

360

NCERT



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BIOLOGY

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Seep Pahuja

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Free Sample Contents

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39-62

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- 3.1 Algae
- 3.2 Bryophytes
- 3.3 Pteridophytes
- 3.4 Gymnosperms
- 3.5 Angiosperms

This sample book is prepared from the book "360 NCERT Biology for NTA NEET (UG) 2025, Class 11/ 12 & Droppers with Previous Year Solved Questions 2nd Edition | Detailed Theory with 6 Level of Practice Exercise".



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3

PLANT KINGDOM



TREND ANALYSIS NEET



	NEET	Remarks
Number of Questions from 2024-16	25	3-4 Questions every year
Weightage	4%	

Year	Topic Name	Concept Used	NEET	
			No. of Questions	Difficulty Level
2024	Algae	Reproduction	1	Difficult
2023	Bryophytes/ Pteridophytes/ Gymnosperms	Reproduction/ <i>Pinus</i>	4	Easy/ Difficult
2022	Algae Pteridophyta	Classification of algae	4	Easy/ Difficult
2021	Algae/ Bryophytes/ Pteridophytes	Reserve food Material/ Spores	4	Easy/ Average
2020	Algae/ Gymnosperms/ Plant Life Cycle	Rhodophyceae/ Cones / Alternation of Generation	3	Easy/ Difficult
2019	Gymnosperms/ Pteridophyte	<i>Pinus</i> / characteristics of Gymnosperms/ General characteristics of Pteridophytes	1	Average
2018	Algae/ Gymnosperms	Characteristics of algae/ Features of Gymnosperms	2	Average
2017	Algae/ Bryophytes/ Gymnosperms/ Angiosperms	Example of different types of algae/ Life cycles of bryophytes/ features of gymnosperms/ Double Fertilisation	4	Easy/ Average
2016	Pteridophytes/ Gymnosperms	Mode of reproduction/ Reproduction	2	Easy



Topic 3.0: INTRODUCTION

Characteristic Features of Kingdom Plantae

- The Kingdom Plantae includes plants which are multicellular eukaryotes.
- All plants contain plastids. Plastids are double membrane organelle that possess photosynthetic pigments. They are called chloroplasts.
- They are usually autotrophic. Chloroplast contains a green colour pigment called chlorophyll and prepares its own food by the process of photosynthesis.
- The cell walls possess mainly cellulose.
- The plant body may be thalloid or differentiated into root, stem and leaves.

- They may be non-vascular or vascular.
- They have two stages in their life cycle- a haploid, sexually reproducing gametophytic generation and a diploid, asexually reproducing sporophytic generation. The two generations alternate. This is called **alternation of generations**.

System of Classification

Five Kingdom Classification

- **Whittaker (1969)** wherein he suggested the Five Kingdom classification viz. **Monera**, **Protista**, **Fungi**, **Animalia** and **Plantae**.

- Fungi, and members of the Monera and Protista having cell walls have now been excluded from Plantae though earlier classifications placed them in the same kingdom.
- So, the **cyanobacteria** that are also referred to as **blue green algae** are not 'algae' any more.
- **Artificial system of classification**
 - ◆ It was given by **Linnaeus**.
 - ◆ It was based mainly on vegetative characters and androecium structures.
 - ◆ This artificial system classification separated the closely related species since they were based on a few characteristics. They gave equal importance to vegetative and sexual characteristics, which is not acceptable since we know that often the vegetative characters are more easily affected by environment.
- **Natural system of classification**
 - ◆ It was given by **George Bentham** and **Joseph Dalton Hooker**.
 - ◆ It was based on natural affinities among the organisms and considers not only the external features, but also internal features, like ultrastructure, anatomy, embryology and phytochemistry.
- **Phylogenetic system of classification**
 - ◆ This is accepted system of classification as it is based on evolutionary relationship between the organisms.
 - ◆ This assumes that organisms belonging to the same taxa have a common ancestor.
- **Numerical taxonomy**
 - ◆ It is based on all observable characteristics.
 - ◆ Numbers and codes are assigned to all characters and the data are then processed. In this way each character is given equal importance and at the same time hundreds of characters can be considered.
 - ◆ Easily carried out using computers.
- **Cytotaxonomy**
 - ◆ It is based on cytological information such as chromosome number, structure, behaviour.
- **Chemotaxonomy**
 - ◆ It is based on chemical constituents of the plant to resolve doubts and confusions.

NEET 2013

Kingdom Plantae

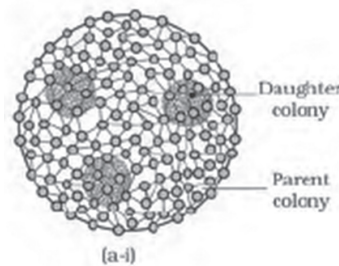
- Kingdom plantae shows a lot of diversity, because of which, it has been divided into four divisions: **Algae, Bryophyta, Pteridophyta, and Spermatophyta (Gymnosperms and Angiosperms)**.



Topic 3.1 : ALGAE

Algae

- **Habit and habitat:** Algae are largely aquatic either freshwater or marine organisms. Some members of algae occur in association with fungi (lichens) and animals (on sloth bear).
- **Characteristic features:**
 - ◆ Algae are chlorophyll-bearing, simple, thalloid, autotrophic organisms.
 - ◆ Their size ranges from microscopic unicellular forms such as *Chlamydomonas* to colonial forms such as *Volvox* and to filamentous forms such as *Ulothrix* and *Spirogyra*. Massive plant-like bodies are seen in some marine forms (such as kelps).
 - ◆ Algae are covered over by mucilage, which protects them from epiphytic growth and decaying effect of water.
- **Reproduction:** The algae reproduce vegetatively, asexually and sexually.
 - ◆ **Vegetative Reproduction:** Vegetative reproduction is by fragmentation. Each fragment develops into a thallus.
 - ◆ **Asexual Reproduction:** It takes place by means of different kinds of spores most common being zoospores. Zoospores are flagellated and motile. (E.g. *Chlamydomonas*).
 - ◆ **Sexual reproduction:** Sexual reproduction involves fusion of two gametes.
- **Isogamy:** It is the fusion of two morphologically and physiologically similar gametes. E.g. *Spirogyra* and some species of *Ulothrix*.
- **Anisogamy:** It is the fusion of two gametes which are morphologically dissimilar but physiologically similar (both motile or both non-motile). E.g. some species of *Eudorina*.
- **Oogamy:** It refers to the fusion of gametes which are both morphologically and physiologically dissimilar. In this type of fusion the male gamete is usually referred to as **antherozoid** which is usually motile and smaller in size and the female gamete which is usually non-motile and bigger in size is referred to as **egg**. The sex organ which produces the antherozoids is called **antheridium** and the egg is produced in **oogonium**. The fusion product of antherozoid and egg is called **zygote**. The zygote may germinate directly after meiosis or may produce **meiospores** which in turn will germinate. E.g., *Volvox*, *Fucus*.



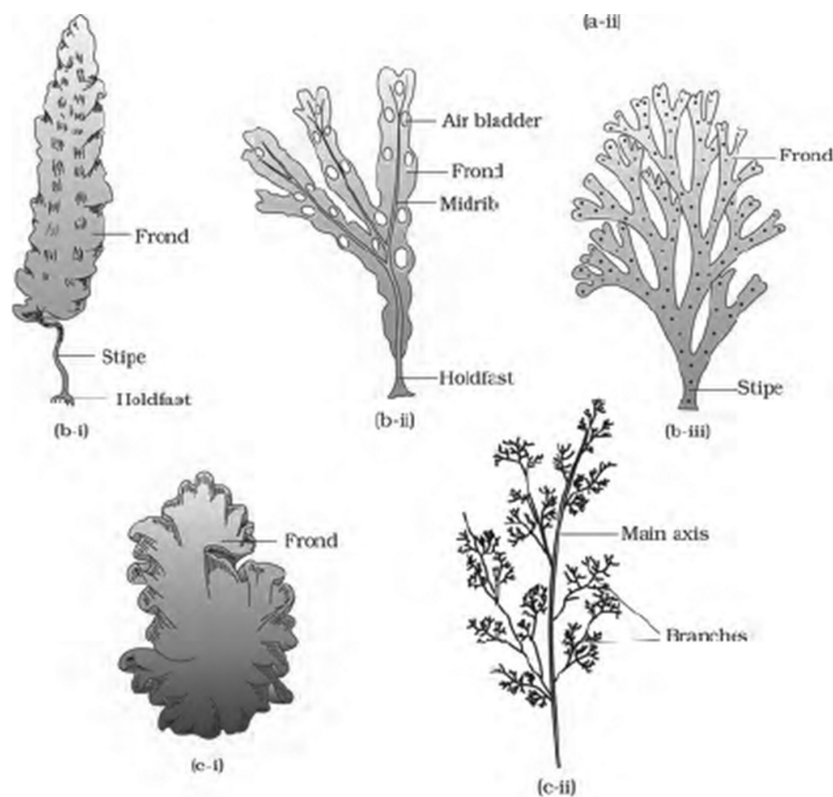


Fig: Algae : (a) Green algae (i) Volvox (ii) Ulothrix, (b) Brown algae (i) Laminaria (ii) Fucus (iii) Dictyota, (c) Red algae (i) Porphyra (ii) Polysiphonia

Economic Importance of Algae

Algae have diverse economic uses. They perform half of the total carbon dioxide-fixation on earth by photosynthesis, acting as the primary producers in aquatic habitats.

- **Food source:** Many species of marine algae such as *Porphyra*, *Sargassum*, and *Laminaria* are edible. *Chlorella* and *Spirulina* are rich in proteins. Thus, they are used as food supplements.
- **Commercial importance:** Agar is used in the preparation of jellies and ice-cream. It is obtained from *Gelidium* and *Gracilaria*. Carrageen is used as an emulsifier in chocolates, paints, and toothpastes. It is obtained from the red algae. Algin from *Laminaria*, *Fucus*, and *Sargassum* is used in stabilising emulsions *i.e.* shaving creams, shampoos, ice creams etc. **AIPMT (2012 & NEET (2021**
- **Medicines:** Many red algae such as *Corallina* are used in treating worm infections.
- **Sewage disposal:** *Chlamydomonas* and *Chlorella* are used for sewage disposal. They are the algae of sewage oxidation tanks which provide aerobic conditions for disposal of sewage by decomposers.
- **Chlorella:** Unicellular alga rich in proteins → used as small letter food supplement for space travellers.

LEARN BEYOND NCERT

Harmful effects of algae:-

- The luxuriant growth of algae in water reservoirs makes the water unfit for drinking. It imparts bad taste, odour and colouration to the water.

- Water blooms are formed by the growth of *Anabaena*, *Nostoc* *Microcystis* etc. in pond water. This may cause fish mortality by causing depletion of oxygen.
- The green algae *Cephaleuros Virescens* is parasitic on tea leaves. It causes a disease called red reist of tea. It also causes leaf spot disease in papaya and guava. Similarly, *Cephaleuros coffea* is parasitic on coffer plants. **NEET (2014**
- **The algae are divided into three classes based on their main pigments:** Chlorophyceae, Phaeophyceae, and Rhodophyceae.
- These divisions are based on the following factors:
 - ◆ Major photosynthetic pigments present
 - ◆ Form of stored food
 - ◆ Cell wall composition

(a) Chlorophyceae

- ◆ The members of chlorophyceae are commonly called green algae.
- ◆ The plant body may be unicellular, colonial or filamentous.
- ◆ The major pigments are Chlorophyll *a* and *b*. The pigments are localised in definite chloroplasts.
- ◆ The chloroplasts may be discoid, plate like, reticulate, cup-shaped, spiral or ribbon-shaped in different species.
- ◆ Most of the members have one or more storage bodies called pyrenoids located in the chloroplasts. Pyrenoids contain protein besides starch.

