their contents near the mouth of the archegonia. Following fertilisation, zygote develops into an embryo and the ovules into seeds. These seeds are not covered.

WHISK FERNS

1. remnants of earliest vascular plants sporophyte consists of branching green stems lack roots or leaves
2. Gametophytes found in soil beneath sporophytes Colorless, filamentous form
3. Have saprobic or parasitic associations with fungi to obtain nutrients.

HORSETAILS

1. Commonly called scouring rushes, **"cajun kudzu"**
2. A single genus, Equisetum worldwide, mostly in damp places
3. Sporophytes are ribbed, jointed stems Arise from underground rhizomes Whorl of scalelike leaves at each stem node
4. Stems are hollow, contain silica deposits in epidermal cells
5. Two groups - branched and unbranched branched form resembles a horse's tail
6. Spores have two ribbonlike elaters (wings) aid in spore dispersal when dry curl around spore when damp
7. Gametophytes are small Numerous flagellated sperm swim to archegonia.

PHYLUM LYCOPHYTA:

- Club Mosses Worldwide, most common in tropics & moist temperate regions
- Resemble mosses, clearly different in internal structures
- Sporophytes have leafy stems
- Lycopodium is typical Sporangia produced in conelike clusters on stems or in upper leaves Leaves (microphylls) are short, linear and in whorls or spirals
- Lycopodium gametophytes are tiny and carrot-shaped some club mosses are used as ornaments (e.g. resurrection

plant) many are now endangered species.

Seed Plants first appear in fossil record in rocks dating to about 425 million years old - Seeds: have protective seed coat, protects embryo from drying out, from predators, provides for food storage for embryonic plant, many have adaptations for dispersal

- All heterosporous, gametophyte dependent upon sporophyte
- Microgametophytes are called pollen and contain sperm
- Megagametophytes are multicellular, contain an egg, and are found within an ovule on the sporophyte
- Pollination precedes fertilization and fertilization may be delayed
- Divided into two informal groups gymnosperms (naked seeds) - ovule not enclosed in sporophyte tissue when first formed (ovule is naked) angiosperms (covered seeds) –
- ovule enclosed in sporophyte tissue when first formed (ovule is enclosed).

Gymnosperms comprise 4 phyla

- Coniferophyta (conifers) - 601 spp. Cycadophyta (cycads) - 206 spp. Gnetophyta (gnetophytes) - 65 spp. Ginkophyta (ginkgo) - 1 sp.

Ovule rests on exposed scale - “naked”

- Seed may be covered with sporophyte tissue at maturity
- Sperm may be flagellated but is delivered within pollen grain

Phylum Coniferophyta –

- the conifers Includes pine, spruce, fir, hemlock and cypress Redwood is tallest plant, bristlecone pine is oldest
- Found in cooler, temperate, drier regions of world Great economic value, timber, paper, resins, turpentine
- One hundred species native to northern hemisphere
- Most have needle-like leaves, in clusters of two to five needles - tough needles retard loss of water have resins that deter insect and fungal attack Wood consists primarily of tracheid’s
- Lack vessels or fibers absence of fibers causes wood to be "soft"
- Thick bark is an adaptation to survive fires and subzero temperatures.

Conifer reproduction:

- Female cones produced on upper branches Larger than male cones, scales become woody at maturity
- Two ovules develop toward base of each scale
- Ovule contains megasporangium embedded in nutritive nucellus Nucellus completely surrounded by thick integument, opening called micropyle
- One integument layer becomes seed coat

- Single megaspore mother cells undergoes meiosis, forms row of four megaspores Three break down, one develops into female gametophyte
- Each gametophyte produces two to six archegonia, each contains an egg
- Female cones may take two or more years to mature
- During first spring are green, with scales spread apart
- Pollen grains carried by wind, catch on fluid oozing out of micropyle
- Pollen grains drawn through micropyle to top of nucellus
- Scales then close Archegonia and other female parts not mature for another year
- Pollen tube emerges from pollen grain at bottom of micropyle Digests through nucellus into archegonia
- Pollen's generative cell divides by mitosis, one cell divides again
- Last two cells function as sperm
- Mature male gametophyte is germinated pollen grain = pollen tube + two sperm
- In 15 months pollen tube reaches an archegonium
- Discharges contents into it One sperm unites with egg forming zygote
- Other sperm and other cells degenerate
- Zygote develops into embryo within a seed
- Seed disperses, germinates, grows into new sporophyte tree

