PLANT KINGDOM

- Plant kingdom is divided into two subkingdoms – cryptogamae and phanerogamae.
- **Cryptogams** (no seed) include algae, bryophytes and pteridophytes. **Phanerogams** (with seeds) include gymnosperms and angiosperms.

ALGAE

- Study of algae (named by Linnaeus, 1753) is called phycology and F.E. Fritsch, the father of algae. Algae are chlorophyllous, thalloid, avascular plants with no cellular differentiation. Algae are usually aquatic, either marine or fresh water. Only a few algae occur in moist terrestrial habitats like on tree trunks, wet, rocks, moist soil, etc.
- Algae may be unicellular or multicellular ranging from small colonial (*Volvox*) to large sized like *Macrocystis* (several hundred feet). Filamentous form may be branched or unbranched, (free floating–*Spirogyra,* attached to the substratum–*Ulothrix*, colonial-*Nostoc*).
- Algae are divided into three main classes-chlorophyceae, phaeophyceae and rhodophyceae.
- Reproduction in algae takes place by vegetative, asexual or sexual means. Vegetative reproduction is the most common method of reproduction. It takes place by the following means:
  - Fragmentation, *e.g.*, *Ulothrix*.
  - Cell division or fission, *e.g.*, desmids.
  - Hormogonia, *e.g.*, *Nostoc*.
  - Tubers, *e.g.*, *Cladophora*.
  - Budding, *e.g.*, *Protosiphon*.
- Asexual reproduction takes place by following methods:
  - Zoospores : (ciliated), *e.g.*, *Ulothrix*, *Oedogonium*.
  - Aplanospore : (non-motile, thin walled), *e.g.*, *Chlorella*, *Microspora*.
  - Hypnospores : (non-motile, thick walled), *e.g.*, *Vaucheria*.
- The sexual reproduction is of two types - isogamous and heterogamous (anisogamous, oogamous). Isogamyoccurs commonly in unicellular algae, *e.g.*, *Ulothrix*.
- Algae are economically important as food source (*e.g.*, *Porphyra*, *Ulva*), nitrogen fixers (*Nostoc*, *Anabaena*). Besides, we obtain carrageenin from red alga *Chondrus crispus*, agar-agar from *Gelidium*, *Gracilaria,* etc., goiter medicines (due to their high iodine content) and alginic acid from brown algae.
- Fritsch classified algae into 11 classes which are discussed in the following table:

Table: Characteristics of different classes of algae

Class/Examples	Structure	Occurrence	Major pigments	Reserve food material	Reproduction		
					Vegetative	Asexual	Sexual
Chlorophyceae (grass green) *e.g., Spirogyra, Ulothrix*	Unicellular motile to heterotrichous filaments. Cell wall consists of cellulose. Pyrenoids are commonly surrounded by starch-sheath. Motile cells have equal flagella (2 to 4).	Most forms are fresh water and a few are marine. There is a marked tendency towards the terrestrial habitat.	Chl *a* & *b* + carotenoids and xanthophyll	True starch and sugar	Fragmentation or fission	Zoospores, aplanospores, hypnospores	Sexual reproduction ranges from isogamous to advanced oogamous type.
Xanthophyceae (yellow green) *e.g., Botrydium, Vaucheria*	Unicellular motile to simple filamentous. Cell wall rich in pectic compounds and composed of two equal pieces overlapping at their edges. Motile cells have two very unequal flagella, pyrenoids absent.	Most forms are fresh water but a few are marine.	Xanthophylls & β-carotenes + Chl *a* & *e*	Oil or leucosin	Most common method occurs by cell division	Aplanospores, akinetes, zoospores, cysts etc. All zoospores except that of *Vaucheria* have unequal flagella.	Sexual reproduction is rare and always isogamous.

