Systems of Biological Classification

1. Artificial System
2. Natural System
3. Phylogenetic System

Systems of Biological Classification

Carl Linnaeus

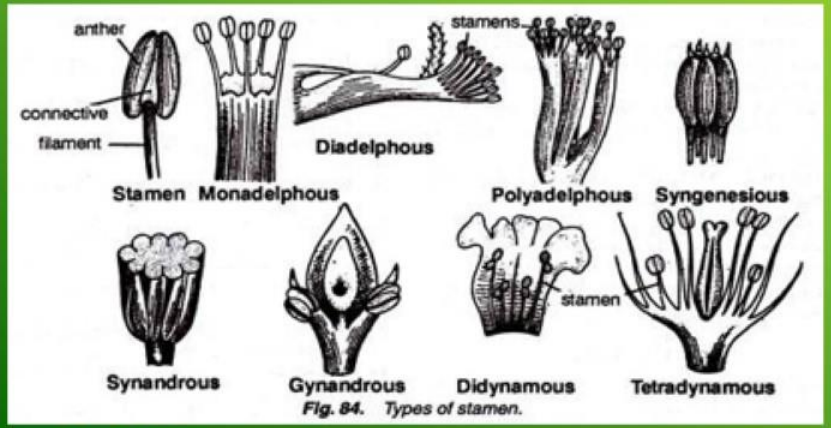


Fig. 84. Types of stamen.

1. Artificial Classification Systems

- Earliest systems of classification.
- They were based on **vegetative characters or superficial morphological characters** such as habit, colour, number and shape of leaves, etc.
- **Linnaeus's artificial system** of classification was based on the **androecium structure.**

Systems of Biological Classification

Carl Linnaeus

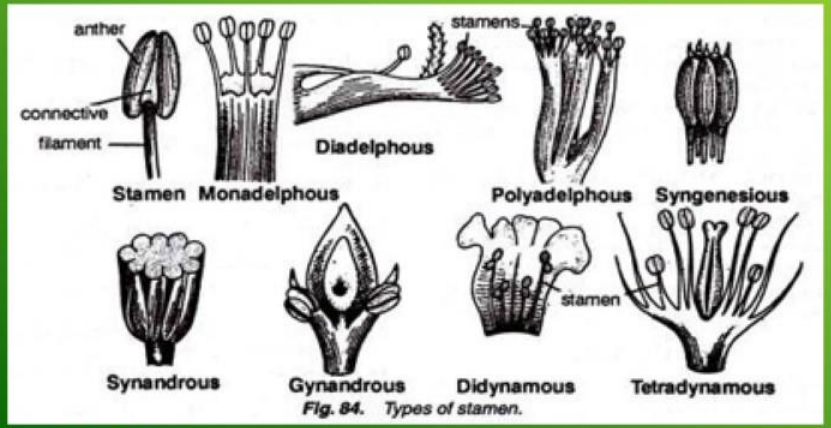


Fig. 84. Types of stamen.

1. Artificial Classification Systems

Drawbacks:

- They **separated the closely related species** since they were based on a few characteristics.
- **Equal weightage to vegetative & sexual characteristics.** This is not acceptable since the vegetative characters are more easily affected by environment.

Systems of Biological Classification

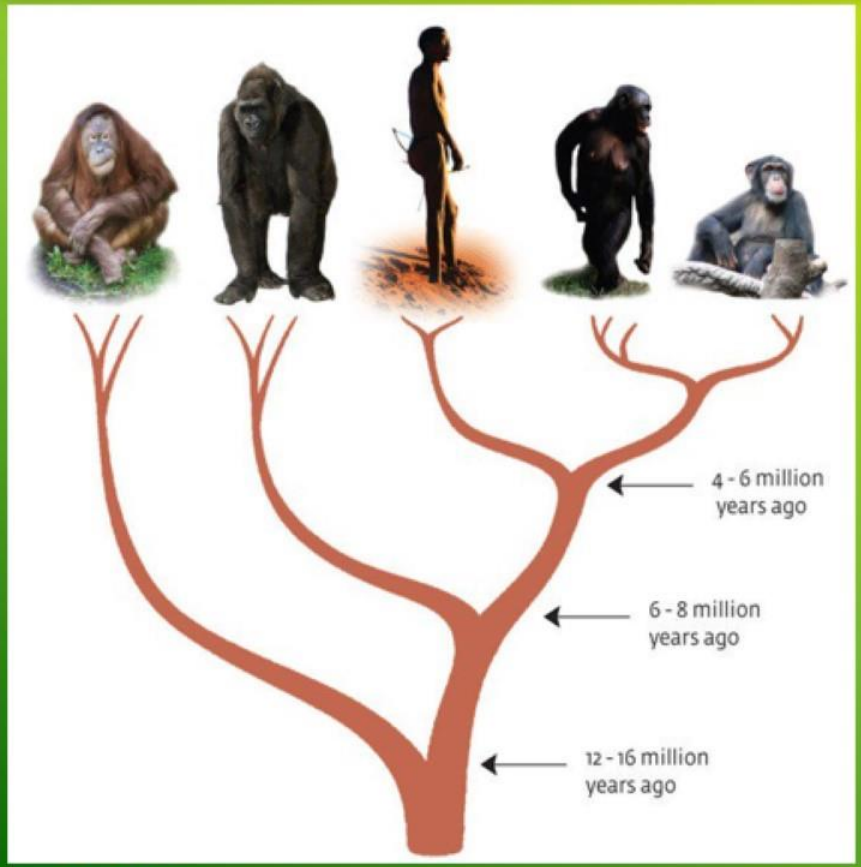
George Bentham

Jospeh Dalton Hooker

2. Natural Classification Systems

- These are based on **natural affinities** among organisms.
- It considers **external features and internal features** (ultrastructure, anatomy, embryology & phytochemistry).
- E.g. Classification for flowering plants given by **George Bentham & Joseph Dalton Hooker.**

Systems of Biological Classification

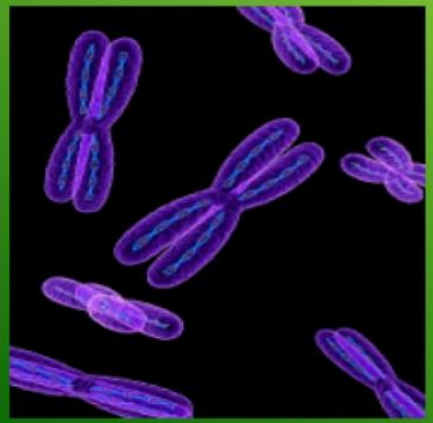


3. Phylogenetic Classification Systems

- These are based on **evolutionary relationships** among the organisms.
- This assumes that organisms in the same taxa have a common ancestor.

Systems of Biological Classification

Taxa	Characters									
	1	2	3	4	5	6	7	8	9	10
A	+	+	+	+	+	+	+	+	+	-
B	+	+	+	-	-	+	+	+	-	-
C	+	+	+	+	-	+	+	+	-	+
D	+	+	-	-	-	+	-	-	-	-
E	+	+	-	-	-	-	+	-	-	-



Other sources to resolve the problems in classification

- **Numerical Taxonomy**: It is based on **all observable characteristics.** It is carried out using computers. Number & codes are assigned to all the characters and the data are processed. Thus hundreds of characters can be equally considered.
- **Cytotaxonomy**: It is based on **cytological information** like chromosome number, structure, behaviour etc.
- **Chemotaxonomy**: It uses the **chemical constituents** of the plant.


ALGAE
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ALGAE


Algae

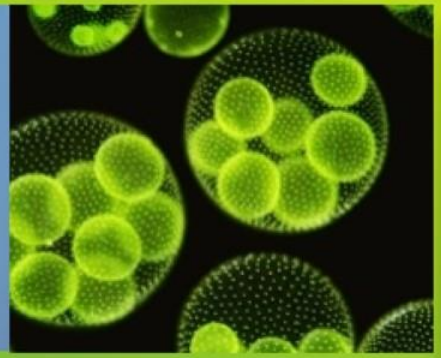

Lichen


Sloth bear green fur is due to presence of certain algae

- Simple, thalloid, autotrophic, chlorophyll–bearing and aquatic (fresh water & marine) organisms.
- They also occur in moist stones, soils & wood.
- Some occur in association with fungi (lichen) and animals (e.g. on sloth bear).

ALGAE

Chlamydomonas



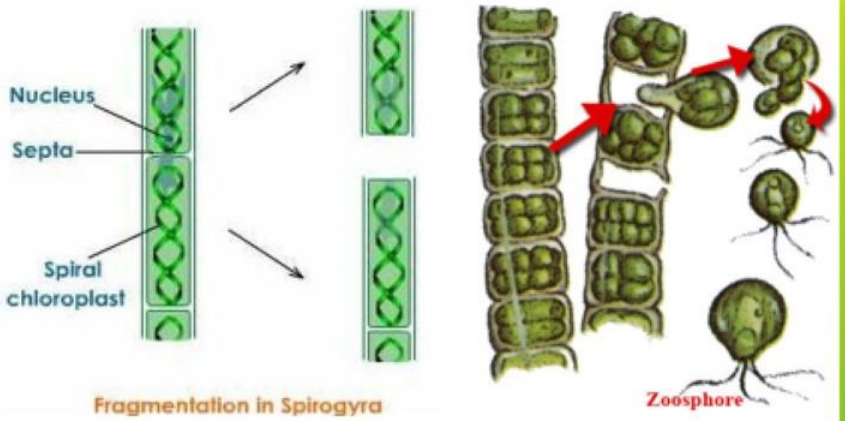
Volvox

Ulothrix

Spirogyra

- The form and size of algae is highly variable.
  - **Microscopic unicellular forms**: E.g. *Chlamydomonas.*
  - **Colonial forms**: E.g. *Volvox.*
  - **Filamentous forms**: E.g. *Ulothrix* and *Spirogyra.*