GNETOPHYTES

- Closest living relative of angiosperms
- **They are the only gymnosperms with vessels in their xylem**
- Gnetophytes differ greatly from one another
- **Welwitschia stem** shaped like large, shallow cup Tapers into tap root
- Two strap-shaped, leathery leaves that grow continuously
- Reproductive structures are cone-like, appear at bases of leaves Produced on separate male and female plants
- **Ephedra comprises more than 35 species**
- Common in arid regions of U.S and Mexico Shrubby plants with jointed stems, scalelike leaves at each node
- Natural source for drug ephedrine.

PHYLUM GINKGOPHYTA:

- Ginkgo Fossils show species once widely distributed
- Only one species remains: Ginkgo biloba
- Historically found in Japan and China
- Commonly used in landscaping but no longer exists in wild Fan-shaped leaves resemble leaflets of fern Reproductive features
- Sperm have flagella
- Reproductive structures produced on separate trees
- Fruits have foul odor Male plants generally planted, propagated from shoots

Very resistant to air pollution, often planted in cities

(c) Angiosperm:

This is the most- important subgroup of plants, whose seeds are coated and developed in an organ or ovary.

Our major food, fibre, spice and beverage crops are flowering plants (angiosperms). Also used as medicinal plants and the respondent flavor species, latex products like rubber etc. These plants are also utilized in making perfumes, soaps and cosmetics from their oils.

Characteristics:

- The reproductive organ of this plant is flower and double fertilization takes place.

- Are saprophytic, symbiotic and parasitic. Some are autotrophic also.

- Normally appear on land but few are aquatic.

- The vascular tissues are extremely well developed.

Unlike the gymnosperms where the ovules are naked, in the angiosperms or flowering plants, the pollen grains and ovules are developed in specialised structures called flowers.

In angiosperms, the seeds are enclosed by fruits.

The angiosperms are an exceptionally large group of plants occurring in wide range of habitats. They range in size from tiny, almost microscopic Wolfia to tall trees of Eucalyptus (over 100 metres).

They provide us with food, fodder, fuel, medicines and several other commercially important products.

They are divided into two classes: the dicotyledons and the monocotyledons.

The dicotyledons are characterised by having two cotyledons in their seeds while the monocolyledons have only one.

The male sex organs in a flower is the stamen.

- Each stamen consists of a slender filament with an anther at the tip.
- The anthers, following meiosis, produce pollen grains.

THE FEMALE SEX ORGANS

1. is the pistil or the carpel.
2. Pistil consists of an ovary enclosing one to many ovules. Within ovules are present highly reduced female gametophytes termed embryo sacs.
3. The embryo-sac formation is preceded by meiosis. Hence, each of the cells of an embryo-sac is haploid. Each embryo-sac has a three-celled egg apparatus – one egg cell and two synergids, three antipodal cells and two polar nuclei.
4. The polar nuclei eventually fuse to produce a diploid secondary nucleus.
5. Pollen grain, after dispersal from the anthers, are carried by wind or various other agencies to the stigma of a pistil. This is termed as pollination.
6. The pollen grains germinate on the stigma and the resulting pollen tubes grow through the tissues of stigma and style and reach the ovule.

7. The pollen tubes enter the embryo-sac where two male gametes are discharged. One of the male gametes fuses with the egg cell to form a zygote (syngamy).
8. The other male gamete fuses with the diploid secondary nucleus to produce the triploid primary endosperm nucleus (PEN).
9. Because of the involvement of two fusions, this event is termed as double fertilization, an event unique to angiosperms.
10. The zygote develops into an embryo (with one or two cotyledons) and the PEN develops into endosperm which provides nourishment to the developing embryo.
11. The synergids and antipodals degenerate after fertilisation

Further Angiosperm is classified into two categories:

(a) Monocotyledonae (monocot): Leaves of these plants are much longer rather than broad. Stems of monocot lack cambium and hence they increase little in girth except palm tree. Examples: Maize, wheat, rice, onion, sugarcane, barley, banana, coconut etc.