Chrysophyceae (orange/brown) *e.g., Ochromonas, Dinobryon*	Plants are unicellular motile to branched filamentous. Flagella are unequal attached at front end. Cells commonly contain one or two parietal chromatophores.	Most forms occur in cold fresh water but a few are marine.	Carotene, fucoxanthin, lutein + Chl. *a* & *c*	Leucosin, rarely oil	Binary fission	Planospores	Sexual reproduction seldom occurs but if occurs is of isogamous type.
Bacillariophyceae *e.g., Fragilaria, Denticula*	All the members are unicellular or colonial. Cell wall is partly composed of silica and partly of pectic substances. It consists of two halves and each has two or more pieces. Cell wall is richly ornamented.	In all kind of fresh water, sea, soil and terrestrial habitats.	Diatoxanthin, diadinoxanthin, fucoxanthin + chl *a* & *c*.	Oil, volutin	Cell division producing two unequal cells.		Forms are diploid. Sexual reproduction is of special type, occurs by fusion of protoplasts of the ordinary individuals.
Cryptophyceae (nearly brown) *e.g., Cryptomonas, Cryptochrysis*	Represented by motile cells and most advanced forms are coccoid, flagella are slightly unequal.	Both in marine and fresh water.	Chl. *a* & *c*, carotenes, xanthophylls	Starch	Cell division	Cysts, plamelloid stage.	Isogamous type in the reported cases.
Dinophyceae (dark yellow) *e.g., Ceratium, Glenodinium*	Plants are unicellular motile to branched filamentous.	Plants occur widely as marine planktons. A few may be fresh water forms.	Chl. *a* & *c*, xanthophylls (diadinoxanthin, dinoxanthin)	Oil & starch	Cell division	Zoospores, aplanospores, autospores.	Sexual reproduction is of isogamous type. It is rare and not very definite.
Chloromonadineae (bright green) *e.g. Vacuolaria*	The plants are motile, flagellate with two almost equal flagella.	All plants are fresh water forms.	Chlorophylls and xanthophylls	Fatty substance or oil	Cell division	Cysts and spores.	–
Euglenineae *e.g., Trachelomoas Euglena*	Motile flagellates, flagella may be one or two arising from the base of canal-like invagination at the front end. Complex vacuolar system and a large and prominent nucleus.	Only fresh water forms are known.	Chl.*a* & *b*, carotenes	Paramylum, a strach like substance but negative to iodine test.		Sometimes cyst, Plammeoid stage are observed.	Sexual reproduction is not substantially known. It is isogamous type.
Phaeophyceae (brown) *e.g., Fucus, Sargassum*	The plants may be simple filamentous to bulky parenchymatous forms. Several plants attain giant size, external and internal differentiation.	Mostly marine.	Fucoxanthin, flavoxanthin β-carotenes + Chl. *a* & *c*	Laminarin, mannitol	Fragmentation is most common	Both motile and non-motile spores are formed *e.g.*, zoospores, tetraspores etc.	Ranges from isogamous to oogamous. Motile gametes have two laterally attached flagella. Varied types of alternation of generation. Except fucales, in all other sexual forms are haploid.

Rhodophyceae (red) *e.g., Bangia, Porphyra*	Simple filamentous to attaining considerable complexity of structure. Motile structures are not known. Except in few forms, cells show protoplasmic or pit connections.	Few forms are fresh water and others are marine.	Phyco-erythrins, phycocyanin + Chl, *a* & *d*	Floridean starch	Uncommon, except unicellular ones.	Monospores, carpospores, polyspores etc.	Advanced oogamous type. The male organ produces non-motile gametes and the female organ has a long receptive neck. After sexual reproduction special spores (carpospores) are produced.
Cyanophyceae or Myxophyceae (blue green) *e.g., Nostoc, Anabaena*	Simple type of cell to filamentous, some of the filamentous forms show false or true branching, very rudimentary nucleus, no proper chromatophores, the photosynthetic pigments being diffused throughout the peripheral cytoplasm. No motile stages.	Found in sea and fresh water.	c-Phycocyanin, c-Phycoerythrin, and Chl-*a*	Cyanophycean starch	Fission, fragmentation, Hormogonia, pseudohormogonia	Endospores, exospores, nannospores, akinetes, heterocysts.	There is no sexual reproduction.

- Various scientists consider cyanophyceae as member of kingdom monera and euglenophyceae, dinophyceae, chrysophyceae in kingdom protista.

BRYOPHYTES

- **Bryophyta,** Greek word (*bryon* = moss, *phyton* = plant), represent a group of plants that includes liverworts, hornworts and mosses growing predominantly in amphibious environment. Bryophytes are land inhabiting or terrestrial plants. They complete their vegetative phase on land but water is necessary for their reproductive phase, *i.e.*, for completion of life cycle. So bryophytes are known as "**Amphibians of plant kingdom**". Dominant plant phase in bryophytes is free living thalloid gametophyte. The gametophyte is thalloid in primitive forms (*Riccia*) and differentiated into **rhizoids, stem** and leaves in higher bryophytes (mosses).