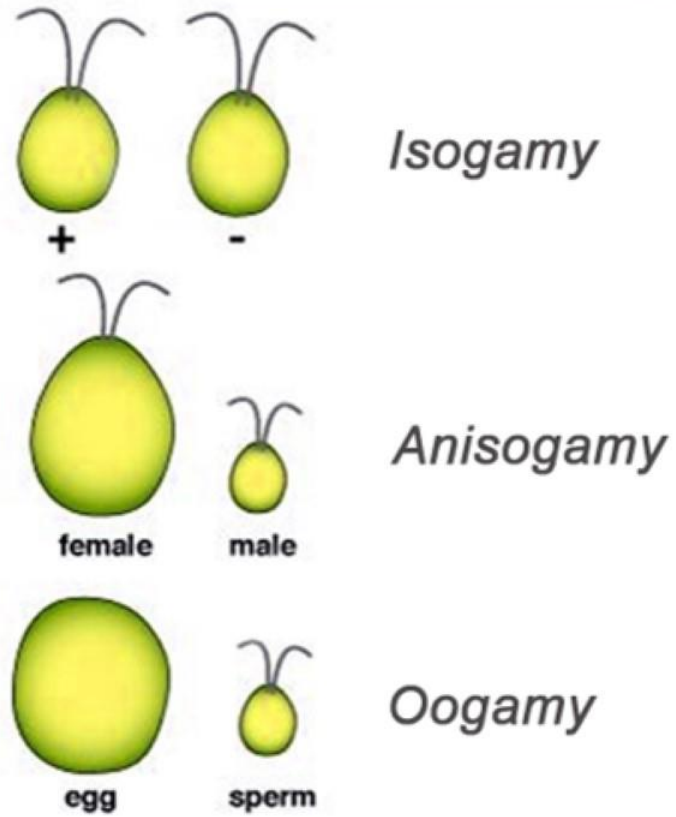
ALGAE



Reproduction

- **Vegetative reproduction:**
  By **fragmentation.** Each fragment develops into a thallus.
- **Asexual reproduction:**
  By the production of **spores.**
  E.g. **zoospores** (most common). They are flagellated (motile). They germinate to give rise to new plants.
- **Sexual reproduction:**
  Through **fusion of two gametes.**

ALGAE

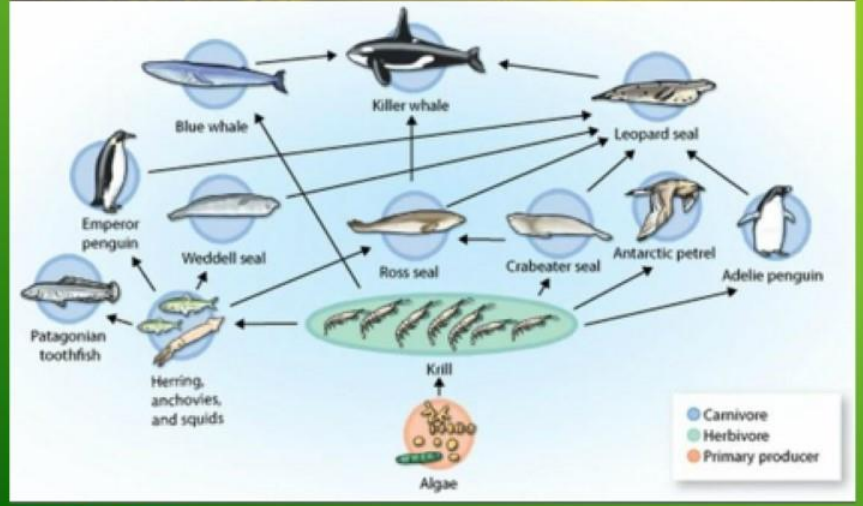


Reproduction

Sexual reproduction is many types:

- **Isogamous:** Fusion of gametes similar in size. They may be **flagellated** (e.g. *Ulothrix*) or **non–flagellated** (non–motile, e.g. *Spirogyra*).
- **Anisogamous:** Fusion of two gametes dissimilar in size.
  E.g. Some species of *Eudorina*.
- **Oogamous:** Fusion between one large, **non–motile (static) female gamete** and a smaller, **motile male gamete.**
  E.g. *Volvox, Fucus.*

ALGAE



Benefits of algae

1. Through photosynthesis, they **fix half of the total CO_2** on earth and increase the level of dissolved oxygen.
2. They are **primary producers** and the basis of the food cycles of all aquatic animals.

ALGAE

Porphyra

Laminaria

Sargassum

Gelidium

Gracilaria

Agar agar

Agar products

Benefits of algae

3. About 70 species of marine algae are used as **food.**

   E.g. *Porphyra, Laminaria* & *Sargassum.*

4. **Agar** (from *Gelidium* & *Gracilaria)* is used to grow microbes and in ice-creams & jellies.

ALGAE

Chlorella *Spirullina*

Benefits of algae

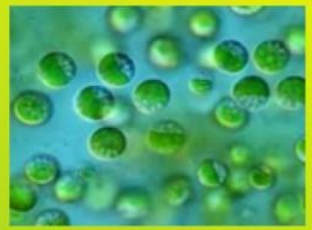
5. Some marine brown & red algae produce **hydrocolloids** (water holding substances). E.g. **algin** (brown algae) & **carrageen** (red algae). These are used commercially.
6. Protein-rich unicellular algae like *Chlorella & Spirullina* are used as food supplements by **space travellers.**

ALGAE

Classification

Classes of Algae

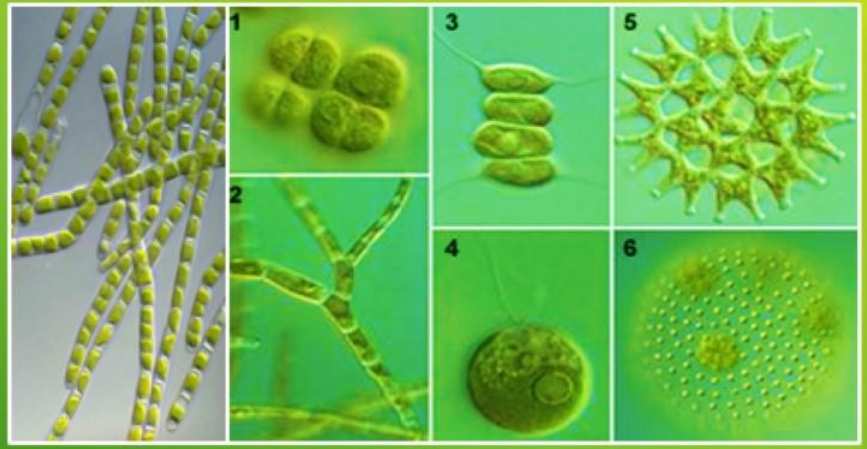
- Chlorophyceae (Green Algae)
- Phaeophyceae (Brown Algae)
- Rhodophyceae (Red Algae)

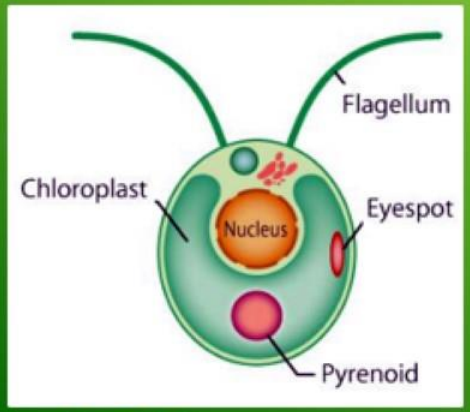


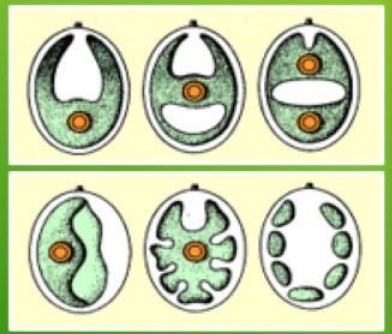



ALGAE

1. Chlorophyceae (green algae)





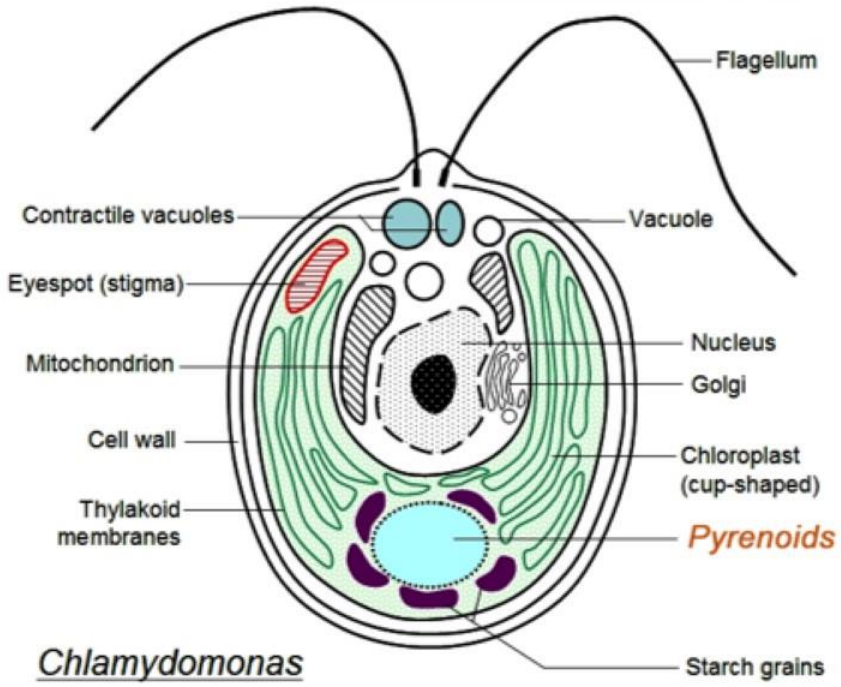


Chloroplasts of *Chlamydomonas*

- Unicellular, colonial or filamentous.
- Usually grass green due to the pigments **chlorophyll a & b** in chloroplasts.
- The chloroplasts may be **discoid, plate–like, reticulate, cup–shaped, spiral or ribbon–shaped** in different species.