Characteristics:

- In the seed of these plants one cotyledon is found.

- Their leaves have parallel venation.

- The roots of these plants are not developed.

- The flowers are trimerous i.e have three or multiple of three petals.

- In the vascular part, cambium doesn't exist.

(b) Dicotyledonae (Dicot): These plants have two seed leaves. Have veins forming a network in their leaves. Almost have all the hardwood tree species, pulses, fruits, vegetables etc. Examples: Pea, potato, sunflower, rose, banyan, apple, neem etc.

Characteristics:

- In the seed of these plants two cotyledons are found.

- In the vascular part cambium exists.

- The flower of the plant has multiples of four or five petals.

- These dicots plants have secondary growth.

3.6 PLANT LIFE CYCLES AND ALTERNATION OF GENERATIONS

In plants, both haploid and diploid cells can divide by mitosis. This ability leads to the formation of different plant bodies – haploid and diploid.

- The haploid plant body produces gametes by mitosis.
- This plant body represents a gametophyte.
- Following fertilisation the zygote also divides by mitosis to produce a diploid sporophytic plant body.
- Haploid spores are produced by this plant body by meiosis. These in turn, divide by mitosis to form a haploid plant body once again.
- Thus, during the life cycle of any sexually reproducing plant, there is an alternation of generations between gamete producing haploid gametophyte and spore producing diploid sporophyte.

However, different plant groups, as well as individuals representing them, differ in the following patterns:

1. Sporophytic generation is represented only by the **one-celled zygote.**

There are ***no free-living sporophytes.*** Meiosis in the zygote results in the formation of haploid spores. **The haploid spores divide mitotically and form the gametophyte.**

The dominant, photosynthetic phase in such **plants is the free-living gametophyte. This kind of life cycle is termed as haplontic.** *Many algae such as Volvox, Spirogyra and some species of Chlamydomomas represent this pattern.*

2. On the other extreme, is the type wherein the diploid sporophyte is the dominant, photosynthetic, independent phase of the plant.

The gametophytic phase is represented by the single to few-celled haploid gametophyte. This **kind of lifecycle is termed as diplontic.** All seedbearing plants i.e. gymnosperms and angiosperms, follow this pattern.

3. **Bryophytes and pteridophytes,** interestingly, exhibit an intermediate condition (Haplodiplontic); both phases are multicellular and often free-living.

However, they differ in their dominant phases

- A dominant, independent, photosynthetic, thalloid or erect phase is represented by a haploid gametophyte and it alternates with the shortlived multicelluler sporophyte totally or partially dependent on the gametophyte for its anchorage and nutrition.
- All bryophytes represent this pattern. The diploid sporophyte is represented by a dominant, independent, photosynthetic, vascular plant body.
- It alternates with multicellular, saprophytic/autotrophic, independent but short-lived haploid gametophyte. Such a pattern is known as haplo-diplontic life cycle.
- All pteridophytes exhibit this pattern. Interestingly, while most algal genera are haplontic, some of them such as Ectocarpus, Polysiphonia, kelps are haplo-diplontic. Fucus, an alga is diplontic.