Reproduction

- Vegetative reproduction occurs by various methods such as by **death and decay of the older thallus, adventitious branches** detached from thallus to form new thallus, *e.g.*, *Riccia*.
- The sexual reproduction is of **oogamous type**, *i.e.*, fusion of a **non-motile passive egg cell** (female gamete) and **biflagellated active male gamete** (antherozoid) takes place. The sex organs are **multicellular and jacketed**, *i.e.*, a sterile layer of cells is present.
- Male sex organ is **antheridium**, which produces single coiled, biflagellated male gamete or spermatozoid or antherozoid. Female sex organ is **archegonium**. It is a flask shaped structure with swollen base called **venter** and upper elongated **neck**.
- The fertilization takes place in presence of water. The spermatozoid swims to the neck of archegonium. It passes through the canal formed by the disintegration of neck canal cells and ventral canal cell and fuses with the egg. Sporophytic generation starts with **zygote**. The zygote immediately secretes cellulosic wall, to develop into multicellular **embryo or sporophyte**.
- The gametophyte provides protection and nourishment to the developing embryo.
- The sporophyte consists of foot, seta and capsule. **In a few cases only seta is absent as in** *Corsinia* **whereas in** *Riccia* **both foot and seta are absent.** In a capsule, the spores are formed after meiosis. These spores (meiospores) are all of one kind. The plants are homosporous.
- They are economically important as they prevent soil erosion, make important link in ecological succession, have high water retention ability thus used in shipping of plants and other desiccating materials, used as food and manure, cause soil aeration etc.

Table: Classification of bryophytes

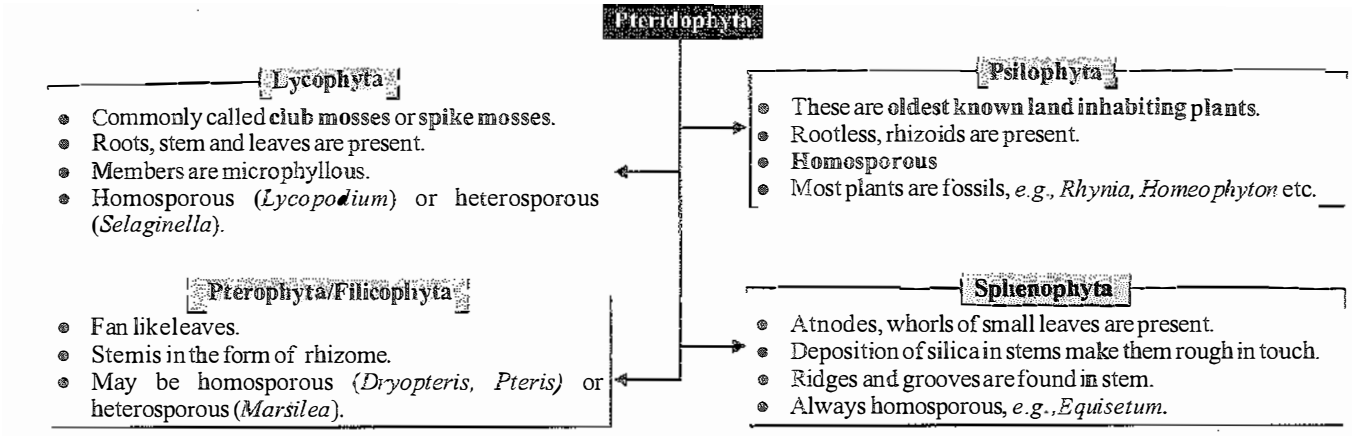
	Features	Hepaticopsida	Anthocerotopsida	Bryopsida
1.	**Common name**	Liverworts	Hornworts	Mosses
2.	**Gametophytic plantbody**	May be thallose or foliose Aseptate rhizoids	Thallose Aseptate rhizoids	Thalloid protonema and leafy gametophore. Obliquely septate rhizoids.
3.	**Sex organs**	Present on dorsal surface of thallus	Present on dorsal surface of thallus.	Develop from the superficial cells at the apex of leafy gametophore.
4.	**Sporophyte or sporogonium**	Differentiated into foot, seta and capsule	Foot, short-meristematic region and capsule.	Foot, seta and capsule.
5.	**Elaters**	Generally present but absent in some plants like *Riccia*	Pseudoelaters are present in the capsule	Absent
6.	**Sporogenous tissue**	Develops from endothecium	Develops from amphithecium and endothecium forms sterile columella.	Develops from outer layer of endothecium. Inner layer forms sterile columella.
7.	**Dehiscence of capsule**	Irregular	Irregular	Regular
8.	**Examples**	*Riccia, Marchantia, Sphaerocarpus* etc.	*Anthoceros, Notothylus, Megaceros,* etc.	*Sphagnum, Polytrichum, Funaria,* etc.