ALGAE

1. Chlorophyceae (green algae)



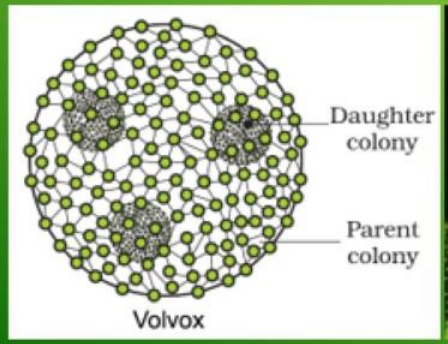
Structure of *Chlamydomonas* showing Pyrenoids, cell wall etc.

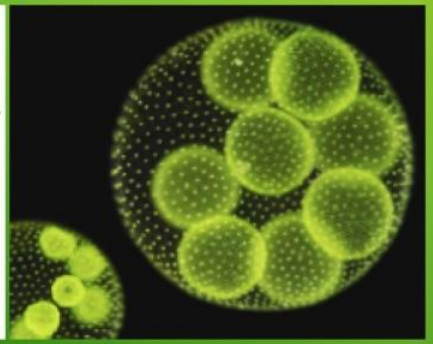
- Most of them have one or more **pyrenoids** (storage bodies) located in chloroplasts. Pyrenoids contain protein besides starch.
- Some algae store food as oil droplets.
- They have rigid cell wall made of an inner **cellulose** layer and an outer **pectose** layer.

ALGAE

1. Chlorophyceae (green algae)

Chlamydomonas

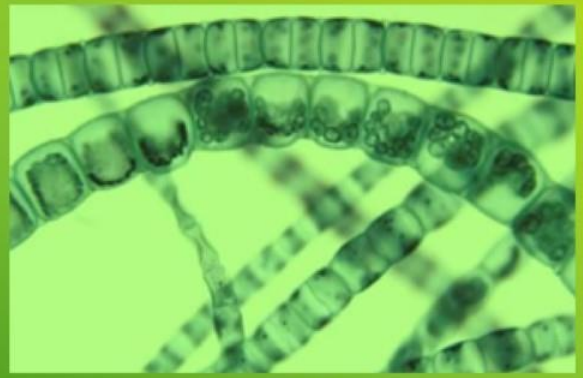




Volvox

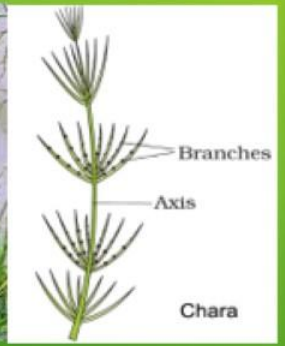
- Most of them have one or more **pyrenoids** (storage bodies) located in chloroplasts. Pyrenoids contain protein besides starch.
- Some algae store food as oil droplets.
- They have rigid cell wall made of an inner **cellulose** layer and an outer **pectose** layer.
- E.g. *Chlamydomonas, Volvox, Ulothrix, Spirogyra* & *Chara.*

ALGAE



Ulothrix

Spirogyra



Chara

1. Chlorophyceae (green algae)

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ALGAE

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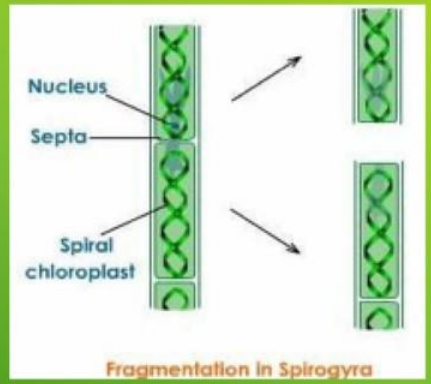
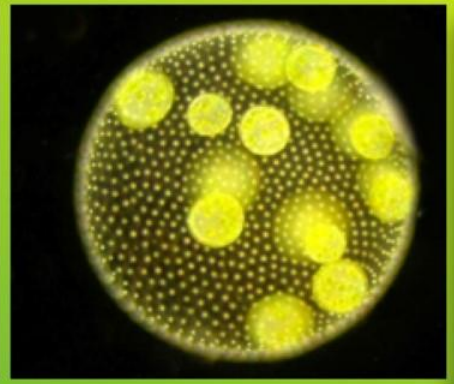
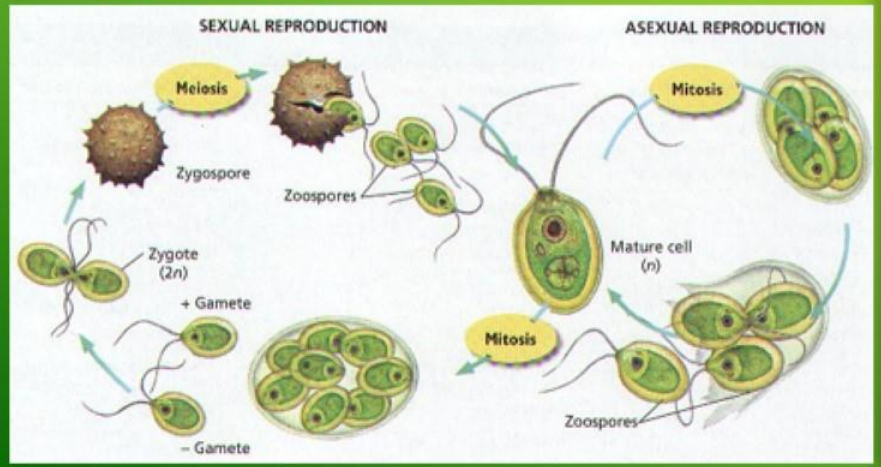






Reproduction

- **Vegetative reproduction**: By fragmentation or by formation of different types of spores.
- **Asexual reproduction**: By flagellated zoospores produced in zoosporangia.
- **Sexual reproduction**: Isogamous, anisogamous or oogamous.

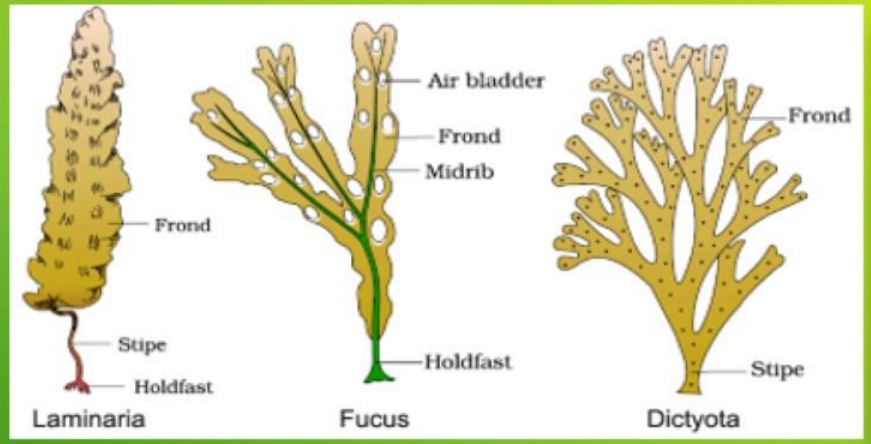
ALGAE

2. Phaeophyceae (brown algae)

- They are mostly marine forms.
- They show great variation in size & form. They range from simple branched, filamentous forms (E.g. *Ectocarpus*) to profusely branched forms (e.g. kelps– 100 m in height).
- They have **chlorophyll *a*, *c*, carotenoids & xanthophylls.**
- They vary in colour from olive green to brown depending upon the amount of a xanthophyll pigment, **fucoxanthin.**

ALGAE

2. Phaeophyceae (brown algae)



- Food is stored as complex carbohydrates **(laminarin** or **mannitol).**
- The vegetative cells have a cellulosic wall covered by a gelatinous coating of **algin.**
- Protoplast contains plastids, central vacuole and nucleus.
- Plant body is attached to substratum by a **holdfast,** and has a stalk **(stipe)** and leaf like photosynthetic organ **(frond).**
- E.g. *Ectocarpus, Dictyota, Laminaria, Sargassum* & *Fucus.*