- ◆ **Stored food :** They store their food in the form of starch. Some algae may store food in the form of oil droplets.
 - ◆ **Cell wall composition :** Green algae usually have a rigid cell wall made of an inner layer of cellulose and an outer layer of pectose.
 - **Reproduction:**
 - ◆ Vegetative reproduction usually takes place by fragmentation or by formation of different types of spores.
 - ◆ Asexual reproduction is by spores. The common asexual spores are flagellated zoospores produced in zoosporangia.
 - ◆ The sexual reproduction may be isogamous, anisogamous or oogamous.
E.g. *Chlamydomonas*, *Volvox*, *Ulothrix*, *Spirogyra*, *Chara*, etc.
 - **Reproduction**
 - ◆ Vegetative reproduction takes place by fragmentation.
 - ◆ Asexual reproduction is by biflagellated zoospores that are pear-shaped and have two unequal laterally attached flagella.
 - ◆ Sexual reproduction may be isogamous, anisogamous or oogamous. **NEET (2024)**
 - ◆ In isogamy and anisogamy both the gametes are motile while in oogamy, only the male gametes are motile or flagellate. The female gametes are non-motile. The 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.
E.g. *Ectocarpus*, *Dictyota*, *Fucus*, *Sargassum* and *Laminaria*.
- (b) Phaeophyceae**
- ◆ The members of Phaeophyceae are commonly called brown algae.
 - ◆ **Habit and habitat:** Brown algae are found primarily in marine habitats.
 - ◆ **Size and Form:** They show great variation in size and form. Body consists of branched, filamentous structures (e.g. *Ectocarpus*) to profusely branched forms as represented by kelps, which may reach a height of 100 metres.
 - ◆ The plant body is usually attached to the substratum by a holdfast, and has a stalk, the stipe and leaf like photosynthetic organ called the frond.
 - ◆ **Major pigments:** They possess chlorophyll *a*, *c*, carotenoids and xanthophyll pigment, called fucoxanthin. The brown colour of algae is due to the presence of large amount of xanthophyll pigment. **NEET (2023, 2024)**
 - ◆ **Stored Food :** Food is stored as complex carbohydrates, which may be in the form of laminarin or mannitol. **NEET (2024)**
 - ◆ **Cell wall composition:** The cells have a cellulosic wall usually covered on the outside by a gelatinous coating of algin.
- (c) Rhodophyceae**
- ◆ **Common name:** Rhodophyta are commonly called red algae because of the predominance of the red pigment, r-phycoerythrin in their body. **NEET (2023)**
 - ◆ **Habit and habitat:** Majority of the red algae are marine with greater concentrations found in the warmer areas.
 - ◆ **Major pigments:** They possess chlorophyll *a* and *b*, and phycoerythrin. The red colour of the red algae is due to abundant formation of phycoerythrin.
 - ◆ **Stored food:** The food is stored as floridean starch. Its constituent is very similar to amylopectin and glycogen in structure. **NEET (2020)**
 - ◆ **Cell wall:** It is made of cellulose, pectin, and polysulphate esters.
 - ◆ Flagella is absent in members of this class.
 - ◆ **Reproduction:**
 - The red algae usually reproduce vegetatively by fragmentation.
 - They reproduce asexually by non-motile spores.
 - They reproduce sexually by non-motile gametes. Sexual reproduction is oogamous and accompanied by complex post fertilisation developments.
E.g. *Polysiphonia*, *Porphyra*, *Gracilaria*, *Gelidium*

Divisions of algae and their main characteristics

Classes	Common name	Major pigments	Stored food	Cell wall	Flagellar number and position of insertions	Habitat
Chlorophyceae	Green algae	Chlorophyll <i>a</i> , <i>b</i>	Starch	Cellulose	2-8, equal, apical	Fresh water, brackish water, salt water
Phaeophyceae	Brown algae	Chlorophyll <i>a</i> , <i>c</i> , fucoxanthin	Mannitol, laminarin	Cellulose and algin	2, unequal, lateral	Fresh water (rare), brackish water, salt water
Rhodophyceae	Red algae	Chlorophyll <i>a</i> , <i>d</i> , phycoerythrin	Floridean starch	Cellulose, pectin and polysulphatesters	Absent	Fresh water (some), brackish water, salt water (most)



Topic 3.2: BRYOPHYTES

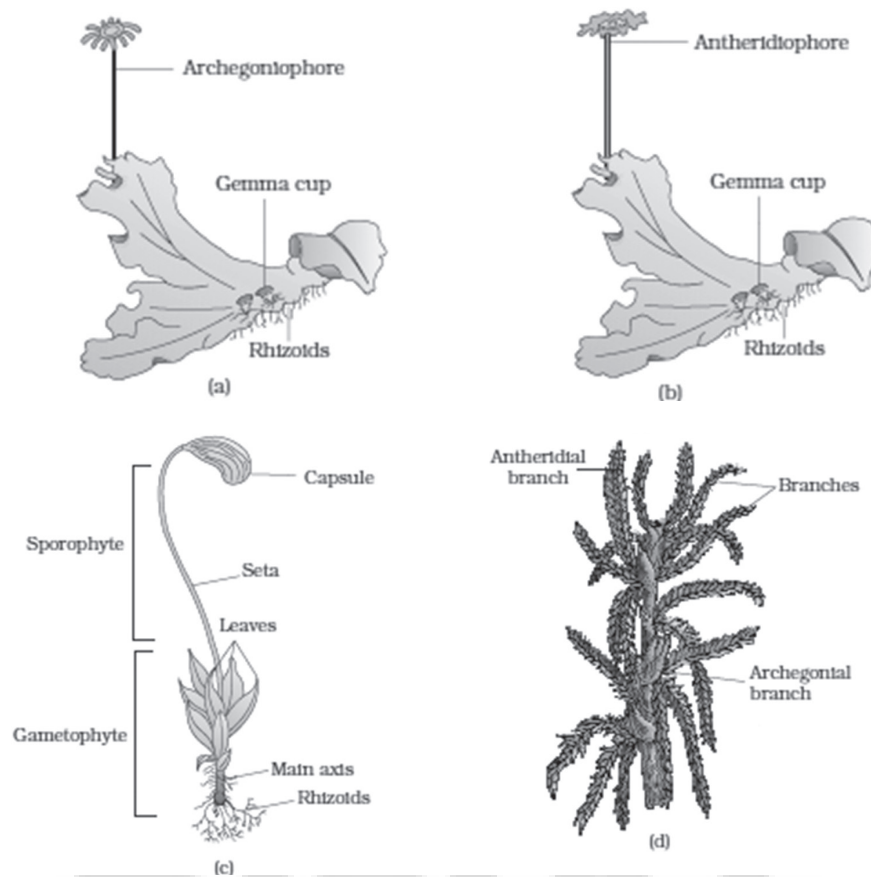


Fig.: Bryophytes: A liverwort – *Marchantia* (a) Female thallus (b) Male thallus Mosses – (c) *Funaria*, gametophyte and sporophyte (d) *Sphagnum* gametophyte

- **Habit and habitat:** They usually occur in moist, damp, and shady areas. They are known as amphibians of plant kingdom since they live on land, but depend on water for sexual reproduction. **AIPMT (2012 & 2015)**
- **Characteristics:**
 - ◆ Bryophyte is a division of non-vascular plants having an embryo stage in their developmental process.
 - ◆ Plant body is more differentiated than algae.
 - ◆ The plant body is thallus-like and is attached to substratum by rhizoids. Rhizoids may be unicellular or multicellular. Roots are absent.
 - ◆ Bryophytes lack true roots, stem and leaves; They may possess root-like, stem-like, and leaf-like structures
 - ◆ They have no specialized tissue for the conduction of water and other substances from one part of the body to another.
 - ◆ The dominant phase in the life cycle is haploid **gametophyte**. It may be a flattened thallus or differentiated into stem-like, root-like and leaf-like structures. The root-like structures are called **rhizoids**.
 - ◆ The gametophyte bears sex organs. Sex organs are multicellular and jacketed.
 - ◆ They are of two types:
 - The male sex organ is called **antheridium**, which produces biflagellate antherozoids or sperms.
 - The female sex organ is called **archegonium**. Archegonium is flask-shaped and produces a fertile egg or oosphere. **AIPMT (2014)**
 - ◆ The antherozoid fuses with the egg to produce **zygote**. The zygote produces a multicellular body called a **sporophyte**.
 - ◆ The sporophyte is not free-living but attached to the photosynthetic gametophyte and derives nourishment from it. That means, the sporophyte is dependent on the gametophyte.
 - ◆ The sporophyte reproduces asexually by producing spores. Meiosis takes place during spore formation, hence they are haploid. These spores germinate to produce the gametophyte.
 - ◆ Bryophytes show distinct alternation of gametophytic generation with sporophytic generation.
- **Economic Importance of Bryophytes**
 - ◆ **Food:** Some mosses are good source of food for herbaceous mammals, birds and other animals.

- ◆ **Peat: *Sphagnum*** in form of peat is used as fuel and also used for trans-shipment of living material as it has water holding capacity, prevent soil erosion, along with lichens are first colonisers on barren rocks.
- ◆ **Soil formation:** 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.
- ◆ **Prevention of soil erosion:** Bryophytes especially mosses form dense mats on the soil, reduce the impact of falling rain and prevent soil erosion.
- ◆ The bryophytes are divided into liverworts and mosses.

Liverworts

- **Characteristics:**
 - ◆ **Habit and habitat:** 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.
 - ◆ **Body features:** The plant body of a liverwort is thalloid, e.g., *Marchantia*. The thallus is dorso-ventral and closely appressed to the substrate.
 - ◆ **Reproduction:**
 - **Asexual reproduction:** It takes place by fragmentation of thalli, or by the formation of **gemmae**. **Gemmae** are small green, multicellular, asexual buds, which are borne dorsally inside gemma cups located on the thalli. The mature gemmae separate from the parent body and germinate to form new individuals. **NEET (2021)**
 - **Sexual reproduction:** The male and female sex organs are produced either on the same or on different thalli. Fertilization produces zygote which grows to form diploid sporophyte. Each 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.

- ◆ **Example:** *Marchantia*.

Mosses

- **Characteristics:**
 - ◆ The predominant stage of the life cycle of a moss is the gametophyte which consists of two stages.
 - **Protonema stage:** It is the first stage and develops directly from a spore. It is a creeping, green, branched and frequently filamentous stage.
 - **Leafy stage:** It is the second stage, which develops from the secondary protonema as a lateral bud. They consist of upright, slender axis bearing spirally arranged leaves. They are attached to the soil through multicellular and branched rhizoids. This stage bears the sex organs.
- ◆ **Reproduction**
 - **Vegetative reproduction:** It is by fragmentation and budding in the secondary protonema.
 - **Sexual reproduction:** In mosses, the primary protonema (developed in the first stage) develops into the secondary protonema. Both these stages are haploid or gametophytic. The secondary protonema bears the sex organs antheridia and archegonia, which produce gametes. These gametes fuse to form a zygote. The zygote develops into a sporophyte, consisting of foot, seta and capsule. The capsule contains spores. Many spores are formed as a result of the reduction division taking place in the capsule of this sporophyte.
- ◆ **Common Examples:** *Funaria*, *Polytrichum* and *Sphagnum* etc.