PTERIDOPHYTES

- Pteridophytes are higher cryptogams or vascular cryptogams (Gk. *kryptos* = hidden, *gamos* = wedded). These are the group of **seedless vascular plants,** that have successfully invaded land and reproduce by means of spores. Pteridophytes are also called **'Snakes of Plant Kingdom'** or **'Botanical Snakes'** as snakes, *i.e.*, reptiles (pteridophytes) evolved after amphibians (bryophytes).
- **Smallest** pteridophyte is *Azolla* (an aquatic fern) and largest is *Cyathea* (tree fern).
- Plant body is **sporophyte** which is differentiated into true stem, leaves and roots. Roots are mainly **adventitious**. Some primitive members of the group may lack true roots and well developed leaves, *e.g.*, order psilophytales and psilotales. In some members, the branching of the stem is of **dichotomous type**, while in others, it is **monopodial**.
- The sporophytic plant presents a great range in the form. Two main categories may be distinguished. One category comprises **megaphyllous types**, in which **the leaves are large in relation to the stem,** and is represented by the ferns; the second category consists of **microphyllous types**, in which the **leaves are small in relation to the stem and is** represented by the **lycopods** and the **horsetails.**
- Large leaves of ferns are called fronds.
- **Leaves bearing the sporangia are called sporophylls.** The sporophylls may be widely scattered on a plant or may be clustered in definite areas and structures, called cones or strobili (*Selaginella* and *Equisetum*).
- The development of sporangium may be **eusporangiate** or **leptosporangiate.**
- **Eusporangiate development** takes place by a **group of cells** and not by a single cell. This is primitive type and is found in *Psilotum, Selaginella, Lycopodium, Equisetum,* etc. **Leptosporangiate development** takes place from a single cell. Occurs in *Salvinia, Azolla, Marsilea* etc.
- Vascular tissues are present. In xylem, vessels are absent and in phloem, companion cells are absent. *Selaginella* and *Equisetum* are exceptions where vessels are present.
- The sporophytes reproduce asexually producing spores in sporangia.
- Spores may be homosporous (*Lycopodium, Dryopteris*) or heterosporous (*Selaginella, Azolla, Salvinia*).
- Gametophyte is usually independent. Sex organs are multicellular and jacketed. Archegonia are partially embedded. Sperms are flagellated. **Fertilization in all cases is accomplished by the agency of water.** Results in the formation of the zygote. The zygote undergoes repeated divisions to form a new sporophyte. The development of zygotes into young embryos takes place within female gametophyte. This event is a precursor to the evolution of seed habit. Alternation of generation is present in life cycle.
- Bower and Goebel named **rhizophore** of *Selaginella* as an **organ sui-generis** *i.e.,* an organ having the characters of both *i.e.* stem as well as root, but independent in origin.
- Pteridophytes show **apogamy (coined by De Bary,** 1878) apospory and parthenogenesis. Apogamy is the formation of sporophyte from a gametophytic cell other than egg without fertilization (*e.g., Lycopodium, Selaginella, Marsilea,* etc.)
- Apospory is the formation of gametophyte from a sporophytic cell without meiosis, *e.g., Pteridium.*
- **Parthenogenesis** is the formation of sporophyte from egg without fertilization *e.g., Selaginella, Marsilea.*
- Pteridophytes are economically important for us.
- The chief economic importance of the pteridophytes is that their fossil remains contributed to the coal deposits of the world.
- *Equisetum arvense* is used in the preparation of diuretic, haemostatic and haemopoietic drugs. Ferns are extensively cultivated in gardens and greenhouses because of their

attractive foliage that are used by people in bouquets and floral decorations.