ALGAE

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ALGAE

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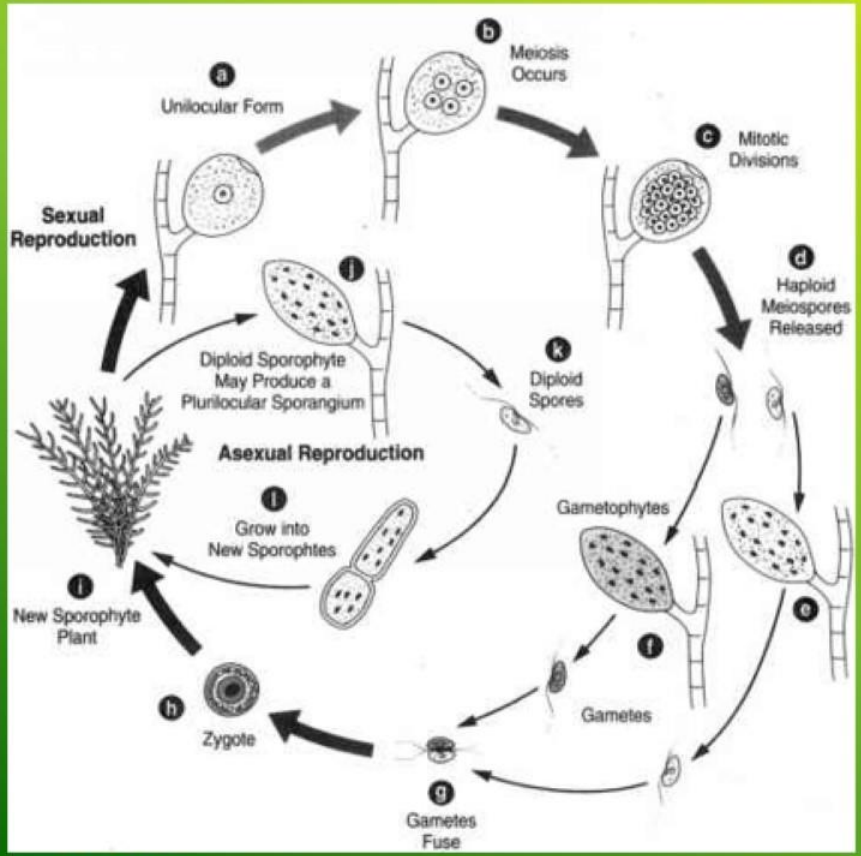
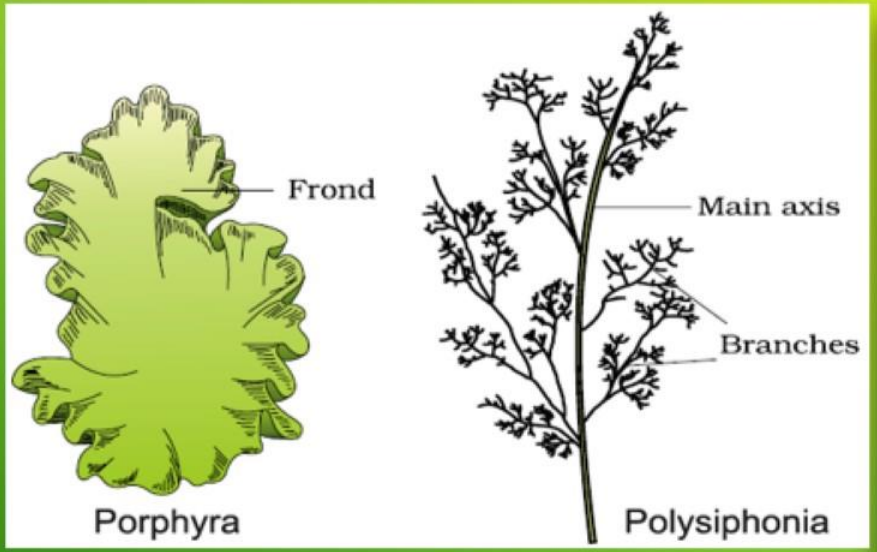


Reproduction

- **Vegetative reproduction**: By **fragmentation.**
- **Asexual reproduction**: By pear-shaped **biflagellate zoospores** (have 2 unequal laterally attached flagella).
- **Sexual reproduction**: **Isogamous, anisogamous or oogamous.** Union of gametes occurs in water or within the oogonium (oogamous species). Gametes are pear-shaped (pyriform) bearing 2 laterally attached flagella.

ALGAE

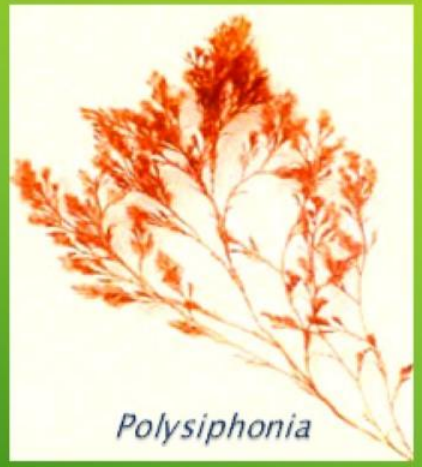
3. Rhodophyceae (red algae)

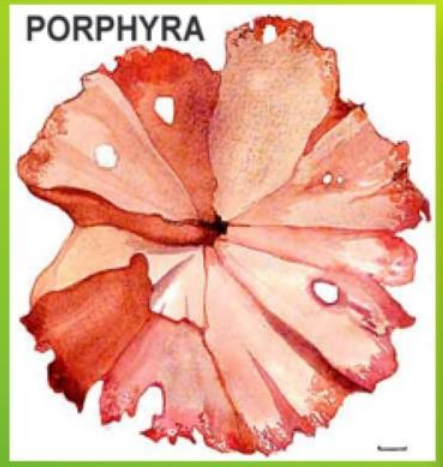


- They have **red thalli** due to the red pigment, **r–phycoerythrin.**
- Majority are marine especially in warmer areas.
- They occur in both well–lighted regions close to the surface of water and at great depths in oceans where relatively little light penetrates.

ALGAE

3. Rhodophyceae (red algae)

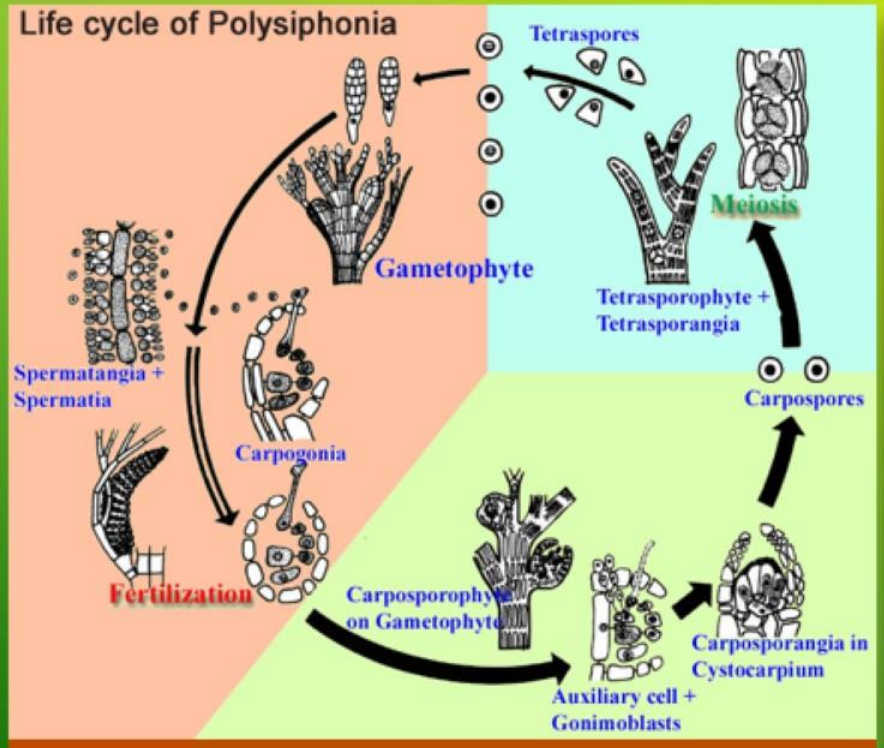




- Most of them are multicellular.
- Some have complex body organisation.
- The food is stored as **floridean starch** which is structurally very similar to amylopectin & glycogen.
- E.g. *Polysiphonia*, *Porphyra*, *Gracilaria* and *Gelidium*.

ALGAE

3. Rhodophyceae (red algae)



Life cycle of *Polysiphonia*

Reproduction

- **Vegetative reproduction:**
  By fragmentation.
- **Asexual reproduction:**
  By non-motile spores.
- **Sexual reproduction:**
  Oogamous. By non-motile gametes. It has complex post fertilisation developments.

ALGAE: A COMPARISON

	Chlorophyceae	Phaeophyceae	Rhodophyceae
Common name	Green algae	Brown algae	Red algae
Major pigments	Chlorophyll a, b	Chlorophyll a, c, Fucoxanthin	Chlorophyll a, d, Phycoerythrin
Stored food	Starch	Mannitol, laminarin	Floridean Starch
Cell wall	Cellulose	Cellulose and algin	Cellulose
Flagellar number & position of insertion	2–8, equal, apical	2, unequal, lateral	Absent
Habitat	Fresh water, salt water & brackish water	Fresh water (rare), salt water & brackish water	Fresh water (some), salt water (most) & brackish water


BRYOPHYTES
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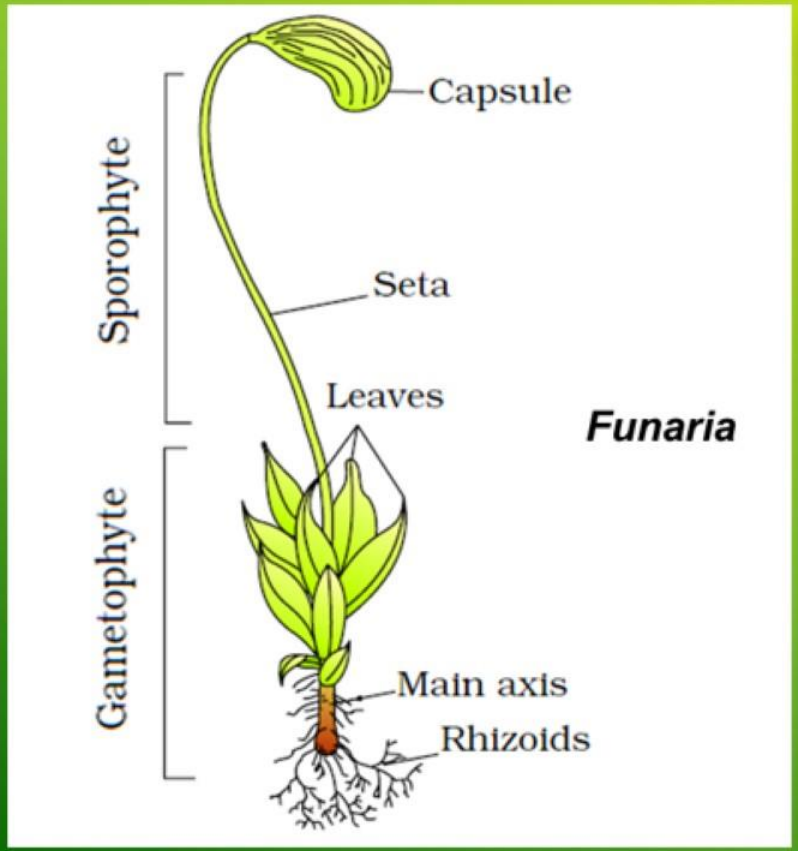
BRYOPHYTES