Topic 3.3: PTERIDOPHYTES

Pteridophyta

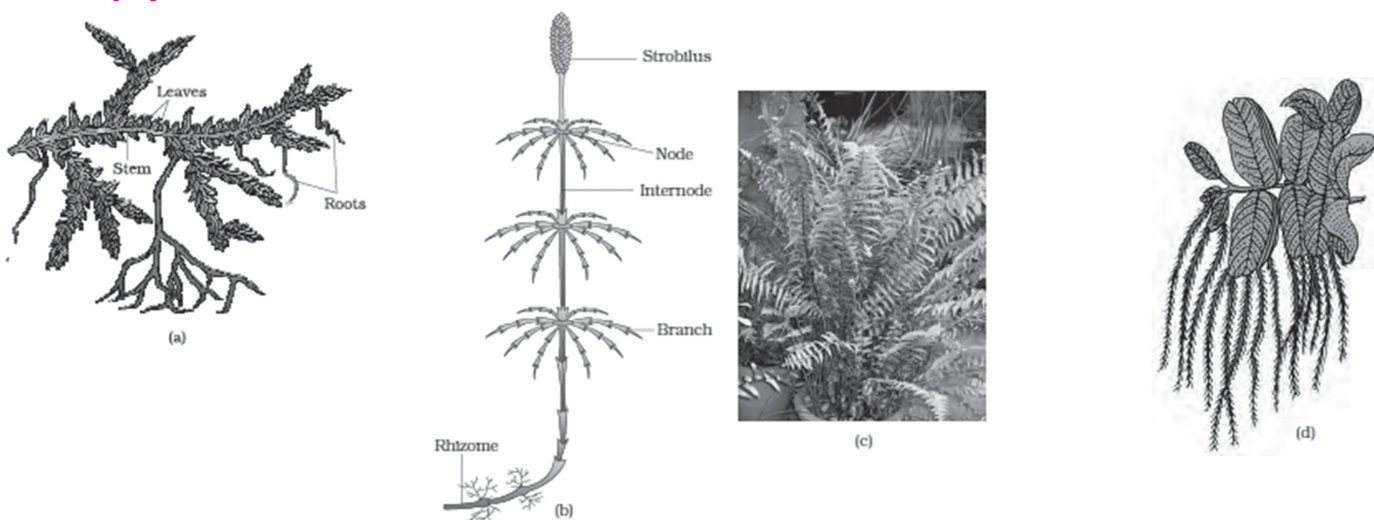


Fig. : Pteridophytes : (a) *Selaginella* (b) *Equisetum* (c) *Fern* (d) *Salvinia*

Habit and habitat: The pteridophytes are found in cool, damp, shady places though some may flourish well in sandy-soil conditions.

• **Characteristic features:**

- ♦ They are first terrestrial plants which possess vascular tissue *i.e.* xylem and phloem.
- ♦ It is a division of seedless vascular plants. Hence commonly known as **vascular cryptogams**.
- ♦ They have well developed vascular system (xylem and phloem).
- ♦ The dominant plant body is sporophyte, which is differentiated into true root, stem and leaves. These organs possess well-differentiated vascular tissues.
- ♦ The leaves in pteridophyta are small (microphylls) as in *Selaginella* or large (macrophylls) as in ferns.
- ♦ The sporophytes bear sporangia that develop in association with leaf-like appendages called **sporophylls**.
- ♦ In some pteridophytes, sporophylls form distinct, compact structures called **strobili** or **cones** (*Selaginella*, *Equisetum*).
- ♦ Seeds are absent. They produce naked embryos called **spores**.

• **Homosporous pteridophytes:** They bear spores that are of same type. E.g. *Pteris*, *Adiantum*, *Nephrolepis*, *Lycopodium*.

• **Heterosporous pteridophytes:** They bear two kinds of spores-microspores (small) and megaspores (large). E.g. *Selaginella*, *Salvinia*, *Marsilea*. **NEET (2020, 2021)**

- ♦ The sporangia produce spores by meiosis in spore mother cells.
- ♦ The spores germinate to give rise to inconspicuous, small but multicellular, free-living, mostly photosynthetic thalloid gametophytes called **prothallus**.
- ♦ The gametophyte, prothallus bear male and female sex organs called antheridia and archegonia, respectively.

- ♦ Antheridia are small and sessile. Archegonia are partially embedded. Archegonial neck is four-rowed.
- ♦ Sperms are motile and require an external supply of water to reach archegonia.
- ♦ Fusion of male gamete with the egg present in the archegonium result in the formation of zygote.
- ♦ Zygote thereafter produces a multicellular well-differentiated sporophyte which is the dominant phase of the pteridophytes.
- ♦ Spores may be similar (homosporous) as in majority of pteridophytes. However, few plants are heterosporous. They produce two types of spores-microspores and megaspores.
- ♦ The megaspores and microspores germinate and give rise to female and male gametophytes, respectively. The female gametophytes in these plants are retained on the parent sporophytes for variable periods. The development of the zygotes into young embryos takes place within the female gametophytes.

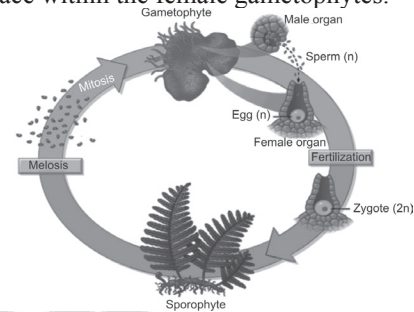


Fig. : Life cycle of a fern

- ♦ The development of zygotes into young embryo takes place within female gametophytes. This event is a precursor of seed habit. **NEET (2019)**
- The pteridophytes are divided into four classes:
 - ♦ **Psilopsida** (Whisk ferns): E.g. *Psilotum*
 - ♦ **Lycopsidea** (Club mosses): E.g. *Lycopodium*, *Selaginella*.
 - ♦ **Sphenopsida** (Horse tails): E.g. *Equisetum*
 - ♦ **Pteropsida** (Ferns): E.g. *Pteris*, *Adiantum*, *Dryopteris*.



Topic 3.4: GYMNOSPERMS

Gymnosperms

Characteristic Features

- The term gymnosperm refers to plants with naked seeds, *i.e.*, the seeds (ovules) are not enclosed inside a fruit. They are naked.
- All gymnosperms are perennial and woody. The plant-body ranges from medium to tall trees and shrubs.
- The root system consists of tap roots. **NEET (2016)**
- Roots in some genera show symbiotic associations.
 - ♦ Mycorrhiza shows association of fungi with *Pinus* roots.

- ♦ The small specialized roots, in *Cycas* called coralloid roots are associated with nitrogen-fixing cyanobacteria. **NEET (2019)**
- The stem can be branched (as in *Pinus* and *Cedrus*) or un-branched (as in *Cycas*). **NEET (2019)**
- The leaves can be simple (as in *Pinus*) or compound (pinnate in *Cycas*).
- The leaves are needle-like, with a thick cuticle and sunken stomata. These help in preventing water loss.
- Gymnosperms are heterosporous. They bear two kinds of spores, haploid microspores and megaspores. **NEET (2016, 2017)**

- The two kinds of spores are produced within sporangia. Sporangia are borne on sporophylls, microsporophylls and megasporophylls that are usually aggregated to form distinct cones or strobili.
 - ◆ The strobili bearing microsporophylls and microsporangia are called **male strobili** or **male cone**.
 - ◆ The microspores develop into a male gametophytic generation which is highly reduced and is confined to only a limited number of cells. This reduced gametophyte is called a pollen grain.
 - ◆ The development of pollen grains takes place within the microsporangia.
 - ◆ The strobili bearing megasporophylls with ovules or megasporangia are called **female strobili** or **female cone**.
 - ◆ The male cones or strobili may be borne on the same tree (*Pinus*) or on different trees (*Cycas*).
- The male gametophyte produces two male gametes and female gametophyte contains archegonia.
- External water is not required for transport of male gametes.
- 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. The pollen grain is released from the microsporangium.
- Pollination occurs mostly through wind and pollen grains reach the pollen chamber of the ovule through the micropyle, borne on megasporophylls.
- The pollen tube carrying the male gametes grows towards archegonia in the ovules and discharges their contents near the mouth of the archegonia. Following fertilisation, zygote develops into an embryo and the ovules into seeds. These seeds contain haploid endosperms and remain uncovered.
- The megaspore mother cell is differentiated from one of the cells of the nucellus.

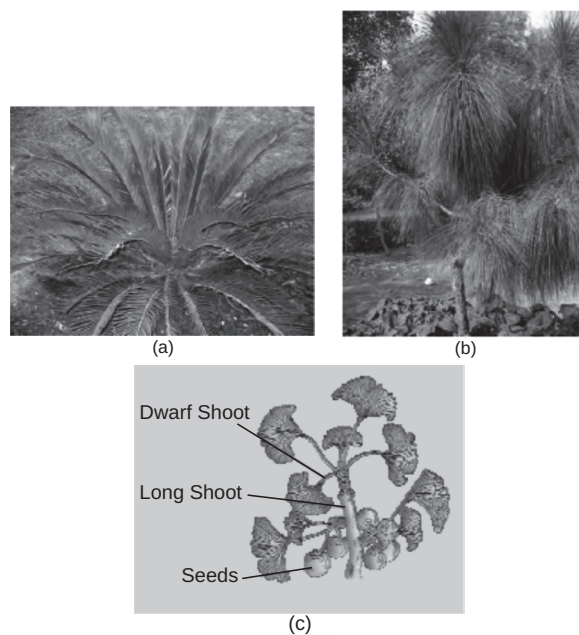


Fig. Gymnosperms: (a) *Cycas* (b) *Pinus* (c) *Ginkgo*

- The nucellus is protected by envelopes and the composite structure is called an ovule. **NEET (2018)**
- The ovules are borne on megasporophylls which may be clustered to form the female cones. **NEET (2018)**
- The megaspore mother cell divides meiotically to form four megaspores.
- One of the megaspores enclosed within the megasporangium (nucellus) develops into a multicellular female gametophyte that bears two or more archegonia or female sex organs.
- The multicellular female gametophyte is also retained within megasporangium.
- **Cycas** is also called living fossil because it possesses a number of characters of extinct pteridophytes and cycads.



Topic 3.5: ANGIOSPERMS

Angiosperms

- **Habit and habitat:** The angiosperms are an exceptionally large group of plants occurring in wide range of habitats.
- **Size:** They range in size from tiny, almost microscopic *Wolffia* to tall trees of *Eucalyptus*, which is over 100 metres.
- **Characteristic features:**
 - ◆ Angiosperms are also known as flowering plants which bear flowers and produce fruit enclosing the seeds. They are the most recently and highly evolved plants.
 - ◆ The plant body is a sporophyte which differentiated into underground root system and aerial shoot system.
 - ◆ They have sporophyll that aggregate to form flowers with the perianth.
 - ◆ Both microsporophylls and megasporophylls are specialised.

- ◆ A microsporophyll or stamen or androecium consists of a slender filament with an anther at the tip. The anthers produce pollen grains by meiosis.
- ◆ The megasporophylls are delicate and rolled, forming carpels or pistils or gynoecium. Pistil contains the ovary, style, and stigma. The ovules are present inside the ovary. A highly reduced haploid female gametophyte called **embryo sac** develops inside the ovule.

Angiosperms are divided into two classes:

- Dicotyledonae:** They are characterised by having two cotyledons in their seeds. E.g: Mustard, bengal gram, pea, potato, rose, banyan, apple etc.
 - Monocotyledonae:** They are characterised by having one cotyledon in their seeds. E.g: Grasses, coconut, maize, wheat, rice, sugarcane, etc.
- Monocots and dicots can be differentiated through their morphological and anatomical characteristics.