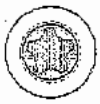
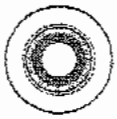
- Pteridophytes can be classified into four groups as shown in the following flowchart.



Stele

- For land plants absorption and conduction of nutrients and food is very much important for survival. To serve the purpose land plants have developed vascular system. Tissues inner to endodermis involving vascular tissue are termed collectively as 'stele'. Stele is first observed in pteridophytes. Various types of stele found in pteridophytes are shown below.

Table : Different types of steles in pteridophytes

	Stele	Occurrence	Features	Figure
1.	**Protostele**	*Lycopodium, Lygodium, Psilotum,* etc.	**Pith is absent.** Most primitive and other types have been derived from it.	
(i)	**Haplostele**	*Horneophyton, Selaginella kraussana, Rhynia,* etc.	Solid round central core of xylem is surrounded by phloem and pericycle.	
(ii)	**Actinostele**	*Lycopodium serratum, Psilotum,* etc.	Central xylem is star shaped with radiating arms and phloem is present in separate patches.	
(iii)	**Plectostele**	*Lycopodium clavatum, L. volubile*	Pholem is present in between the separate plates of xylem.	
(iv)	**Mixed protostele**	*L. cernuum*	Xylem is present in the form of discrete units embedded in phloem.	
2.	**Siphonostele**		**Pith is present.** It is the protostele with pith.	
(i)	**Ectophloic siphonostele**	*Osmunda, Schizaea* etc.	Phloem is present only on outer side of xylem	
(ii)	**Amphiphloic siphonostele**	*Marsilea, Dipteris, Adiantum,* etc.	Phloem is present on both sides of xylem.	
3.	**Solenostele**	*Adiantum, Marsilea*	Siphonostele with single leaf gap is called solenostele.	

(i)	**Ectophloic solenostele**		It is derived from ectoploic siphonostele	
(ii)	**Amphiphloic solenostele**		It is derived from amphiphloic siphonostele	
4.	**Dictyostele**	*Dryopteris, Pteris*, etc.	A number of leaf gaps are present. Vascular cylinder breaks up into a number of meristeles.	
5.	**Polycylic stele**	*Pteridium aquilinum, Pteris vittata,* etc.	More than one ring of vascular tissue is present.	

GYMNOSPERMS

- Gymnosperms constitute a sub-division of **spermatophyta** or **phanerogams**. They are the **phanerogams without ovary** (**Goebel, 1887**). These act as a **connecting link** between pteridophytes and angiosperms. In the evolutionary point of view gymnosperms are the **most primitive seed plants.** Most of the genera are **entirely extinct** and only a few are living.
- The term "gymnosperms" (*Gymnos*-naked, *Sperma*-seeds) was coined by **Theophrastus** (300 B.C.). Gymnosperms are naked seeded plants having freely exposed ovules on megasporophylls. Sporophylls generally aggregate into **strobili.** Sporophyte is divisible into root, stem and leaf. In general, tallest trees are in gymnosperms, *e.g.*, *Sequoia sempervirens* is 366 ft in height and *S. gigantea* is 342 ft in height. *Zamia pygmaea* is the smallest gymnosperm (25 cm in height).
- Visible plants represent sporophytic generation (2n) and are usually slow growing plants commonly of moderate size. Plants possess tap root system but in some forms additional symbiotic relationship is exhibited between roots and algae in **coralloid** roots (*Cycas*) and between roots and fungi in **mycorrhizic** roots (*Pinus*). The stems are aerial, erect, branched (unbranched in *Cycas, Zamia*) and woody. Majority of gymnosperms have branched stem. Leaves are generally dimorphic, foliage and scale leaves. The foliage leaves do not have lateral veins. Leaves are protected by thick layers of cuticle and sometimes by an additional waxy layer. Stomata are protected as they develop in cavities.
- Plants are **heterosporous**, *i.e.*, producing microspores and megaspores. Both dioecious (*Cycas*) and monoecious (*Pinus*) types of plants are found in gymnosperms. Microsporangia are borne on the abaxial or lower surface of microsporophylls. They may be numerous and grouped in **sori** (*Cycas*) or reduced to two (*Pinus*). Megasporangia or ovules are naked and are borne on the megasporophylls. Ovules occur in opposite alternate pairs on the lateral sides in middle part of megasporophyll. Each ovule has a mass of tissue called nucellus. It is equivalent to megasporangium. A megaspore mother cell develops in it.