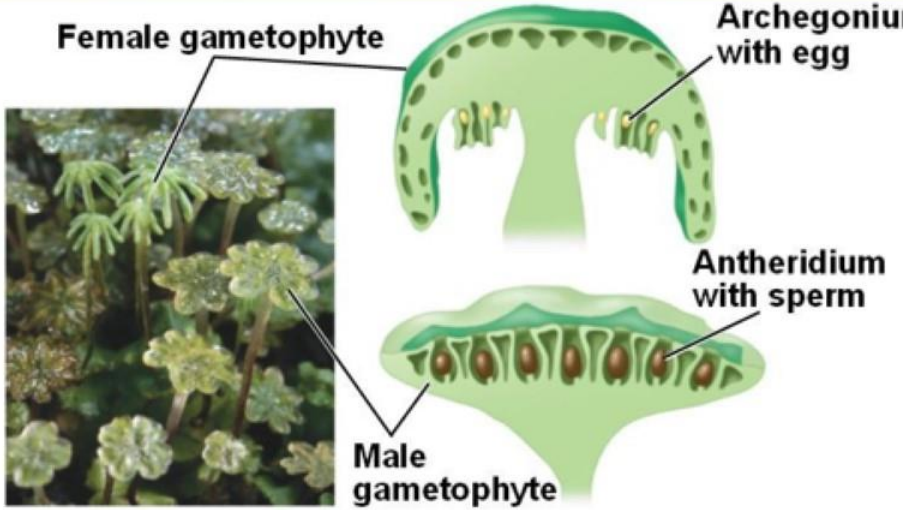
- They are called **amphibians of the plant kingdom** because they can live in soil but need water for sexual reproduction.
- They occur in damp, humid and shaded localities.

BRYOPHYTES

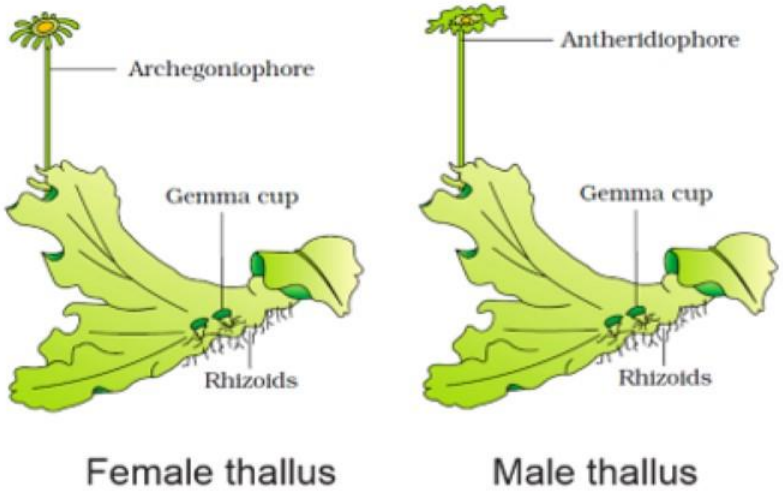


- Body is more differentiated than that of algae. It is thallus-like and prostrate or erect, and attached to the substratum by unicellular or multicellular **rhizoids.**
- They lack true roots, stem or leaves.
- They may possess root-like, leaf-like or stem-like structures.
- The main plant body is haploid. It produces gametes, hence is called a **gametophyte.**

BRYOPHYTES



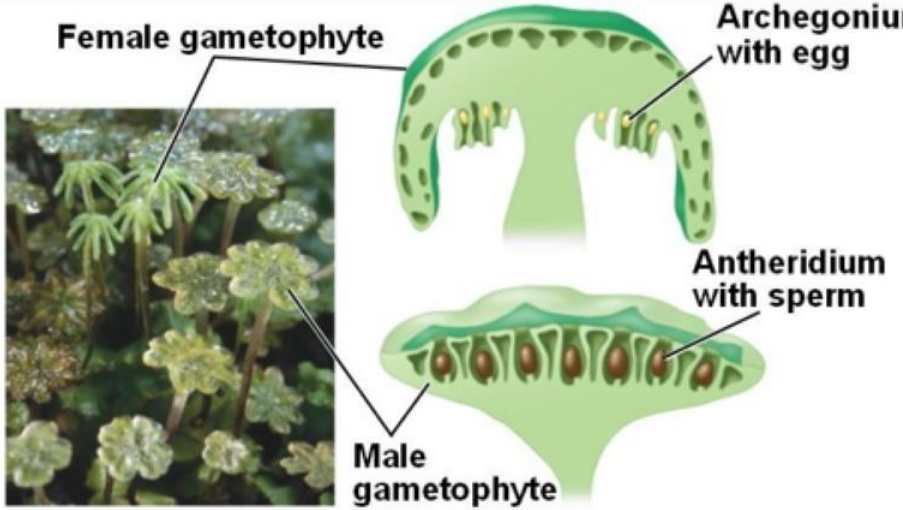
Archegonia and antheridia of *Marchantia* (a liverwort)



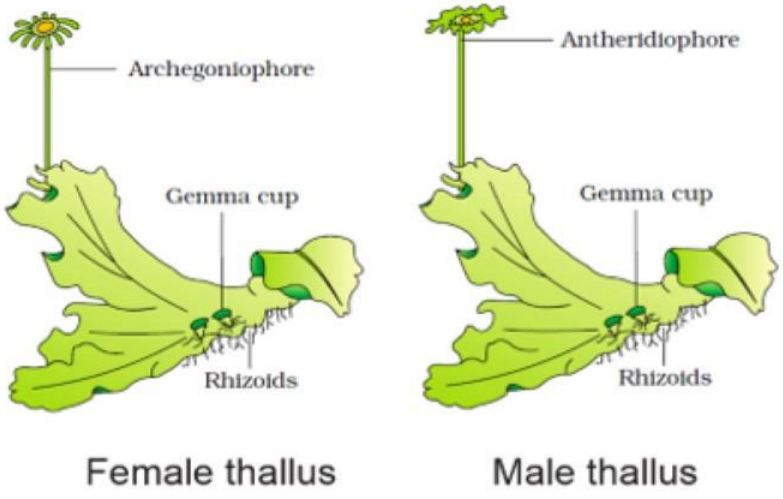
Bryophytes: A liverwort – *Marchantia*

- The sex organs in bryophytes are multicellular.
- Male sex organ **(antheridium)** produces biflagellate **antherozoids.**
- Female sex organ **(archegonium)** is flask-shaped and produces a single **egg.**

BRYOPHYTES



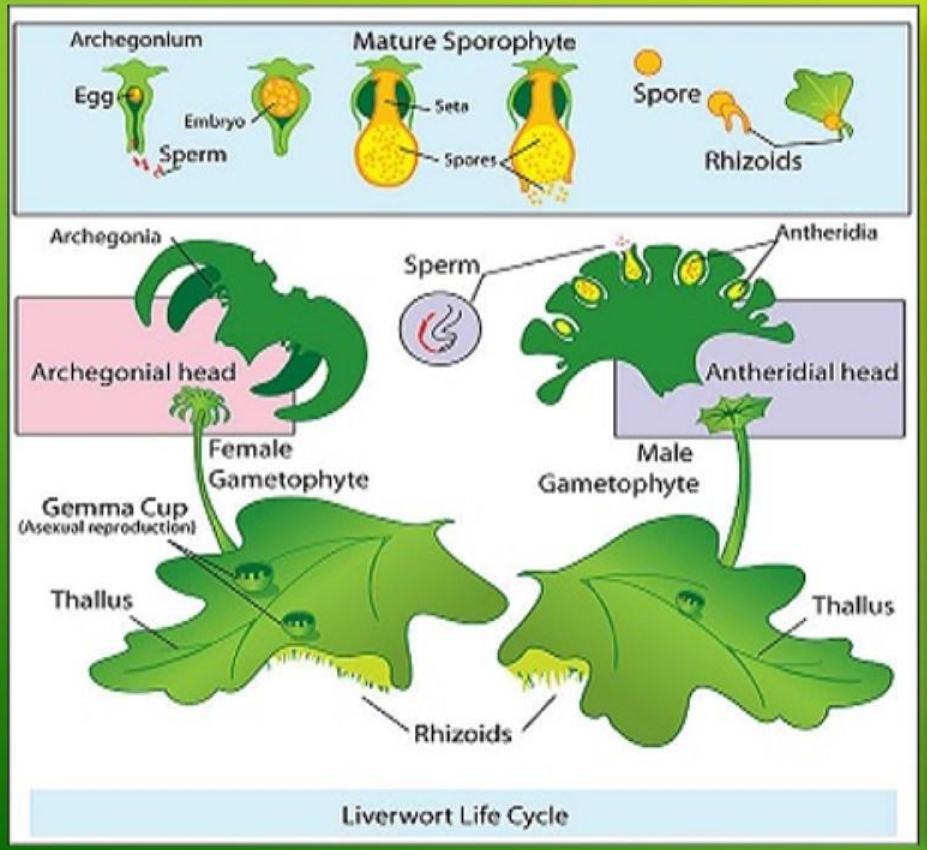
Archegonia and antheridia of *Marchantia* (a liverwort)



Bryophytes: A liverwort – *Marchantia*

- Antherozoids are released to water and meet archegonium.
- An antherozoid fuses with the egg to form **zygote.**

BRYOPHYTES



- Zygotes do not undergo meiosis immediately. They produce a multicellular body called a **sporophyte.**
- Sporophyte is not free-living but attached to the photosynthetic gametophyte and derives nourishment from it. Some cells of the sporophyte undergo meiosis to produce haploid spores. These spores germinate to form gametophyte.

BRYOPHYTES

Importance of Bryophytes

1. Some mosses provide food for herbaceous mammals, birds etc.
2. Species of *Sphagnum* (a moss) provide peat. It is used as fuel. It has water holding capacity so that used as packing material for trans-shipment of living material.