KEY TERM REFRESHER – FIB

1. _____ based on evolutionary relationships between the various organisms are acceptable.
2. _____ that is based on cytological information like chromosome number, structure, behaviour and _____ that uses the chemical constituents of the plant to resolve confusions, are also used by taxonomists these days
3. _____ are chlorophyll-bearing, simple, thalloid, autotrophic and largely aquatic (both fresh water and marine) _____.
4. Fusion between one large, nonmotile (static) female gamete and a smaller, motile male gamete is termed _____.
5. Bryophytes are also called _____ of the plant kingdom.
6. Asexual reproduction in liverworts takes place by fragmentation of thalli, or by the formation of specialised structures called _____.
7. Genera like *Selaginella* and *Salvinia* which produce two kinds of spores, macro (large) and micro (small) spores, are known as _____.
8. The _____ (*gymnos* : naked, *sperma* : seeds) are plants in which the ovules are not enclosed by any ovary wall and remain exposed, both before and after fertilisation.
9. One of the gymnosperms, the giant redwood tree _____ is one of the tallest tree species. The roots are generally tap roots.
10. The male sex organ in a flower is the _____.
11. The female sex organ in a flower is the _____.
12. The _____ and _____ degenerate after fertilisation.
13. 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 _____.


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EXERCISE 1 : NCERT PRACTICE PROBLEM LEVEL-1

INTRODUCTION



- Cytological information like chromosome number, structure, behaviour are related with
 - numerical taxonomy
 - cytotaxonomy
 - chemotaxonomy
 - All of the above

ALGAE



- In spirogyra sexual reproduction involves fusion of
 - morphologically similar gametes
 - physiologically similar gametes
 - physiologically dissimilar gametes
 - Both (a) and (c)
- Agar-agar is obtained from
 - Gigartina
 - Gelidium*
 - Gracilaria*
 - Both (b) and (c)
- Pyrenoids in green algal cells are related to
 - Starch formation
 - Protein storage
 - General metabolism
 - Both (a) and (b)
- Which type of sexual reproduction is found in *Spirogyra*?
 - Fusion
 - Binary fission
 - Fragmentation
 - Spores formation
- Which of the following class of algae rarely found in fresh water?
 - Chlorophyceae
 - Phaeophyceae
 - Rhodophyceae
 - Both (a) and (b)
- Floridean starch is found in
 - chlorophyceae
 - rhodophyceae
 - myxophyceae
 - cyanophyceae
- A research student collected certain alga and found that its cells contained both chlorophyll a and chlorophyll d as well as phycoerythrin. The alga belongs to
 - rhodophyceae
 - bacillariophyceae
 - chlorophyceae
 - phaeophyceae
- Laminaria* (kelp) and *Fucus* (rock weed) are the examples of
 - red algae
 - brown algae
 - green algae
 - golden brown algae
- In which of the following, all listed genera belong to the same class of algae
 - Chara, Fucus, Polysiphonia*
 - Volvox, Spirogyra, Chlamydomonas*
 - Porphyra, Ectocarpus, Ulothrix*
 - Sargassum, Laminaria, Gracilaria*
- Which of the following class of algae mostly found in salt water?
 - Phaeophyceae
 - Rhodophyceae
 - Chlorophyceae
 - Both (a) and (b)
- Mannitol is the stored food in
 - Chara
 - Porphyra
 - Fucus
 - Gracilaria

- If you are asked to classify the various algae into distinct groups, which of the following characters you should choose?
 - Nature of stored food materials in the cell
 - Structural organization of thallus
 - Chemical composition of the cell wall
 - Types of pigments present in the cell

- Ulothrix* can be described as
 - non-motile colonial alga lacking zoospores
 - filamentous alga lacking flagellated reproductive stages
 - membranous alga producing zoospores
 - filamentous alga with flagellated reproductive stages

BRYOPHYTES



- Bryophytes are called amphibians of plant kingdom because
 - their reproductive phase requires water
 - their sex organs are multicellular and jacketed
 - they have tracheids
 - All of these
- Which commonly known as 'Peat moss' or 'Bog moss' ?
 - Polytrichum*
 - Funaria*
 - Sphagnum*
 - Riccia*
- Sporophyte is independent of gametophyte in
 - Bryophytes*
 - Gymnosperms*
 - Angiosperms*
 - Pteridophytes*
- Bryophytes are different from fungi in having
 - Land habit
 - Sterile jacket layers
 - Multiflagellate gametes
 - Gametophytic plant body
- The plant body is thalloid in
 - Funaria*
 - Sphagnum*
 - Salvinia*
 - Marchantia*
- Protonema stage is found in
 - Ferns
 - Mosses
 - Liverworts
 - Fungi
- Which of the following stage of *Funaria* is haploid?
 - Gametophyte
 - Sporophyte
 - Both (a) and (b)
 - None of these
- Multicellular branched rhizoids and leafy gametophytes are characteristic of
 - all bryophytes
 - some bryophytes
 - all pteridophytes
 - some pteridophytes
- In a moss the sporophyte
 - produces gametes that give rise to the gametophyte
 - arises from a spore produced from the gametophyte
 - manufactures food for itself as well as for the gametophyte
 - is partially parasitic on the gametophyte



24. Protonema
 (a) is a stage of gametophytic generation.
 (b) is a creeping, green, branched and develops directly from a spore.
 (c) Filamentous stage.
 (d) All of the above
25. Which one of the following pairs of plants are not seed producers?
 (a) *Funaria* and *Pinus*
 (b) Fern and *Funaria*
 (c) *Funaria* and *Ficus*
 (d) *Ficus* and *Chlamydomonas*
26. The unique feature of bryophytes compared to other plant groups is that –
 (a) They produce spores
 (b) They lack vascular tissues
 (c) They lack roots
 (d) Their sporophyte is attached to the gametophyte
27. Female reproductive part of bryophytes is
 (a) Antheridium (b) Oogonium
 (c) Archegonium (d) Sporangium
28. The plant group that produces spores and embryo but lacks vascular tissues and seeds is
 (a) pteridophyta (b) rhodophyta
 (c) bryophyta (d) phaeophyta
29. Mosses and ferns are found in moist and shady places because both
 (a) Require presence of water for fertilization.
 (b) Do not need sunlight for photosynthesis.
 (c) Depend for their nutrition on micro-organisms which can survive only at low temperature.
 (d) Can not compete with sun-loving plants.
30. The plant body of moss (*Funaria*) is
 (a) completely sporophyte
 (b) completely gametophyte
 (c) predominantly sporophyte with gametophyte
 (d) predominantly gametophyte with sporophyte
31. Peat Moss is used as a packing material for sending flowers and live plants to distant places because
 (a) it is hygroscopic
 (b) it reduces transpiration
 (c) it serves as a disinfectant
 (d) it is easily available
32. Which of the following groups of plants play an important role in plant succession on bare rocks/soil?
 (a) Algae (b) Bryophytes
 (c) Pteridophytes (d) Gymnosperms
33. In bryophytes, male and female sex organs are called _____ and _____ respectively.
 (a) microsporangia; macrosporangia
 (b) male strobili; female strobili
 (c) antheridia; archegonia
 (d) androecium; gynoecium
34. The body of bryophytes remain fixed to the substratum by means of
 (a) scales (b) rhizoids
 (c) gemmae (d) Both (a) and (b)



35. Which of the following in bryophytes is an adaptation to water conditions?
 (a) Absence of true roots (b) Absence of vascular tissue
 (c) Movement of sperms (d) All of these
36. Due to which of the following, bryophytes and algae resemble each other?
 (a) Thalloid plant body (b) No roots
 (c) No vascular tissue (d) All of these

PTERIDOPHYTES



37. The spreading of living pteridophytes is limited and restricted to narrow geographical region because
 (a) gametophytic growth needs cool, damp and shady places.
 (b) it requires water for fertilization
 (c) due to absence of stomata in leaf and absence of vascular tissue.
 (d) both (a) and (b)
38. Which of the following is not a pteridophyte?
 (a) *Ginkgo* (b) *Selaginella*
 (c) *Polypodium* (d) *Azolla*
39. Male and female gametophytes are independent and free-living in:
 (a) Mustard (b) *Castor* (c) *Pinus* (d) *Sphagnum*
40. Fern plant is a –
 (a) Haploid gametophyte (b) Diploid gametophyte
 (c) Diploid sporophyte (d) Haploid sporophyte
41. Seed habit first originated in
 (a) Certain pteridophytes (b) Certain pines
 (c) Certain monocots (d) Certain dicots
42. Prothallus means –
 (a) Immature gametophyte (b) Thalloid gametophyte
 (c) Immature archegonium (d) None of these
43. The gametophyte of fern bears
 (a) True roots (b) Antheridia
 (c) Archegonia (d) Both (b) and (c)
44. Sporangia and spore bearing leaf in fern is called as
 (a) Ramentum (b) Sorus
 (c) Indusium (d) Sporophyll/Frond
45. Which one of the following is heterosporous?
 (a) *Dryopteris* (b) *Salvinia*
 (c) *Adiantum* (d) *Equisetum*

GYMNOSPERMS



46. *Cycas* and *Adiantum* resemble each other in having
 (a) seeds (b) motile sperms
 (c) cambium (d) vessels
47. Cones and flowers are similar because –
 (a) Both are bright and showy
 (b) Both are reproductive organs
 (c) Do not contain endosperm
 (d) Do not contain starch
48. *Cycas* and *Adiantum* resemble each other in having:
 (a) Seeds (b) Motile Sperms
 (c) Cambium (d) Vessels

49. In *Pinus* male and female reproductive structures occur
 (a) On different branches of the same plant
 (b) On different plants
 (c) On same branch
 (d) None of these
50. Pollination of pollen grains in *Pinus* takes place via
 (a) Insect (b) Water
 (c) Both (a) and (b) (d) Air
51. In Gymnosperms,
 (a) Cuticle is thin
 (b) Cannot withstand extreme temperatures
 (c) Stomata is sunken
 (d) *Sequoia* is smallest tree species
52. Which of the following is the tallest gymnosperm?
 (a) *Cycas* (b) *Sequoia* (c) *Pinus* (d) *Ephedra*
53. Coralloid roots of *Cycas* are useful in
 (a) N_2 -fixation (b) Absorption of water
 (c) Transpiration (d) Fixation
54. Which of the following structures in *Pinus* are haploid?
 (a) Megaspore, integument, root
 (b) Pollen grain
 (c) Leaf, root
 (d) Megaspore, endosperm, embryo
55. Male and female cones are borne on different trees
 (a) *Pinus* (b) *Cycas* (c) *Sequoia* (d) *Ginkgo*
56. Fruits are not formed in Gymnosperms because of –
 (a) Absence of pollination (b) Absence of seed
 (c) Absence of fertilization (d) Absence of ovary
57. Mycorrhizal association is found in _____.
 (a) *Cycas* (b) *Pinus* (c) *Sequoia* (d) *Ginkgo*



EXERCISE 2 : NCERT PRACTICE PROBLEM LEVEL-2

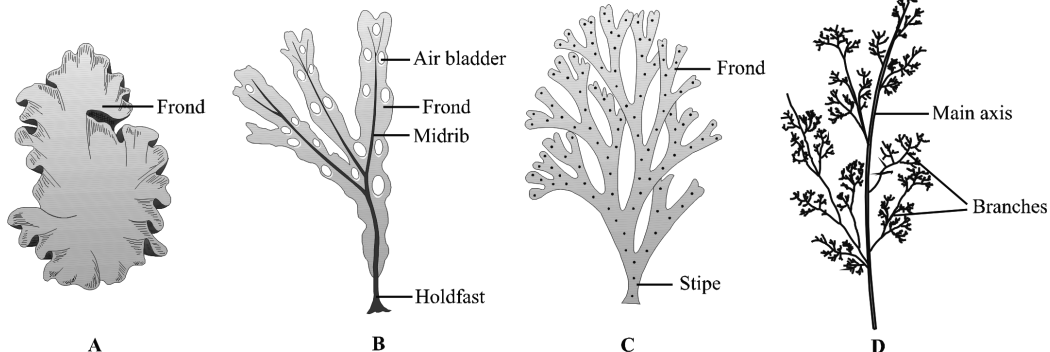
INTRODUCTION

1. Why are reproductive characters given more weightage during advanced classification?
 (a) Vegetative characters are more or less constant over the generation
 (b) Reproductive characters are less constant over the generation
 (c) Vegetative characters are easy to get affected by environment
 (d) Reproductive characters are more or less constant over the generation

ALGAE

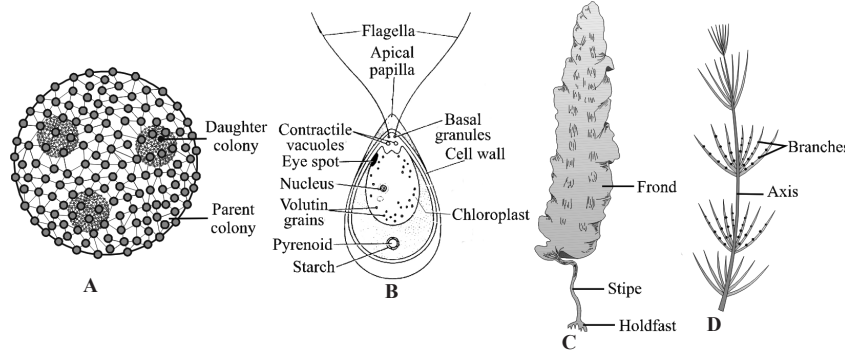
2. Mannitol is the stored food in
 (a) *Chara* (b) *Porphyra*
 (c) *Fucus* (d) *Gracilaria*
3. Which one is incorrect character of brown algae?
 (a) Presence of chl a and b
 (b) It remain attached to substratum
6. Which of the following is the correct option ?