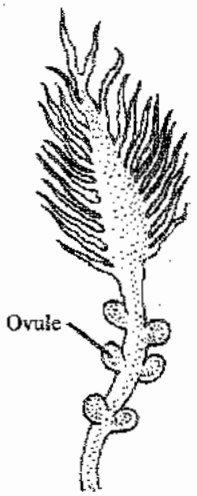
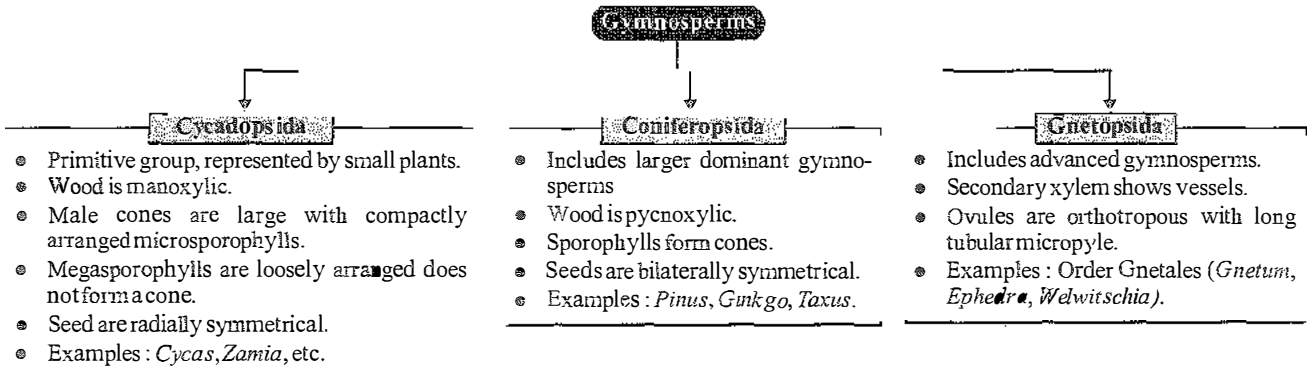


Fig.: Megasporophyll of *Cycas*

- Gametophytic generation (n) is much reduced. The first male gametophytic cell is **microspore** or **pollen grain**. The first female gametophytic cell is **functional megaspore** that produces nuclear and later cellular female gametophyte. Female gametophyte develops **archegonia**. Smallest archegonium of plant kingdom is present in this group. **Pollination** takes place by means of **wind** by the direct contact of pollen grains with the ovules. Siphonogamy occurs. At the time of fertilization nuclei of male and female gametes fuse and result in the formation of a zygote. Zygote develops into an embryo.
- As endosperm is derived from the female gametophyte, it is always **haploid.** Gymnosperms do not possess an ovary and hence **do not produce a fruit.**
- **Polyembryony,** *i.e.*, development of several embryos in one seed, out of which only one survives, is of common

occurrence in *Pinus*. The number of cotyledons may be one or two (*Cycas*) or a whorl of many (*Pinus*). Endosperm is gametophytic. Distinct alternation of generation occurs.

- Gymnosperms are economically very important. The members of this group are variously used by human beings as food, as medicines, as plants for decoration and in industries.
- Gymnosperms can be classified into three groups as discussed in the following flow chart.



- Primitive group, represented by small plants.
- Wood is manoxylic.
- Male cones are large with compactly arranged microsporophylls.
- Megasporophylls are loosely arranged does not form a cone.
- Seed are radially symmetrical.
- Examples : *Cycas*, *Zamia*, etc.

- Includes larger dominant gymnosperms
- Wood is pycnoxylic.
- Sporophylls form cones.
- Seeds are bilaterally symmetrical.
- Examples : *Pinus*, *Ginkgo*, *Taxus*.

- Includes advanced gymnosperms.
- Secondary xylem shows vessels.
- Ovules are orthotropous with long tubular micropyle.
- Examples : Order Gnetales (*Gnetum*, *Ephedra*, *Welwitschia*).