MCQ CHAPTER-3

1. Spores of Funaria on germination give rise to
A) Antheridium
B) Bud
C) Protonema
D) Archegonium
c

2. The discovery of gibberellins is related with one of the following

A Blast disease of rice

B Rust disease of wheat

C 'Bakanae' disease of rice

D Early blight disease of potato

c

3. The female reproductive structure of small, nonvascular plants that produces a single egg by mitosis is

A Archegonium

B Antheridium

C Gemmae cup

D Sporangiophore

a

4. The gametophyte is not an independent, free-living generation in

A Pinus

B Polytrichum

C Adiantum

D Marchantia

a

5. The ladder-like structure found in Spirogyra is due to

A Scalariform conjugation

B Lateral conjugation

C Direct conjugation

D Asexual reproduction

a

6. The nonvascular plants whose gametophytes are larger than their sporophytes are

A fungi

B Pteridophytes

C Algae

D ryophytes

D

7. The seedless vascular plants whose sporophytes are larger than their small and independent gametophytes are

A Pteridophytes

B Angiosperms

C Gymnosperms

D None of these

A

8. The sporophytes are heterosporous in

A Selaginella

B Nephrolepis

C Marchantia

D Polytrichum

A

9. The term prothallus refers to

A a plant body not differentiated into root, stem and leaves

B reduced sporophyte

C a stage before thallus formation

D reduced gametophyte

D

10. The term 'vascular cryptogams' is used for

A Bryophyta

B Pteridophyta

C Angiosperms

D Gymnosperms

B

11. The unicellular green algae that undergo both asexual and sexual reproduction are

A Chlamydomonas

B Selaginella

C Pinus

D Dryopteris

A

12. The walking fern is so named because

A it is dispersed through the agency of walking animals

B it propagates vegetatively by its shoot tips

C its spores are able to walk

D it knows how to walk by itself

B

13. Transgenic plants are the ones

A Grown in artificial medium after hybridization in the field

B Produced by a somatic embryo in artificial medium

C Generated by introducing foreign DNA in to a cell and regenerating a plant from that cell

D Produced after protoplast fusion in artificial medium

C

14. Trumpet hyphae of certain brown algae are similar to

A Sieve tubes

B Tracheids

C Tracheae

D Companion cells

A

15. Which cells within the microsporangia undergo meiosis and produce microspores.

A Zygotic cells

B Spore mother cells

C Archegonial cells

D Antheridial cells

B

PART 2

16. A fresh water green alga, rich in protein is

A Ulothrix

B Chlorella

C Chlamydomonas

D Spirogyra

B

17. After fertilization the zygote of a seed plant becomes

A Fruit

B Embryo

C Seed

D Ovule

B

18. A pine seed has cotyledons and tissue from the _____.

A Male gametophyte

B Female gametophyte

C Megasporangium

D pollen grain

B

Question 4

19. A prokaryotic autotrophic nitrogen fixing symbiont found in

A Pisum

B Alnus

C Cycas

D Cicer

C

20. Algae having oil as reserve food belongs to

A Xanthophyceae

B Rhodophyceae

C Chlorophyceae

D Phaeophyceae

A

21. Antheridia and Archegonia are sex organs of

A Moss

B Mucor

C Spirogyra

D Puccinia

A

22. Archegoniophore is found in

A Funaria

B Marchantia

C Chara

D Adiantum

B

23. Archegonium is absent in

A Thallophyta

B Pteridophyta

C Bryophyta

D Gymnosperms

A

24. Chlorenchyma develops in

A Mycelium of a green mold such as Aspergillus

B Cytoplasm of Chlorella

C Capsule of a moss

D Pollen tube of Pinus

C

25. Chloroplast of Chlamydomonas is

A Collar-shaped

B Cup-shaped

C Stellate-shaped

D Spiral

B

26. Chloroplast of Ulothrix is

A Ribbon shaped and spirally coiled

B Laminate

C Stellate

D Girdle shaped

D

27. Compared with the gametophytes of the bryophytes the gametophytes of vascular plants tend to be

A Smaller and to have smaller sex organs

B Smaller but to have larger sex organs

C Larger but to have smaller sex organs

D Larger and to have larger sex organs

A

28. Consider the following four statements whether they are correct or wrong?

(a) The sporophyte in liverworts is more elaborate than that in mosses

(b) Salvinia is heterosporous

(c) The life-cycle in all seed bearing plants is diplontic

(d) In Pinus male and female cones are borne on different trees

The two wrong statements together are

A Statements (b) and (c)

B Statements (a) and (b)

C Statements (a) and (c)

D Statements (a) and (d)