- (c) Presence of chl a and c
 (d) Presence of fucoxanthin
4. Which of the following correctly explains why rhodophyta exhibit a red colour?
 (a) Since most rhodophyta grow at great depths, the chlorophyll can only absorb light in the red area of the spectrum.
 (b) The wavelengths of light that are absorbed by chlorophyll are passed to phycoerythrin (a red pigment).
 (c) Phycoerythrin absorbs all the light waves.
 (d) Light reaching the greatest depth in water is in the blue-green region of the spectrum. This light is absorbed by phycoerythrin.
5. In class phaeophyceae, the plant body is usually attached to the substratum by a ____ (a)____, and has a stalk, the ____ (B)____ and leaf like photosynthetic organ the ____ (C)____.
 (a) A – holdfast, B – stipe, C – frond
 (b) A – stipe, B – holdfast, C – frond
 (c) A – frond, B – stipe, C – holdfast
 (d) A – stipe, B – frond, C – holdfast



S. No.	A	B	C	D
(a)	<i>Porphyra</i>	<i>Fucus</i>	<i>Dictyota</i>	<i>Polysiphonia</i>
(b)	<i>Polysiphonia</i>	<i>Porphyra</i>	<i>Dictyota</i>	<i>Fucus</i>
(c)	<i>Fucus</i>	<i>Dictyota</i>	<i>Porphyra</i>	<i>Polysiphonia</i>
(d)	<i>Porphyra</i>	<i>Polysiphonia</i>	<i>Fucus</i>	<i>Dictyota</i>

7. Choose the right option.



S. No.	A	B	C	D
(a)	<i>Volvox</i>	<i>Chlamydomonas</i>	<i>Laminaria</i>	<i>Chara</i>
(b)	<i>Chara</i>	<i>Laminaria</i>	<i>Volvox</i>	<i>Chlamydomonas</i>
(c)	<i>Laminaria</i>	<i>Volvox</i>	<i>Chlamydomonas</i>	<i>Chara</i>
(d)	<i>Chlamydomonas</i>	<i>Chara</i>	<i>Laminaria</i>	<i>Volvox</i>

8. Select the correct match from the options given below.

- | | | |
|-------------------|-----|--------------------|
| (A) Phaeophyceae | - | Mannitol |
| (B) Rhodophyceae | - | Dictyota |
| (C) Chlorophyceae | - | Non-motile gametes |
| (D) Rhodophyceae | - | r-Phycocerythrin |
| (a) A, B & C | (b) | B, C & D |
| (c) A & D | (d) | C & D |

Bryophytes

9. *Funaria* may be differentiated from *Pinus* by the character

- No fruits are produced
- No seeds are produced
- Antheridia and archegonia
- Both (a) and (b)

Pteridophytes

10. A bryophyte differs from pteridophytes in –

- Archegonia
- Lack of vascular tissue
- Swimming antherozoids
- Independent gametophytes

11. Which of the following statements is incorrect?

- Pyrenoids contain protein besides starch.
- Sexual reproduction may be isogamous, oogamous and anisogamous in green and brown algae.
- Some of the members of algae also occur in association with fungi (lichen) and animals (eg, on sloth bear).
- The leaves in pteridophyta are small (macrophyll) and large (microphyll) Horsetails and ferns.

12. In the prothallus of a vascular cryptogam, the antherozoids and eggs mature at different times. As a result

- there is high degree of sterility
- one can conclude that the plant is apomictic
- self-fertilization is prevented
- there is no change in success rate of fertilization

13. Fern plant is a

- haploid gametophyte
- diploid gametophyte
- diploid sporophyte
- haploid sporophyte

14. In which group of the following would you place the plants having vascular tissue and lacking seeds?

- Algae
- Fungi
- Bryophytes
- Pteridophytes

15. The gametophyte of pteridophyte grows in damp, moist and shady places because

- they are limited and restricted to a narrow geographical region
- they need water for fertilisation of gametes
- water is required for gamete formation
- egg cell swims in water to reach to the antheridia

16. Possible advantage of antheridia occurring on the under surface for fern prothallus is

- Protection from wind
- protection from direct rays
- easy diffusion of nutrients from prothallus
- accumulation of capillary water

Gymnosperms

17. Which of the following is not a characteristic of coralloid roots?
- Apogeotropic
 - Bluish-green in colour
 - Unbranched
 - Presence of *Anabaena*
18. Female strobili is called _____.
- microsporophyll
 - megasporangia
 - microsporangia
 - megasporophyll

19. Plants of this group are diploid and well adapted to extreme conditions. They grow bearing sporophylls in compact structures called cones. The group in reference is
- monocots
 - dicots
 - pteridophytes
 - gymnosperms

Angiosperms

20. Smallest tree of angiosperm is _____.
- Wolffia*
 - Sequoia*
 - Eucalyptus*
 - Pinus*

**EXERCISE 3 : NEW PATTERN QUESTIONS****Two Statement Type Questions**

DIRECTION: Read the statements carefully and answer the question on the basis of following options.

- Both Statement I and Statement II are incorrect
 - Statement I is correct but Statement II is incorrect
 - Statement I is incorrect but Statement II is correct
 - Both Statement I and Statement II are correct
- Statement I:** The pteridophytes are found in cool, damp, shady places
Statement II: In pteridophytes, the main plant body is a sporophyte.
 - Statement I:** Most-algal genera are haplontic.
Statement II: The dominant phase in all Bryophytes is gametophyte.
 - Statement I:** In numerical taxonomy observable characters are not given equal importance.
Statement II: More than 20 characters can't be studied at a time in numerical taxonomy.
 - Statement I:** Bryophytes are amphibians of plant kingdom.
Statement II: They live in soil but depend on water for sexual reproduction.
 - Statement I:** Main plant body of bryophytes is sporophytic.
Statement II: Main plant body of pteridophytes is gametophytic.

Assertion & Reason Questions

DIRECTION: These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.

- Both (A) and (R) are correct but (R) is not the correct explanation of (A)
- (A) is correct but (R) is not correct
- (A) is not correct but (R) is correct
- Both (A) and (R) are correct and (R) is the correct explanation of (A)

- Assertion :** *Chlorella* could be utilised to keep the air pure in space vehicles.
Reason : The space travellers feed on *Chlorella* soup.
- Assertion:** The colour of brown algae varies from olive green to brown.
Reason: In brown algae, fucoxanthin is responsible for colour variation.
- Assertion:** *Spirogyra* shows haplontic life cycle.
Reason: Zygotic meiosis occurs in *Spirogyra*.
- Assertion:** Sporophyte is dominant in diplontic life cycle.
Reason: In diplontic life cycle, free living sporophyte is absent.
- Assertion:** Archegonium is the female sex organ in bryophytes.
Reason: Algae also possess the archegonium.
- Assertion:** Liverworts fail to spread to a new locality through fragmentation.
Reason: Gemmae are helpful in propagating liverworts in different locality.
- Assertion:** *Selaginella* and *Salvinia* are homosporous.
Reason: In *Selaginella* and *Salvinia*, different kind of spores are produced .

Four/Five Statement Type Questions

13. Which of the following statement(s) about algae is/are correct?
- Algae are chlorophyll bearing simple, thalloid, heterotrophic and aquatic (both fresh water and marine) organisms.
 - Algae reproduce by vegetative means only.
 - Fusion of two gametes dissimilar in size is termed as oogamous.
 - A few of the massive forms of algae such as kelps, form massive plant bodies.
 - Algae are not useful to man.
- Only (i)
 - Both (i) and (iii)
 - Only (iv)
 - All of these

14. Which of the following statement(s) is/are correct about gemmae?
- These are specialised structures by which asexual reproduction take place in liverworts.
 - They are green, multicellular and asexual buds.
 - They develop in small receptacles called gemma cups.
 - They detach from parent body and germinate to form new individuals.
- (a) (i) and (ii) (b) (ii) and (iii)
(c) (i), (ii) and (iii) (d) All of these
15. Refer to the following statement(s) and identify the group of plant which is being described by the given statements?
- They include various mosses and liverworts that are found commonly growing in moist shaded areas in the hills.
 - They lack true roots, stem or leaves.
 - The main plant body is haploid.
 - They produce a multicellular body sporophyte which is not free living but attached to the photosynthetic gametophyte and derives nourishment from it.
 - Its plant body is more differentiated than that of algae.
- (a) Algae (b) Fungi
(c) Bryophytes (d) Pteridophytes
16. Which of the following group of plant is being described by the given statements?
- They are plants in which the ovules are not enclosed by any ovary wall and remain exposed before and after fertilization.
 - The giant red wood tree *Sequoia* is one of the tallest tree species of the group.
 - The roots are generally tap roots.
 - They are heterosporous and they produce haploid microspores and megaspores.
 - Roots in some genera have fungal association.
- (a) Algae (b) Bryophytes
(c) Gymnosperms (d) Pteridophytes
17. Which of the following statements with respect to gymnosperms and angiosperms is/are correct?
- The process of double fertilization is present in gymnosperms.
 - Angiosperms range in size from microscopic *Wolffia* to tall trees of *Sequoia*.
 - In gymnosperms, the seeds are not covered.
 - In gymnosperms, the male and female gametophytes have an independent free living existence.
- Of the above statements
- (a) (i) and (ii) (b) (iii) only
(c) (ii) and (iii) (d) (iii) and (iv)
18. Which of the following statement(s) is/are correct about angiosperms?
- In angiosperms or flowering plants, the pollen grains and ovules are developed in specialised structure called flowers.
 - They are divided into two classes : the dicotyledons and the monocotyledons.
 - The male sex organ in a flower is the pistil or the carpel.
 - The female sex organ is the stamen.
 - Ovules are naked.
- (a) Only (i) (b) Both (i) and (ii)
(c) Both (ii) and (iv) (d) All of these
19. Choose the correct statement about liverworts.
- In liverworts, the antheridium and archegonium produce the antherozoid and the egg which fuse during sexual reproduction.
 - Both male and female sex organs may be present on same thalli or different thalli.
 - A sporophyte is formed from the zygote which is differentiated into the foot, seta and capsule.
 - Meiosis occurs in some cells of the capsule giving rise to haploid spores.
 - The spores germinate to form free - living sporophytes.
- (a) (i) and (iii) only
(b) (i), (ii) and (iii)
(c) (iii) and (iv) only
(d) (i), (ii), (iii) and (iv)
20. The correct statements about bryophytes are:
- Sex organ in bryophytes are multicellular
 - The sperms are released into water which swim through water to fuse with the egg to produce the zygote outside the body.
 - Immediate reduction division occurs in zygotes.
 - A multicellular body called a sporophyte is then produced.
 - The sporophyte is not -free living but attached to photosynthetic gametophyte.
- (a) (i), (ii) and (iii)
(b) (i), (ii) and (iv), (v)
(c) (i) and (iv)
(d) (iii) and (iv)
21. In mosses, the second gametophytic stage is leafy stage. Consider and choose the correct statements about leafy stage.
- They consist of upright, slender axes bearing spirally arranged leaves.
 - This leafy stage bears the sex organs.
 - They are attached to the soil through multicellular rhizoids.
 - Leafy stage is produced from the secondary protonema as a lateral bud.
- (a) (i) and (ii)
(b) (i), (iii) and (iv)
(c) (iii) and (iv)
(d) (i), (ii), (iii) and (iv)
22. How many of the following statements is/are correct ?
- In *Equisetum*, the female gametophyte is retained on the parent sporophyte.
 - In *Ginkgo*, male gametophyte is not independent.
 - The sporophyte in *Riccia* is more developed than that in *Polytrichum*.
 - Sexual reproduction in *Volvox* is isogamous.
- (a) Two (b) Three
(c) Four (d) One