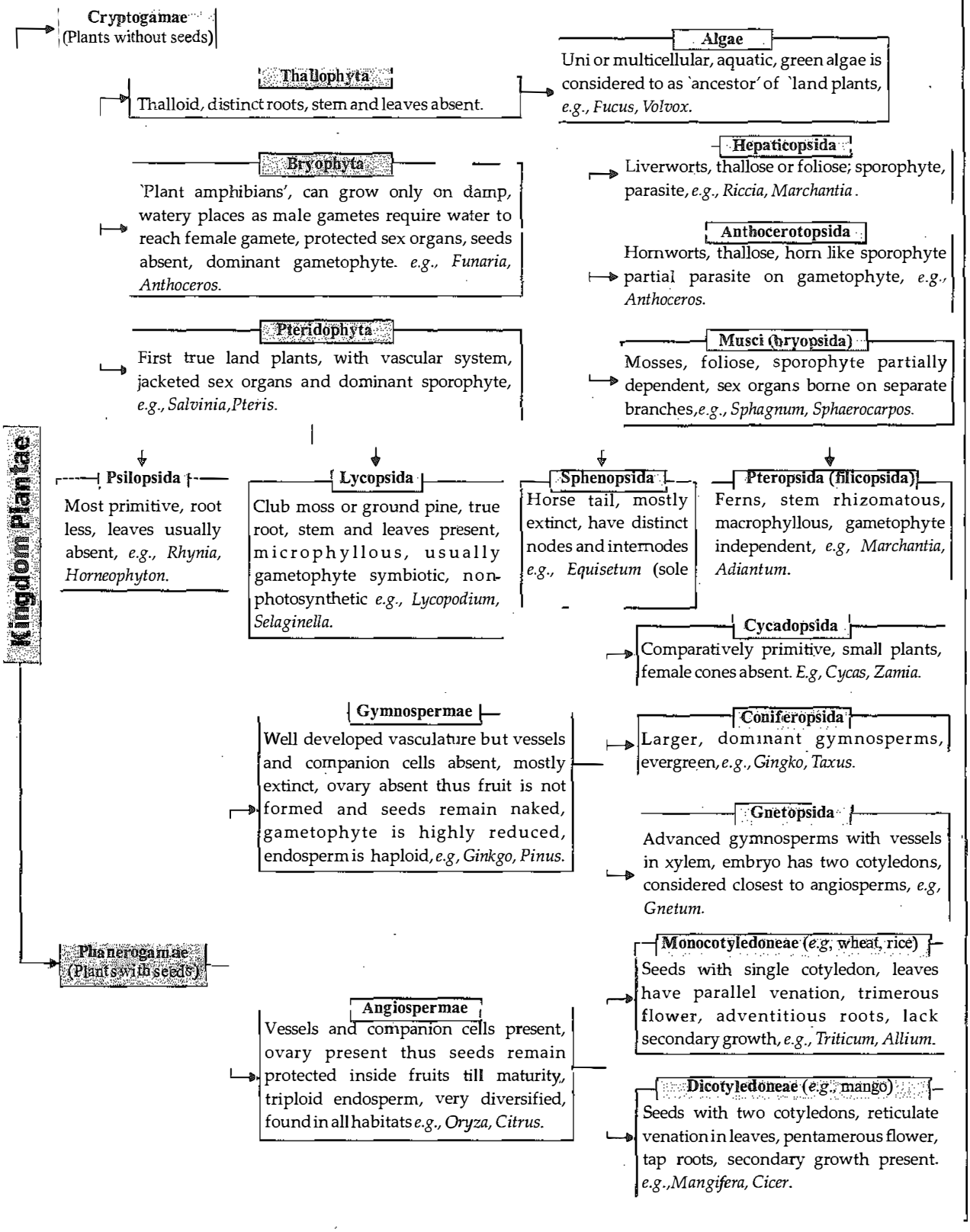
ANGIOSPERMS

- Angiosperms are seed plants in which sporophylls are organised into flowers and the seeds are produced inside fruits. The smallest is water plant *Wolffia* (less than 0.1 cm) while the tallest is *Eucalyptus regnans* (114 m and above). Angiosperms are highly evolved plants and form the dominant vegetation of present day earth. Sporophyte shows differentiation into root, stem and leaf. Xylem is mainly made up of vessels. Companion cells are present in the phloem. In the flower, essential organs (androecium and gynoecium) are surrounded by non-essential organs (calyx and corolla). Male gametophyte is known as pollen grain and female gametophyte is known as embryo sac. Pollination is indirect because the pollen grains reach the stigma. As the male gametes are non-motile, water is not essential for fertilization.
- They are divided into two classes-dicotyledons (two cotyledons) and monocotyledons (single cotyledon). These two classes show various morphological variations. These variations are discussed in brief in the given table.