BRYOPHYTES


Primary succession


Dense mat of mosses on soil

Importance of Bryophytes

3. They are ecologically important because of their role in **plant succession** on bare rocks/soil. Mosses along with lichens decompose rocks making the substrate suitable for the growth of higher plants.
4. Since mosses form dense mats on the soil, they can prevent soil erosion.

BRYOPHYTES

Types of Bryophytes

- Liverworts

- Mosses

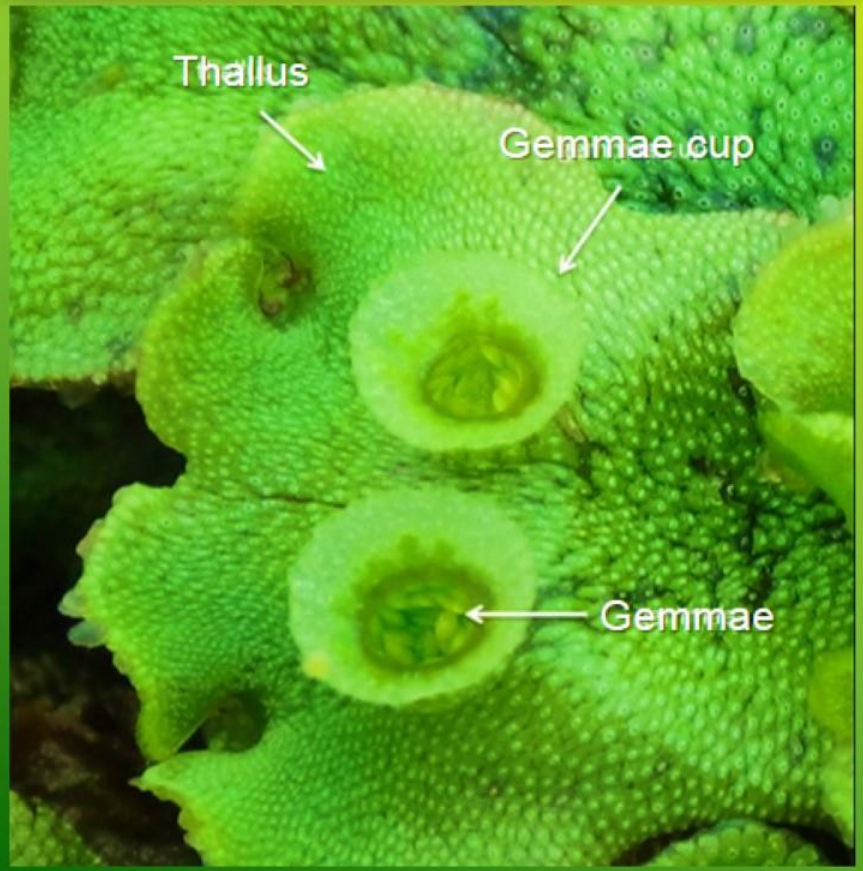
BRYOPHYTES

1. Liverworts

- They grow usually in moist, shady habitats such as banks of streams, marshy ground, damp soil, bark of trees and deep in the woods.
- Their plant body is thalloid. E.g. *Marchantia*.
- Thallus is dorsi-ventral and closely appressed to the substrate.
- The leafy members have tiny leaf-like appendages in two rows on the stem-like structures.

BRYOPHYTES

1. Liverworts



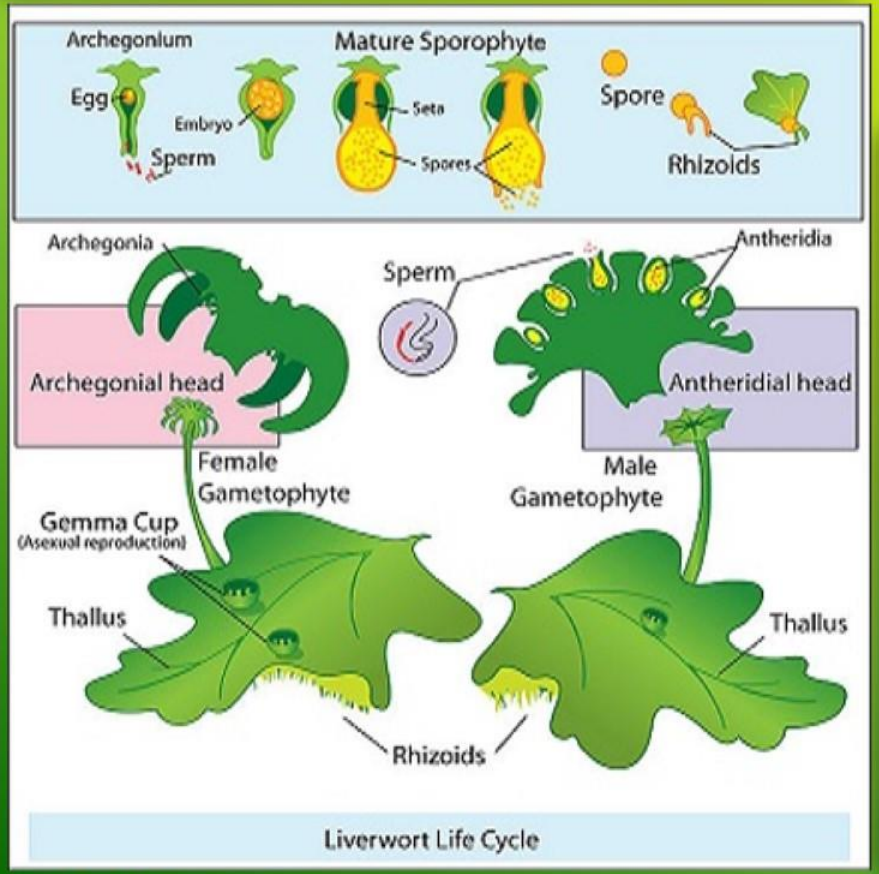
Reproduction

Asexual reproduction

- By **fragmentation** of thalli, or by the formation of **gemmae** (sing. gemma).
- Gemmae are green, multicellular, asexual buds that develop in small receptacles **(gemma cups)** on the thalli.
- The gemmae are detached from the parent body and germinate to form new individuals.

BRYOPHYTES

1. Liverworts



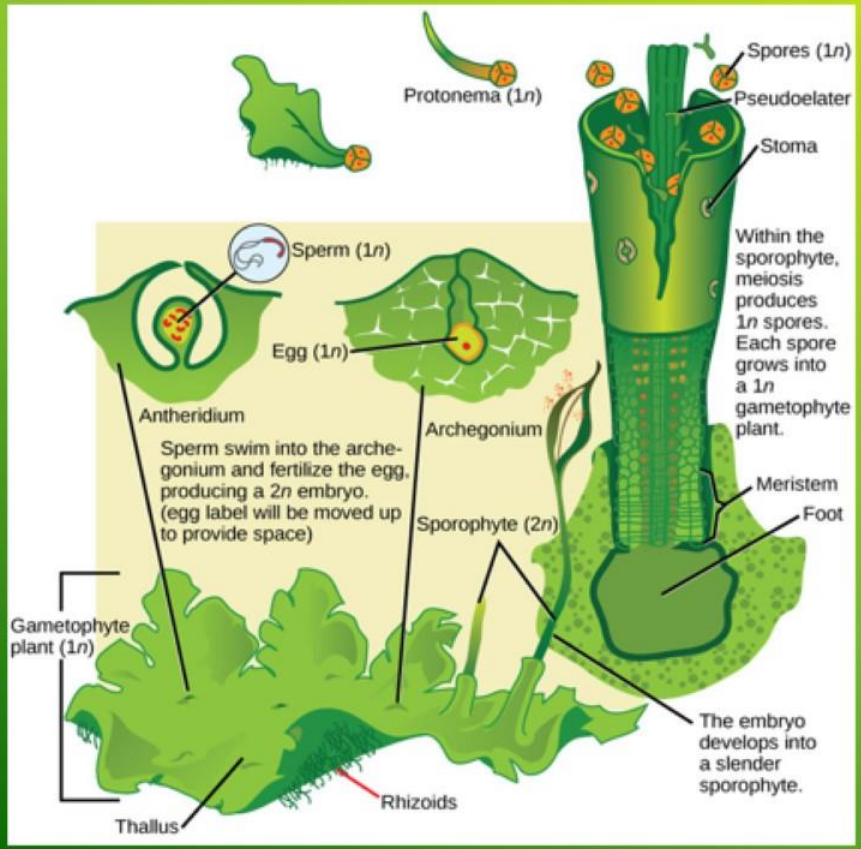
Reproduction

Sexual reproduction

- Male and female sex organs are produced on the same or different thalli.
- 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.

BRYOPHYTES

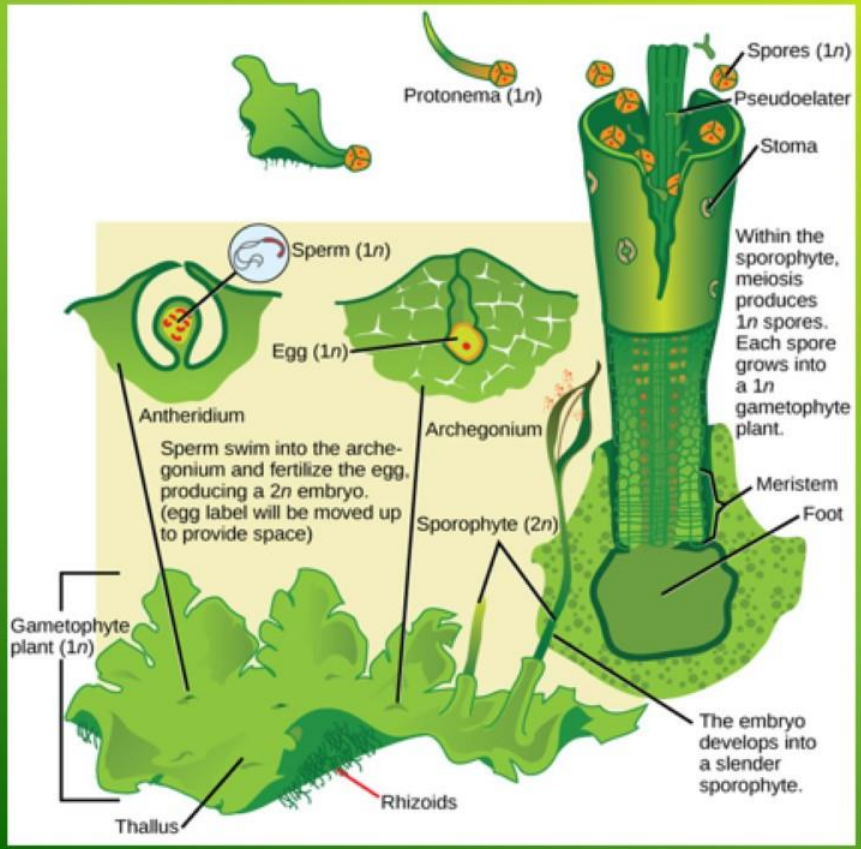
2. Mosses



- The predominant stage of the life cycle of a moss is the **gametophyte.**
- It consists of two stages:
  - **First stage**: **Protonema stage**
  - **Second stage**: **Leafy stage**