MATCH THE COLUMNS



23. Match the column-I with column-II and choose the correct option.

Column-I (System of classification)		Column-II (Characteristics)	
A.	Artificial system of classification	I.	Based on few morphological characters
B.	Natural system of classification	II.	Based on evolutionary relationships between the various organisms
C.	Phylogenetic system of classification	III.	Based on natural affinities among the organisms and consider external as well as internal features.
D.	Numerical Faxonomy	IV.	Carried out using computer

- (a) A – II; B – I; C – III; D – IV
 (b) A – I; B – III; C – II; D – IV
 (c) A – III; B – II; C – I; D – IV
 (d) A – I; B – II; C – III; D – IV

24. Match the following columns.

Column-I		Column-II	
A.	<i>Chlorella</i>	I.	Pteropsida
B.	<i>Adiantum</i>	II.	Marine algae
C.	<i>Sargassum</i>	III.	Moss
D.	Prothallus	IV.	Pteritophyta
		V.	Unicellular alga rich in proteins

- (a) A – II; B – V; C – I; D – III
 (b) A – V; B – IV; C – III; D – II
 (c) A – V; B – I; C – II; D – IV
 (d) A – III; B – II; C – I; D – V

25. Match the following

Column-I (Classes)		Column-II (Examples)	
A.	Psilopsida	I.	<i>Dryopteris, Pteris, Adiantum</i>
B.	Lycopsida	II.	<i>Equisetum</i>
C.	Sphenopsida	III.	<i>Selaginella</i>
D.	Pteropsida	IV.	<i>Lycopodium</i>
		V.	<i>Psilotum</i>

- (a) A – V; B – III; C – II; D – I
 (b) A – I; B – II; C – III; D – IV
 (c) A – IV; B – III; C – II; D – I
 (d) A – III; B – V; C – I; D – II

26. Match column-I with column-II and choose the correct option.

Column-I		Column-II	
A.	Phaeophyceae	I.	Have an elaborate mechanism of spore dispersal
B.	Rhodophyceae	II.	First terrestrial plant with vascular tissue-phloem and xylem

C.	Mosses	III.	Asexual reproduction by biflagellate zoospores
D.	Pteridophytes	IV.	<i>Polysiphonia, Porphyra, Gracilaria</i>

- (a) A – III; B – IV; C – I; D – II
 (b) A – IV; B – III; C – I; D – II
 (c) A – IV; B – III; C – II; D – I
 (d) A – IV; B – I; C – III; D – II

27. Match the column-I with column-II and select the correct answer using the codes given below.

Column-I (Group of Plant Kindgom)		Column-II (Examples)	
A.	Algae	I.	<i>Solanum tuberosum</i>
B.	Fungi	II.	<i>Equisetum</i>
C.	Angiosperm	III.	<i>Cycas</i>
D.	Pteridophyte	IV.	<i>Chlamydomonas</i>
		V.	<i>Rhizopus</i>

- (a) A – V; B – IV; C – I; D – II
 (b) A – IV; B – V; C – I; D – II
 (c) A – IV; B – I; C – V; D – II
 (d) A – IV; B – I; C – V; D – III

28. Match the column-I with column-II and choose the correct option.

Column-I		Column-II	
A.	Smallest flowering plant	I.	<i>Eucalyptus</i>
B.	Male sex organ in flowering plant	II.	<i>Wolffia</i>
C.	Female sex organ in flowering plant	III.	Stamen
D.	Tallest tree	IV.	Pistil

- (a) A – I; B – II; C – III; D – IV
 (b) A – IV; B – III; C – II; D – I
 (c) A – II; B – III; C – IV; D – I
 (d) A – II; B – IV; C – III; D – I

29. Match the column-I with column-II and choose the correct option.

Column-I		Column-II	
A.	Amphibian of the plant kingdom	I.	<i>Sphagnum</i>
B.	Specialized structures in liverworts for asexual reproduction	II.	Angiosperms
C.	Monocotyledons and dicotyledons	III.	Bryophytes
D.	A plant which has capacity to holding water	IV.	Gemmae

- (a) A – III; B – IV; C – I; D – II
 (b) A – III; B – IV; C – II; D – I
 (c) A – IV; B – III; C – II; D – I
 (d) A – III; B – II; C – IV; D – I

30. Select the correct match of the feature present in column I with its respective terms given in column II.

Column-I (features)		Column-II (term)	
A.	Presence of tap roots and coralloid roots	I.	Bryophyte
B.	The synergids and antipodal cells degenerates after fertilization	II.	Pteridophytes
C.	The food is stored as floridean starch which is very similar to amylopectin and glycogen in structure	III.	Red algae

D.	Presence of sporophyte which is not free living but attached to the photosynthetic gametophytes and derives nourishment from it	IV.	Angiosperms
		V.	Gymnosperms

- (a) A – I; B – II; C – III; D – IV
 (b) A – III; B – V; C – II; D – IV
 (c) A – III; B – I; C – V; D – II
 (d) A – V; B – IV; C – III; D – I



EXERCISE 4 : NCERT EXEMPLAR

- Cyanobacteria are classified under
 - Protista
 - Plantae
 - Monera
 - Algae
- Fusion of two motile gametes which are dissimilar in size is termed as
 - oogamy
 - isogamy
 - anisogamy
 - zoogamy
- Holdfast, stipe and frond constitutes the plant body in case of
 - Rhodophyceae
 - Chlorophyceae
 - Phaeophyceae
 - All of these
- A plant shows thallus level of organisation. It shows rhizoids and is haploid. It needs water to complete its life cycle because the male gametes are motile. Identify the group to which it belongs to
 - pteridophytes
 - gymnosperms
 - monocots
 - bryophytes
- Plants of this group are diploid and well adapted to extreme conditions. They grow bearing sporophylls in compact structures called cones. The group in reference is
 - monocots
 - dicots
 - pteridophytes
 - gymnosperms
- The embryo sac of an angiosperm is made up of
 - 8 cells
 - 7 cells and 8 nuclei
 - 8 nuclei
 - 7 cells and 7 nuclei
- If the diploid number of a flowering plant is 36. What would be the chromosome number in its endosperm?
 - 36
 - 18
 - 54
 - 72
- Protonema is
 - haploid and is found in mosses
 - diploid and is found in liverworts
 - diploid and is found in pteridophytes
 - haploid and is found in pteridophytes
- The giant redwood tree (*Sequoia sempervirens*) is a/an
 - angiosperm
 - free fern
 - pteridophyte
 - gymnosperm



EXERCISE 5 : PAST YEAR TOPIC-WISE QUESTIONS

ALGAE



- Read the following statements and choose the set of correct statements: **2024**
 In the members of Phaeophyceae,
 - Asexual reproduction occurs usually by biflagellate zoospores.
 - Sexual reproduction is by oogamous method only.
 - Stored food is in the form of carbohydrates which is either mannitol or laminarin.
 - The major pigments found are chlorophyll a, c and carotenoids and xanthophyll.
- Vegetative cells have a cellulosic wall, usually covered on the outside by gelatinous coating of algin. Choose the correct answer from the options given below:
 - A, B, C and D only
 - B, C, D and E only
 - A, C, D and E only
 - A, B, C and E only
- Which classes of algae possess pigment fucoxanthin and pigment phycoerythrin, respectively? **Ph-II 2023**
 - Chlorophyceae and Rhodophyceae
 - Rhodophyceae and Phaeophyceae
 - Phaeophyceae and Chlorophyceae
 - Phaeophyceae and Rhodophyceae

3. Hydrocolloid carrageen is obtained from: 2022
 (a) Phaeophyceae and Rhodophyceae
 (b) Rhodophyceae only
 (c) Phaeophyceae only
 (d) Chlorophyceae and Phaeophyceae
4. Which of the following is incorrectly matched? 2022
 (a) *Ulothrix* - Mannitol
 (b) *Porphyra* - Floridian Starch
 (c) *Volvox* - Starch
 (d) *Ectocarpus* - Fucoxanthin
5. Match List -I with List -II : 2022
- | List-I | List-II |
|--------------------------|-------------------|
| (A) <i>Chlamydomonas</i> | (i) Moss |
| (B) <i>Cycas</i> | (ii) Pteridophyte |
| (C) <i>Selaginella</i> | (iii) Alga |
| (D) <i>Sphagnum</i> | (iv) Gymnosperm |
- Choose the correct answer from the options given below.
 (a) (A) - (ii), (B) - (iii), (C) - (i), (D) - (iv)
 (b) (A) - (iii), (B) - (i), (C) - (ii), (D) - (iv)
 (c) (A) - (iii), (B) - (iv), (C) - (ii), (D) - (i)
 (d) (A) - (iii), (B) - (ii), (C) - (i), (D) - (iv)
6. Which of the following algae produce Carrageen? 2021
 (a) Blue-green algae (b) Green algae
 (c) Brown algae (d) Red algae
7. Which of the following algae contains mannitol as reserve food material? 2021
 (a) *Ulothrix* (b) *Ectocarpus*
 (c) *Gracilaria* (d) *Volvox*
8. Phycoerythrin is the major pigment in Ph-II 2020
 (a) Brown algae (b) Red algae
 (c) Blue green algae (d) Green algae
9. Which of the following pairs is of unicellular algae? 2020
 (a) *Gelidium* and *Gracilaria*
 (b) *Anabaena* and *Volvox*
 (c) *Chlorella* and *Spirulina*
 (d) *Laminaria* and *Sargassum*
10. Floridean starch has structure similar to 2020
 (a) Amylopectin and glycogen
 (b) Mannitol and algin
 (c) Laminarin and cellulose
 (d) Starch and cellulose
11. Which one is wrongly matched? 2018
 (a) Uniflagellate gametes – *Polysiphonia*
 (b) Biflagellate zoospores – *Brown algae*
 (c) Unicellular organism – *Chlorella*
 (d) Gemma cups – *Marchantia*
12. An example of colonial alga is: 2017
 (a) *Volvox* (b) *Ulothrix*
 (c) *Spirogyra* (d) *Chlorella*
13. Zygotic meiosis is characteristic of: 2017
 (a) *Fucus* (b) *Funaria*
 (c) *Chlamydomonas* (d) *Marchantia*
14. Male gametes are flagellated in : 2015
 (a) *Anabaena* (b) *Ectocarpus*
 (c) *Spirogyra* (d) *Polysiphonia*
15. Which one of the following statements is wrong? 2015
 (a) Agar - agar is obtained from *Gelidium* and *Gracilaria*
 (b) *Chlorella* and *Spirulina* are used as space food
 (c) Mannitol is stored food in Rhodophyceae
 (d) Algin and carragen are products of algae
16. Which one of the following shows isogamy with non-flagellated gametes? 2014
 (a) *Sargassum* (b) *Ectocarpus*
 (c) *Ulothrix* (d) *Spirogyra*
17. Which one of the following is wrong about *Chara*? 2014
 (a) Upper oogonium and lower round antheridium.
 (b) Globule and nucule present on the same plant.
 (c) Upper antheridium and lower oogonium.
 (d) Globule is male reproductive structure.
18. An alga which can be employed as food for human being is: 2014
 (a) *Ulothrix* (b) *Chlorella*
 (c) *Spirogyra* (d) *Polysiphonia*
19. Isogamous condition with non-flagellated gametes is found in : 2013
 (a) *Spirogyra* (b) *Volvox*
 (c) *Fucus* (d) *Chlamydomonas*
20. Which of the following is not correctly matched for the organism and its cell wall degrading enzyme? 2013
 (a) Plant cells-Cellulase (b) Algae-Methylase
 (c) Fungi-Chitinase (d) Bacteria-Lysozyme
21. Which one of the following is wrongly matched? Kar.2013
 (a) *Nostoc*-Water blooms
 (b) *Spirogyra*-Motile gametes
 (c) *Sargassum*-Chlorophyll *c*
 (d) Basidiomycetes-Puffballs
22. Select the wrong statement: 2013
 (a) Anisogametes differ either in structure, function or behaviour.
 (b) In oomycetes female gamete is smaller and motile, while male gamete is larger and non-motile.
 (c) *Chlamydomonas* exhibits both isogamy and anisogamy and *Fucus* shows oogamy.
 (d) Isogametes are similar in structure, function and behaviour.