Table: Differences between dicots and monocots

	Dicots	Monocots
1.	There are usually two cotyledons.	The seeds contain one cotyledon.
2.	Flowers are generally pentamerous or tetramerous (floral parts in sets of 5 and 4 or their multiples).	Flowers are usually trimerous (floral parts in sets of three or its multiples).
3.	Pollen grains commonly have three germ pores.	Pollen grains generally possess a single germinal furrow.
4.	Leaves are net veined or with reticulate venation.	The leaves possess parallel venation with a few exceptions.
5.	Primary root often long lived forming tap root system. Adventitious roots occur in some cases.	Primary root is short-lived. Tap roots are absent. Instead adventitious roots are found.
6.	Stem possesses concentric arrangement of tissue systems – epidermis, cortex, endodermis, pericycle, pith, etc.	Tissue systems are not differentiated in the stem. A ground tissue occurs.
7.	Vascular bundles of the stem are arranged in a ring.	Vascular bundles are scattered.
8.	Vascular bundles of the stem possess cambium (vascular bundles open), so that secondary growth is possible.	Cambium is absent (vascular bundle closed).
9.	In root, a pith is absent or small. Vascular bundles are few (8 or less).	In root, a pith is always present. Vascular bundles are many (more than 8).
10.	Vessels are polygonal in outline.	Vessels are rounded in outline.

CONCEPT MAP


Kingdom Plantae
Cryptogamae (Plants without seeds)
Thallophyta
Thalloid, distinct roots, stem and leaves absent.
Algae
Uni or multicellular, aquatic, green algae is considered to as 'ancestor' of 'land plants, e.g., Fucus, Volvox.
Bryophyta
'Plant amphibians', can grow only on damp, watery places as male gametes require water to reach female gamete, protected sex organs, seeds absent, dominant gametophyte. e.g., Funaria, Anthoceros.
Hepaticopsida
Liverworts, thallose or foliose; sporophyte, parasite, e.g., Riccia, Marchantia.
Anthocerotopsida
Hornworts, thallose, horn like sporophyte partial parasite on gametophyte, e.g., Anthoceros.
Pteridophyta
First true land plants, with vascular system, jacketed sex organs and dominant sporophyte, e.g., Salvinia, Pteris.
Musci (bryopsida)
Mosses, foliose, sporophyte partially dependent, sex organs borne on separate branches, e.g., Sphagnum, Sphaerocarpos.
Psilopsida
Most primitive, root less, leaves usually absent, e.g., Rhynia, Horneophyton.
Lycopsida
Club moss or ground pine, true root, stem and leaves present, microphyllous, usually gametophyte symbiotic, non-photosynthetic e.g., Lycopodium, Selaginella.
Sphenopsida
Horse tail, mostly extinct, have distinct nodes and internodes e.g., Equisetum (sole
Pteropsida (filicopsida)
Ferns, stem rhizomatous, macrophyllous, gametophyte independent, e.g, Marchantia, Adiantum.
Cycadopsida
Comparatively primitive, small plants, female cones absent. E.g, Cycas, Zamia.
Phanerogamae (Plants with seeds)
Gymnospermae
Well developed vasculature but vessels and companion cells absent, mostly extinct, ovary absent thus fruit is not formed and seeds remain naked, gametophyte is highly reduced, endosperm is haploid, e.g, Ginkgo, Pinus.
Coniferopsida
Larger, dominant gymnosperms, evergreen, e.g., Gingko, Taxus.
Gnetopsida
Advanced gymnosperms with vessels in xylem, embryo has two cotyledons, considered closest to angiosperms, e.g, Gnetum.
Angiospermae
Vessels and companion cells present, ovary present thus seeds remain protected inside fruits till maturity, triploid endosperm, very diversified, found in all habitats e.g., Oryza, Citrus.
Monocotyledoneae (e.g, wheat, rice)
Seeds with single cotyledon, leaves have parallel venation, trimerous flower, adventitious roots, lack secondary growth, e.g., Triticum, Allium.
Dicotyledoneae (e.g, mango)
Seeds with two cotyledons, reticulate venation in leaves, pentamerous flower, tap roots, secondary growth present. e.g., Mangifera, Cicer.