BRYOPHYTES

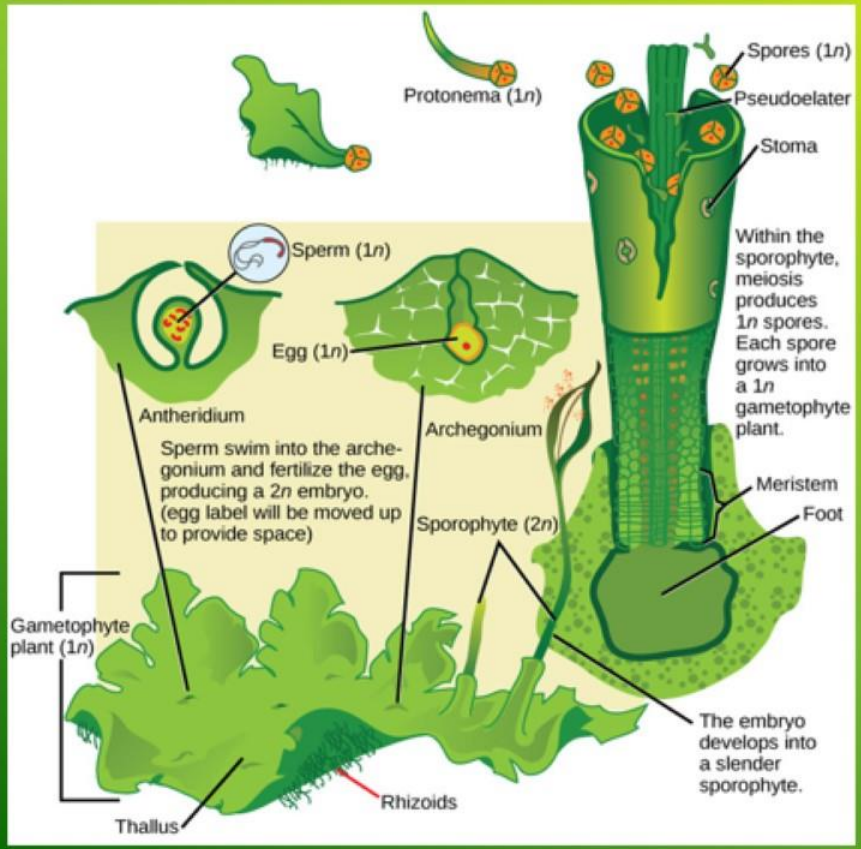
2. Mosses



1. **Protonema stage**: It develops directly from a spore. It is a creeping, green, branched and frequently filamentous stage.
2. **Leafy stage**: It develops from the secondary protonema as a lateral bud. They consist of upright, slender axes bearing spirally arranged leaves. They are attached to soil through multicellular and branched rhizoids. This stage bears the sex organs.

BRYOPHYTES

2. Mosses



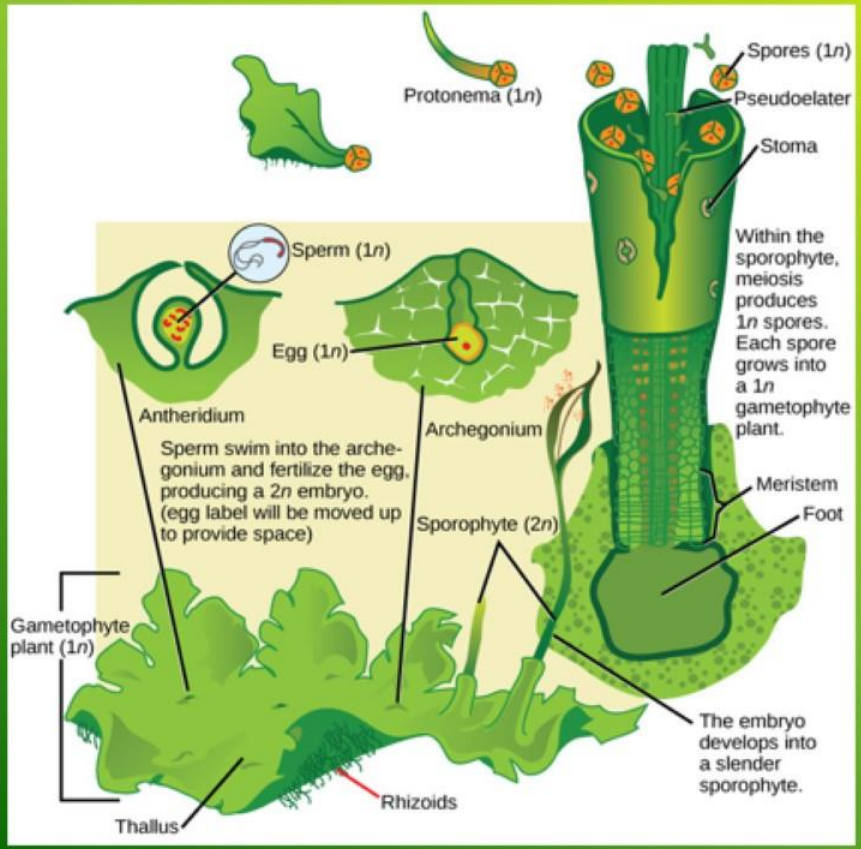
Reproduction

Vegetative reproduction

- By fragmentation and budding in the secondary protonema.

BRYOPHYTES

2. Mosses



Reproduction

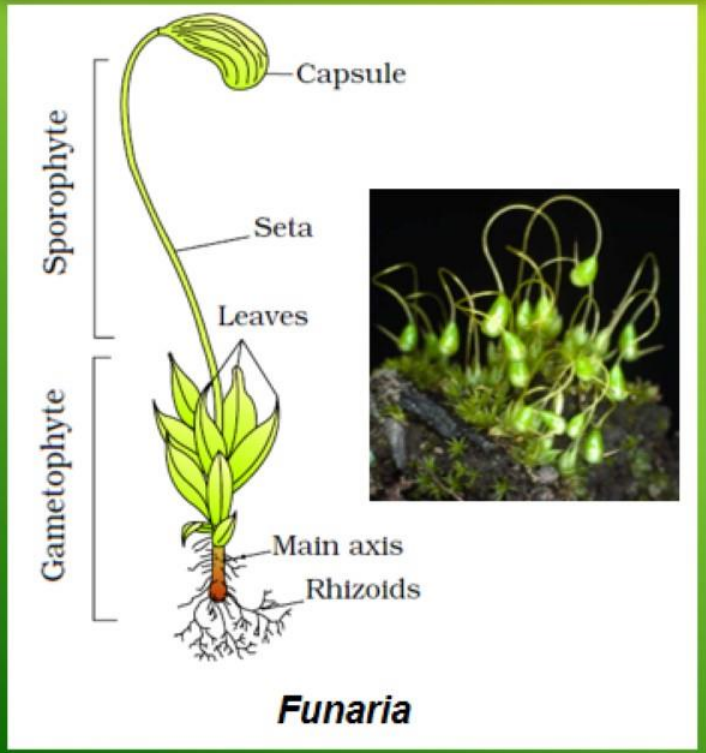
Sexual reproduction

- The antheridia & archegonia are produced at the apex of leafy shoots.
- After fertilisation, zygote develops to a sporophyte having a foot, seta & capsule.
- The sporophyte in mosses is more elaborate than that in liverworts.
- The capsule contains spores. Spores are formed after meiosis.
- Mosses have an elaborate mechanism of spore dispersal.