Bryophytes



23. Given below are two statements : One labelled as Assertion A and the other labelled as Reason R: 2023
Assertion A : The first stage of gametophyte in the life cycle of moss is protonema stage.
Reason R : Protonema develops directly from spores produced in capsule.
 In the light of the above statements, choose the most appropriate answer from options given below:
 (a) Both A and R are correct and R is the correct explanation of A
 (b) Both A and R are correct but R is NOT the correct explanation of A
 (c) A is correct but R is not correct
 (d) A is not correct but R is correct

24. Gemmae are present in **2021**
 (a) Some Liverworts (b) Mosses
 (c) Pteridophytes (d) Some Gymnosperms
25. Which one is wrong statement? **2015**
 (a) *Mucor* has biflagellate zoospores
 (b) Haploid endosperm is typical feature of gymnosperms
 (c) Brown algae have chlorophyll *a* and *c* and fucoxanthin
 (d) Archegonia are found in Bryophyta, Pteridophyta and Gymnosperms.
26. Which of the following is responsible for peat formation?
 (a) *Marchantia* (b) *Riccia* **2014**
 (c) *Funaria* (d) *Sphagnum*
27. The plant body is thalloid in **2013**
 (a) *Funaria* (b) *Sphagnum*
 (c) *Salvinia* (d) *Marchantia*
- (b) (A)-(iii), (B)-(iv), (C)-(i), (D)-(ii)
 (c) (A)-(ii), (B)-(iv), (C)-(i), (D)-(iii)
 (d) (A)-(iv), (B)-(i), (C)-(ii), (D)-(iii)
31. Genera like *Selaginella* and *Salvinia* produce two kinds of spores. Such plants are known as: **2021**
 (a) Heterosporous (b) Homosorus
 (c) Heterosorus (d) Homosporous
32. Strobili or cones are found in **2020**
 (a) *Pteris* (b) *Marchantia*
 (c) *Equisetum* (d) *Salvinia*
33. In bryophytes and pteridophytes, transport of male gametes requires **2016**
 (a) Wind (b) Insects
 (c) Birds (d) Water

PTERIDOPHYTES



28. Identify the pair of heterosporous pteridophytes among the following : **2023**
 (a) *Lycopodium* and *Selaginella*
 (b) *Selaginella* and *Salvinia*
 (c) *Psilotum* and *Salvinia*
 (d) *Equisetum* and *Salvinia*

29. Match List-I with List-II. **Ph-II 2023**

	List-I		List-II
(A)	Pteropsida	(I)	<i>Psilotum</i>
(B)	Lycopsida	(II)	<i>Equisetum</i>
(C)	Psilopsida	(III)	<i>Adiantum</i>
(D)	Sphenopsida	(IV)	<i>Selaginella</i>

Choose the correct answer from the options given below

- (a) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
 (b) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
 (c) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
 (d) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
30. Match the plant with the kind of life cycle it exhibits: **2022**

List-I	List-II
(A) <i>Spirogyra</i>	(i) Dominant diploid sporophyte vascular plant, with highly reduced male or female gametophyte
(B) Fern	(ii) Dominant haploid free-living gametophyte
(C) <i>Funaria</i>	(iii) Dominant diploid sporophyte alternating with reduced gametophyte called prothallus
(D) <i>Cycas</i>	(iv) Dominant haploid leafy gametophyte alternating with partially dependent multicellular sporophyte

Choose the **correct** answer from the options given below:

- (a) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)

Gymnosperms



34. Given below are two statements : One labelled as Assertion A and the other labelled as Reason R : **2023**
Assertion A : In gymnosperms the pollen grains are released from the microsporangium and carried by air currents.
Reason R : Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed.
 In the light of the above statements, choose the correct answer from the options given below :
 (a) Both A and R are true and R is the correct explanation of A
 (b) Both A and R are true but R is NOT the current explanation of A
 (c) A is true but R is false
 (d) A is false but R is true
35. *Pinus* seed cannot germinate and establish without fungal association. This is because: **2019**
 (a) its embryo is immature.
 (b) it has obligate association with mycorrhizae.
 (c) it has very hard seed coat.
 (d) its seeds contain inhibitors that prevent germination.
36. Winged pollen grains are present in **2018**
 (a) Mustard (b) *Cycas* (c) *Pinus* (d) Mango
37. Select the mismatch **2017**
 (a) *Cycas* – Dioecious
 (b) *Salvinia* – Heterosporous
 (c) *Equisetum* – Homosporous
 (d) *Pinus* – Dioecious
38. Select the correct statement: **2016**
 (a) Gymnosperms are both homosporous and heterosporous
 (b) *Salvinia*, *Ginkgo* and *Pinus* all are gymnosperms
 (c) *Sequoia* is one of the tallest trees
 (d) The leaves of gymnosperms are not well adapted to extremes of climate
39. Conifers are adapted to tolerate extreme environmental conditions because of **Ph-II 2016**
 (a) thick cuticle (b) presence of vessels
 (c) broad hardy leaves (d) superficial stomata

3. (a) In numerical taxonomy numbers and codes are assigned to each observable characteristics and the data is then processed. In this way each charalter is given equal importance and at the same time hundreds of characters can be considered.
4. (d) Bryophytes are known as ‘amphibians of plant kingdom’. In their vegetative structure, bryophytes have become adapted to land but they depend on water for sexual reproduction because the swimming habit is retained by their sperms.
5. (a) Main plant body is gametophytic in bryophytes and sporophytic in pteridophytes.
6. (a) Chlorella could be utilised to keep the air in space vehicles pure and supply food in space stations and prolonged space flight trips. The space travellers could feed on Chlorella soup. It is nourishing but not appetizing food.
7. (d) Brown algae show a range of colour from olive green to various shades of brown depending upon the amount of fucoxanthin, xanthophyll pigment, present in them.
8. (d) Haplontic life cycle is characterized by a haploid thallus and zygotic meiosis. It is also called as haplobiontic because only a single type of free living individual is involved in the life cycle. Spirogyra shows haplontic life cycle and therefore, it shows zygotic meiosis as well.
9. (b) The diploid sporophyte is the dominant, photosynthetic and independent phase in diplontic life cycle. It is highly reduced and is retained within sporangia.
10. (b) Archegonium is the female sex organ of the bryophytes. It appears for the first time in the liverworts and mosses and continues in the pteridophytes. Archegonium is absent in thallophytes (algae and fungi).
11. (a) Fragmentation leads to an increase in the number of plants in a locality but it does not permit the spread of the plant to an entirely new locality. Gemmae are easily carried as they are small and sufficiently buoyant. They spread by water and wind currents to new habitats when detached, and each grows into a new individual immediately.
12. (c) All the spores are of similar kinds in majority of the pteridophytes; such plants are called homosporous. Genera like Selaginella and Salvinia produce two kinds of spores i.e. macro (large) spores and micro (small) spores, hence, are known as heterosporous.
13. (c) Algae are chlorophyll bearing simple, thalloid, autotrophic and largely aquatic organisms. They reproduce by vegetative, asexual and sexual methods. Fusion of two gametes dissimilar in size is termed as anisogamous.
14. (d) Gemmae are a means of asexual reproduction found in many bryophytes (e.g. liverworts). They are 1 to many celled, specially produced clonal plant fragments. They are green, multicellular, asexual buds which develop in small receptacles (called gemma cups) located on the thalli. Gemmae become detached from the parent body and germinate to form new individuals.
15. (c) Bryophytes are small, non-vascular plants, such as mosses, liverworts and hornworts. Bryophytes do not have seeds or flowers. Instead they reproduce via spores.
16. (c) Gymnosperms are seed-bearing vascular plants, such as cycads, ginkgo, yews and conifers, in which the ovules or seeds are not enclosed in an ovary. Gymnosperm seeds develop either on the surface of scale or leaf-like appendages of cones or at the end of short stalk. The largest group of living gymnosperms are the conifers (pines, cypresses and relatives) and the smallest is ginkgo, a single living plant species found in China.
17. (b) Double fertilization is a characteristic of angiosperms not gymnosperms. But in both of these two groups, gametophytic phase is highly reduced and is retained inside sporophytic structures. Sequoia is the tallest gymnosperm not angiosperm. Tallest angiosperm belong to the genus *Eucalyptus*.
18. (b) In angiosperms, the male sex organ is the stamen and the female sex organ is the pistil or the carpel. Each stamen consists of a slender filament with an anther at the tip. The anther, following meiosis, produce pollen grains. Pistil consists of an ovary enclosing one to many ovules.
19. (d) All the statements are correct. Sexual reproduction occurs by the formation of sex organs born on special branches. The male antheridia are produced on antheridiophore and the female reproductive organs are ‘archegonia’. They are borne on special stalked structures called archegoniophore. Both male and female sex organs may be present on same thalli or different thalli. After fertilisation, the egg becomes zygote, which grows to form sporophyte. It is differentiated into foot, seta and capsule. Inside the capsule, the diploid spore mother cells divide by meiosis and produce haploid spores. These spores germinate to form free-living gametophytes.
20. (b) Minute, slender, spirally curved body furnished with two long, terminal whiplash type flagella is usually seen in bryophyte sperms. The sperms once liberated from antheridia, in the presence of water swim and are attracted towards the archegonium. They enter and fertilise the egg in the archegonia and form a zygote. The zygote does not undergo immediate reduction division. A multicellular body called a sporophyte is produced.
21. (d) All the statements are correct. In mosses, vegetative reproduction occurs through fragmentation or through bud in secondary protonema.
22. (a) Statement (i) and (ii) are correct. *Riccia* is liverwort in which simplest sporophyte consists of capsule only while *Polytrichum* is moss in which sporophyte consists of foot, seta & capsule. *Volvox* is a fresh water green colonial alga. Reproduction is both sexual and asexual in *Volvox*. Sexual reproduction is of oogamous type.
23. (b) A – I, B – III, C – II, D – IV
24. (c) A – V, B – I, C – II, D – IV
25. (a) A – V, B – III, C – II, D – I
26. (a) A – III, B – IV, C – I, D – II
27. (b) A – IV, B – V, C – I, D – II
28. (c) A – II, B – III, C – IV, D – I
29. (b) A – III, B – IV, C – II, D – I
30. (d) A – V, B – IV, C – III, D – I

EXERCISE - 4



1. (c) Kingdom Monera exclusively includes all forms of bacteria. All bacteria are prokaryotes and do not possess a well defined nucleus and other cell organelles.