D

29. Corn and beans are often cited as representative examples of _____, respectively.

A Ferns and mosses

B Cycads and conifers

C Monocots and dicots

D Whisk ferns and horsetails

C

30. Fern gametophyte is nutritionally

A Chemoautotroph

B Parasite

C Sporophyte

D Photoautotroph

D

SET 3

31. Gymnosperms produce neither flower nor fruit because they do not possess

A Embryo

B Ovary

C Ovule

D Seed

B

32. In moss stomata appears on

A Capsule

B Leaves

C Stem

D All of these

A

33. Fern plant is

A Haploid sporophyte

B Diploid gametophyte

C Diploid sporophyte

D Haploid gametophyte

C

34. Gymnosperms are

A Flowering plants

B Seed bearing plants

C Seedless flowering plants

D Fruit bearing seed plants

B

35. In a flower, _____ generally consist of two pollen sacs.

A Sepal

B Anthers

C Filament

D Ovary

B

36. In a flower, which terminal structure is part of a stamen?

A Anther

B Ovary

C Stigma

D Style

A

37. In a flowering plants megaspore undergoes mitosis and develops into a

A Anther

B Seed

C Ovary

D Sepal

B

38. In a seed plant the microspore gives rise to the

A Pollen grain

B Egg

C Female gametophyte

D Sporophyte

A

39. In a seed-bearing plant the megaspore develops/grows into

A Male gametophyte

B Female gametophyte

C Pollen grain

D None of these

B

40. In gymnosperms, the ovule is naked because

A Ovary wall is absent

B Integuments are absent

C Perianth is absent

D Nucellus is absent

A

41. In pteridophytes the xylem mainly consists of

A Sclereids

B Tracheids

C Vessels

D All of these

B

42. In Spirogyra sexual reproduction takes place by

A Somatogamy

B Fragmentation

C Conjugation

D None of the above

C

43. In which of the following groups would you place a plant which produces seeds but lacks flowers?

A Fungi

B Pteridophytes

C Bryophytes

D Gymnosperms

D

44. Gymnosperm seeds are naked due to lack of

A Nucellus

B Perianth

C Pericarp

D Integuments

C

45. Indusium is found in

A Selaginella

B Pinus

C Pteris

D Cycas

C

46. Which of the following has largest gametophyte?

A Pinus

B Oryza

C Funaria

D Selaginella

c

47. Which of the following is a living fossil?

A Spirogyra

B Cycas

C Moss

D Saccharomyces

b

48. Which of the following is commonly called as 'pond scum'?

A Nostoc

B Ulothrix

C Spirogyra

D Anabaena

c

49. Which of the following is haploid in the life-cycle of Funaria?

A Embryo

B Peristome teeth

C Protonema

D Sporophyte

c

50. Which of the following is often referred to as "pond scum"?

A Anabaena

B Spirogyra

C Ulothrix

D Nostoc

b

51. Which of the following plant group produces spores and embryo but Lacks vascular tissue and seeds?

A Bryophyta

B Rhodophyta

C Pteridophyta

D Phaeophyta

a

52. Which of the following plant groups is called amphibians?

A Tracheophyta

B Bryophyta

C Pteridophyta

D Thallophyta

b

53. Which of the following plant species you would select for the production of bioethanol?

A Jatropha

B Brassica

C Zea mays

D Pongamia

c

54. Which of the following plants is used extensively for the study of photosynthesis?

A Amaranthus

B Asparagus

C Chlorella

D Sunflower

c

55. Which of the following species propagates through leaf-tip?

A Funaria

B Walking fern

C Moss

D Marchantia

b

56. Which of the following is harvested commercially to produce agar?

A Brown algae

B Blue-green algae

C Green algae

D Red algae

d

57. Which of the followings is haploid in Funaria?

A Seta

B Protonema

C Columella

D Capsule

b

58. Which one helps in spore dispersal in moss?

A Peristome teeth

B Operculum

C Columella

D None of these

A

59. Which one of the following has haplontic life cycle?

A Wheat

B Funaria

C Polytrichum

D Ustilago

60. Which one of the following is a vascular cryptogram?

A Cedrus

B Equisetum

C Ginkgo

D Marchantia

a