Protista, Algae and Plantae include eukaryotic and unicellular or multicellular organisms.

2. (c) Lower group of plants like algae exhibit great variation in mode of sexual and asexual reproduction. Some algae produce gametes which are not similar in shape, size and structure. Their fusion is called anisogamy. e.g., *Chlamydomonas*. Isogamy is the fusion of similar gametes, zoogamy is sexual reproduction of animals.
3. (c) **Phaeophyceae** : In the members of the class-Phaeophyceae, the plant body is usually attached to the substratum by means of a holdfast and has a stalk called stipe and a leaf like photosynthetic organ called frond.
4. (d) Bryophyta is a group of plants which have gametophytic haploid thalloid body. The motile male gametes are produced in special male reproductive structures called antheridia. These gametes need thin film of water to swim and reach the female reproductive organ called archegonia. Pteridophytes, gymnosperm and monocots show higher level of organisation.
5. (d)
6. (b) Embryo sac in angiosperm contains 2 synergids, 1 egg cell, 3 antipodal cells and one secondary nucleus.
7. (c) Endosperm is a product of triple fusion. One male nuclei ($n = 18$) fuses with diploid secondary nucleus ($2n = 36$), so it becomes triploid ($3n = 54$). Thus, ploidy of endosperm is ($3n$) and chromosomes will be 54.
8. (a) The germination of haploid spores of mosses produced by sporophyte after reductional division form the protonema. This structure later develops into an independent gametophytic plant.
9. (d) **Sequoia sempervirens** is a gymnosperm. It has thick, woody and branched stems. The plant also shows some xeric adaptations which helps it to survive in adverse climatic conditions.

EXERCISE - 5



1. (c) In Phaeophyceae sexual reproduction can occur by oogamy, isogamy or anisogamy . Hence correct statements are A, C, D and E.
2. (d)
3. (b) Hydrocolloid carrageen is obtained from red algae (rhodophyceae).
4. (a) Ulothrix belong to Chlorophyceae (green algae). Members of this class have starch as reserve food material.
5. (c) *Chlamydomonas* is an example of unicellular alga. *Cycas* is an example of gymnosperm. *Selaginella* is an example of pteridophyte and *Sphagnum* is an example of moss.
6. (d) Carrageen is produced by red algae.
7. (b) *Ectocarpus* belongs to class-Phaeophyceae, in which reserve food is found in the form of laminarin, mannitol and oil.
Ulothrix and *Volvox* belong to chlorophyceae (green algae). Members of this class have starch as reserve food material. *Gracilaria* is a member of red algae (Rhodophyceae). This class is characterised by having Floridean starch as stored food material.
8. (b) Phycoerythrin is the major pigment in red algae or rhodophytes. The photosynthetic pigments in red algae include chlorophyll-a, carotenoids and phycobilins. Phycoerythrin belongs to the phycobilins. These pigments are soluble in water.
Phycoerythrin (PE) is a red protein pigment complex produced by the light-harvesting phycobiliprotein family. It is present in red algae and cryptophytes as an accessory to the main chlorophyll pigments responsible for photosynthesis.
9. (c) *Chlorella* and *Spirulina* are unicellular algae. *Gelidium*, *Gracilaria*, *Laminaria* and *Sargassum* are multicellular. *Volvox* is colonial.
10. (a) Floridean starch is stored food material in red algae. Its structure is similar to Amylopectin and Glycogen.
11. (a) *Polysiphonia* is a genus of red algae, where asexual spores and gametes are non-motile or non-flagellated.
12. (a) *Volvox* is a motile colonial fresh water green alga. It forms spherical colonies.
13. (c) *Chlamydomonas* has haplontic life cycle hence shows zygotic meiosis.
14. (b) Male gametes are flagellated in *Ectocarpus* belonging to Phaeophyceae. In *Ectocarpus* the female gamete too, is flagellated but is different in structure. In *Polysiphonia* (Rhodophyceae) flagellated gametes are not observed, in *Anabaena* sexual reproduction through gametes is absent while in *Spirogyra* sexual reproduction takes place by conjugation wherein male gamete passes through a tube to the adjacent filament. The male gametes here are non-flagellated and show amoeboid movement.
15. (c) Mannitol or laminarin is the stored food in phaeophyceae (brown algae). Example, *Ectocarpus*, *Fucus*, *Sargassum* etc.
16. (d) In *Spirogyra*, sexual reproduction occurs through conjugation. Gametes are non-flagellated, morphologically similar. But physiologically different (isogamy with physiological anisogamy).
17. (c) *Chara* belongs to chlorophyceae, is a green alga found attached to bottoms of shallow water of ponds, pools and lakes. Male sex organ is called antheridium. Female sex organ is called oogonium. Oogonium is borne at the top of the four celled filament.
18. (b) *Chlorella* and *Spirulina* are unicellular algae, rich in proteins and are used as food supplements by space travellers.
19. (a) In *Spirogyra*, sexual reproduction occurs through conjugation. Gametes are non-flagellated, morphologically similar. But physiologically different (isogamy with physiological anisogamy). *Volvox* and *Fucus* are examples of oogamous and *Chlamydomonas* contains isogamous flagellated gametes.
20. (b) Algae is a plant and so its cell wall is made up of cellulose. Cellulase enzyme is needed for degradation of its cell wall.
21. (b) Cyanobacteria, e.g., *Nostoc*, grow in such abundance as to form water blooms. *Sargassum* belongs to brown algae which possess chl *a, c*, carotenoids, xanthophyll and a characteristic brown pigment, fucoxanthin. Commonly known forms of basidiomycetes are mushrooms, bracket fungi or puffballs. In *Spirogyra* gametes are non-flagellated (non-motile) but similar in size. They show amoeboid movements.

22. (b) Because it is not that in oomycetes, female gamete is smaller and motile, while male gamete is larger and non-motile. It is actually the opposite, i.e., in oomycetes the female gamete is larger and non motile, while the male gamete is smaller and motile.
23. (a) Both the assertion and reason is correct and reason is the correct explanation of assertion. The predominant stage of life cycle of moss is gametophyte which consist of 2 stages. The first stage is protonema that directly develops from spore.
24. (a) The gemmae are green, small discs of haploid tissue, and they directly give rise to new gametophytes. They are produced by some liverworts like *Marchantia*. Mosses reproduce vegetatively by fragmentation and budding of protonema. Pteridophytes and Gymnosperms normally do not reproduce asexually.
25. (a) *Mucor* is a microbial genus of molds commonly found in soil, digestive system plant surfaces etc. *Mucor* is a non-flagellate fungus.
26. (d) *Sphagnum*, a moss, provides peat that has long been used as fuel. It has the capacity to retain water for long periods and as such used to cover the plant roots during transportation.
27. (d) The plant body of a liverwort is haploid (n), gametophytic, small, dorsiventrally flattened, thallose, dichotomously branched fixed by unicellular and unbranched rhizoids, e.g., *Marchantia*.
28. (b) Pteridophytes that produce two types of spores are known as heterosporous. *Selaginella* and *Salvinia* are heterosporous pteridophytes.
29. (b)
30. (a) *Spirogyra* is a green algae which have dominant haploid –free living gametophyte. Fern is a pteridophyte having dominant sporophyte alternating with reduced gametophyte.
31. (a) Genera like *Selaginella* and *Salvinia* which produce two kinds of spores i.e. macro (large) and micro (small) spores, are known as heterosporous. Most of the pteridophytes produce single type of spores and are called homosporous. Sorus are brownish or yellowish cluster of spores producing structures located on the lower surface of fern leaves.
32. (c) Strobili or cones are found in *Equisetum*. Strobili or cones are the dense and compact structure present on non flowering plants. They contain sporangia and perform function of protecting spores from wild animals and harsh conditions of environment.
33. (d) Bryophytes neither have pollen nor flowers and rely on water to carry the male gametes (sperm) to the female gametes (eggs). The antherozoids (male gametes of pteridophytes) are armed with hair-like or whip-like cilia or flagellae and are able to swim through water; they do not travel great distances and are only released when free water is available.
34. (c) Assertion is correct but reason is false as in gymnosperms the pollen grains are released from the microsporangium and they are carried in air currents. They come in contact with the opening of the ovules borne on megasporophylls. The pollen tube carrying the male gametes grows towards archegonia in the ovules and discharge their contents near the mouth of the archegonia.
35. (b) Fungus associated with roots of *Pinus* increases minerals and water absorption for the plant by increasing surface area and in turn fungus gets food from plant. Therefore, mycorrhizal association is obligatory for *Pinus* seed germination.
36. (c) Winged pollen grains are present in *Pinus*. Each pollen grain has two wing-like structures which enables it to float in air, as an adaptation for dispersal by the wind.
37. (d) *Pinus* is monoecious plant comprising of both male and female cones on same plant.
38. (c) *Sequoia* is one of the tallest trees. It is also known as the reduced tree. Leaves of gymnosperm are well adapted to the extremes of climate. Gymnosperm are heterosporous. They have both pollen and tubules *Salvinia* is a pteridophyte whereas *Ginkgo* and *pinus* are gymnosperms.
39. (a) Conifers are adapted to tolerate extreme environmental conditions because of thick waxy cuticle.
40. (c) *Pinus* belongs to gymnosperms in which male and female gametophytes do not have an independent free living existence. They remain within the sporangia which are of two types — microsporangia and megasporangia.
41. (b) *Selaginella* is a heterosporous pteridophyte containing micro & megaspores. In *Cycas*, coralloid root has the cyanobacteria - *Anabaena*.
42. (a) In *Cycas* specialised root called coralloid roots are associated with N_2 –fixing cyanobacteria either *Nostoc* or *Anabaena*. Coralloid roots lie near the soil surface. They are irregular and often dichotomously branched. Root hair and root cap are absent in these roots.
43. (b) Statement (i), (ii) and (iii) are correct. In liverworts and ferns gametophytes are free living while in fern, sporophytes are free living. Gymnosperms and genera like *Selaginella* and *Salvinia* are heterosporous. The sporophyte in mosses are more elaborate than that of liverworts, *Pinus* is monoecious and heterosporous. *Marchantia* is dioecious.
44. (b) The female sex organ archegonium is formed in bryophytes (*Funaria*), pteridophytes (*Dryopteris*) and gymnosperms (*Ginkgo*).
45. (d) Male and female gametophyte do not have an independent free-living existence in gmnosperms and angiosperms. In them they remains within the sporangia retained on the sporophytes. The pollen grain is released from the microsporangium and are carried in air currents and come in contact with the opening of the ovules borne on megasporophylls. The pollen tube carrying the male gametes grows towards archegonia in the ovules and discharge their contents near the mouth of the archegonia.
46. (c) Double fertilisation is a unique feature exhibited only by angiosperms. It involves both syngamy and triple fusion.
47. (b) In meiosis, the number of chromosomes are reduced by half producing haploid daughter cells. The microspore mother cell and the megaspore mother cell undergo meiosis to produce haploid microspore and megaspore respectively.