BRYOPHYTES

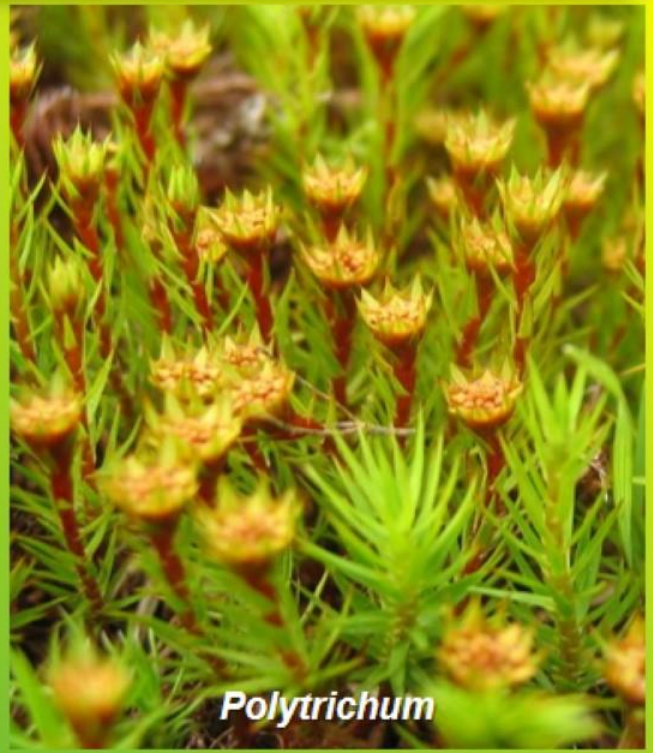
2. Mosses

Examples for Mosses



Funaria

Sphagnum



Polytrichum


PTERIDOPHYTES

PTERIDOPHYTES

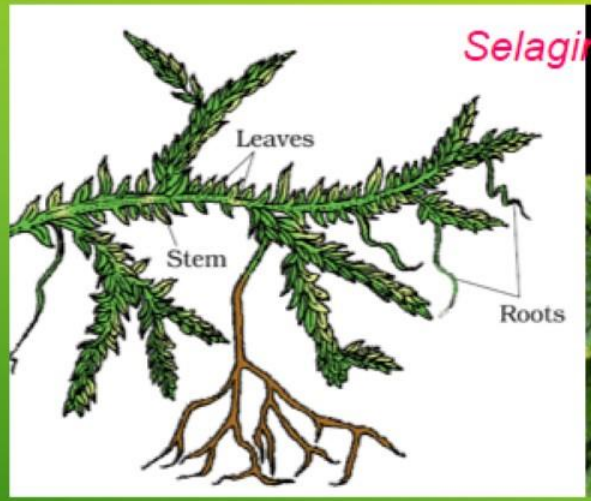

A Horsetail

They include **horsetails** and **ferns.**


Fern

- They are found in cool, damp, shady places. Some flourish well in sandy-soil conditions.
- Evolutionarily, they are the **first terrestrial plants to possess vascular tissues** (xylem & phloem).

PTERIDOPHYTES



- In bryophytes, the dominant phase is the gametophyte. In pteridophytes, the dominant phase (main plant body) is a **sporophyte.** It is differentiated into **true root, stem** and **leaves.** These organs have well-differentiated vascular tissues.
- The leaves in pteridophyta are small **(microphylls)** as in *Selaginella* or large **(macrophylls)** as in ferns.

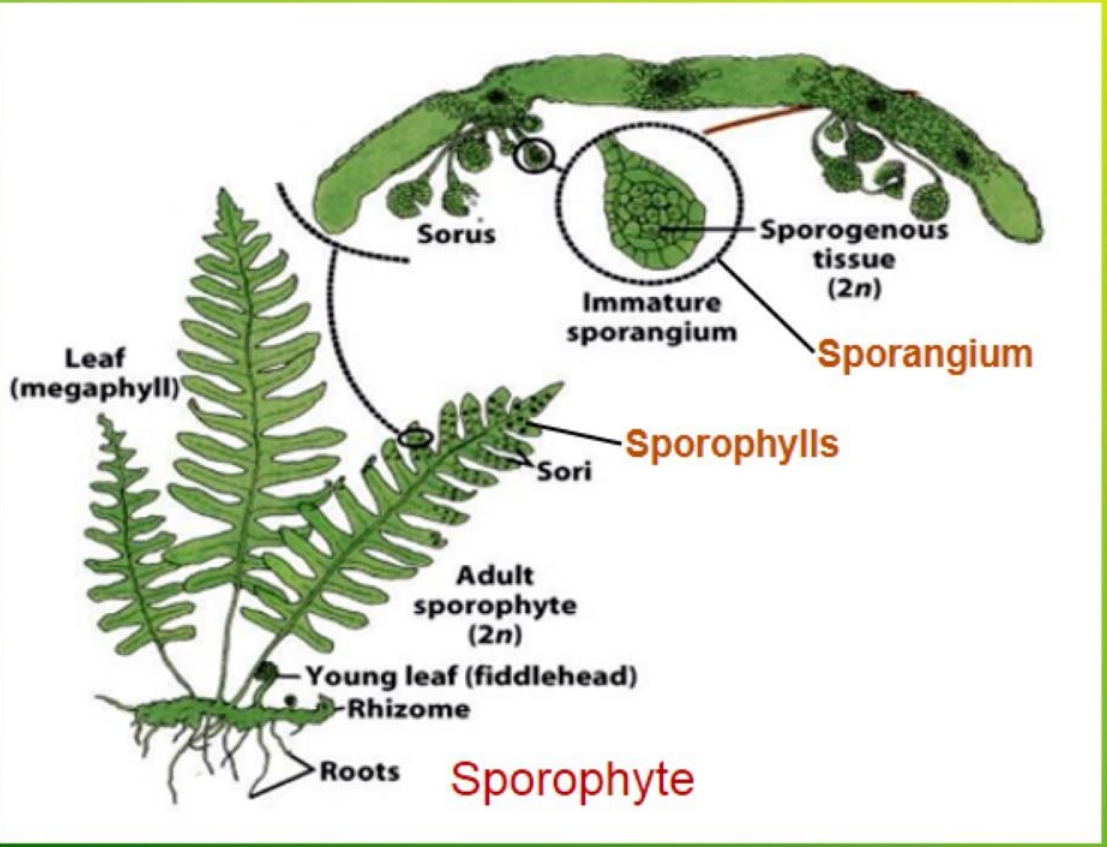
PTERIDOPHYTES: ECONOMIC IMPORTANCE

Some ferns having medicinal value

Some ornamental ferns

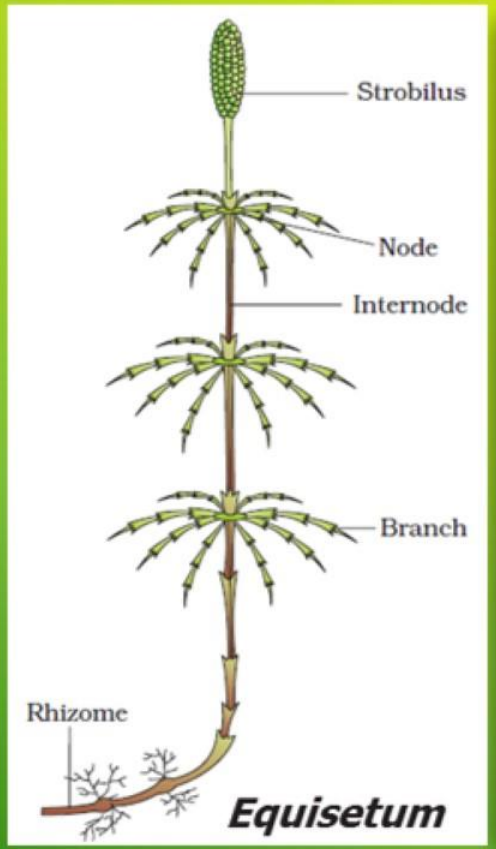
- They are used for **medicinal purposes.**
- They are used as **soil–binders.**
- They are grown as **ornamentals.**

PTERIDOPHYTES: REPRODUCTION



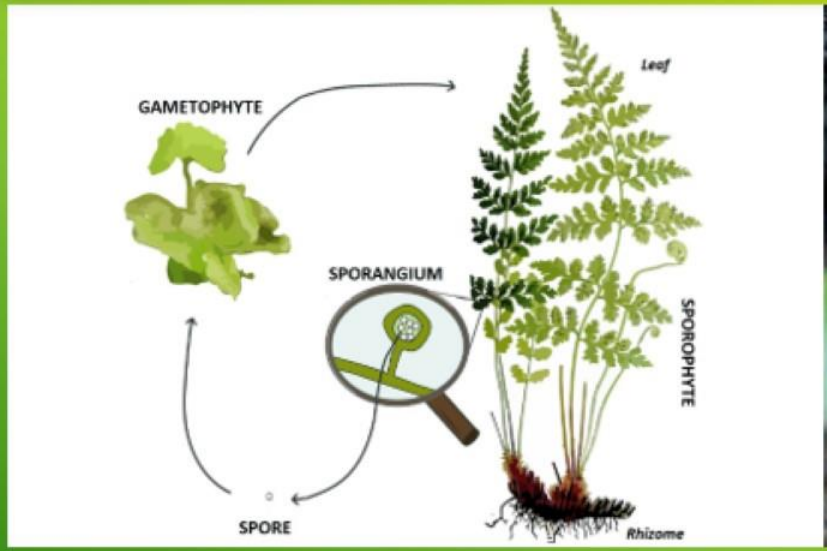
- The sporophytes bear **sporangia** that are subtended by leaf-like appendages called **sporophylls**.

PTERIDOPHYTES: REPRODUCTION



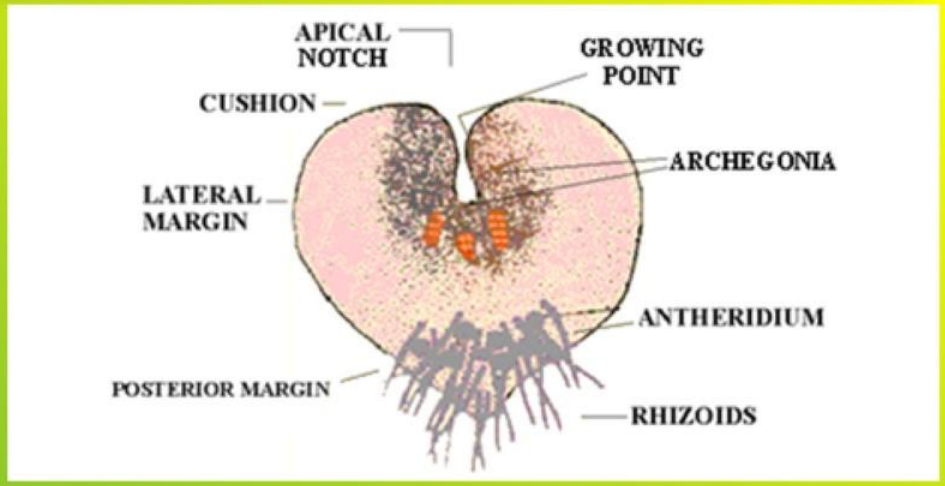
- In some cases, sporophylls form distinct compact structures called **strobili or cones** (E.g. *Selaginella, Equisetum*).

PTERIDOPHYTES: REPRODUCTION



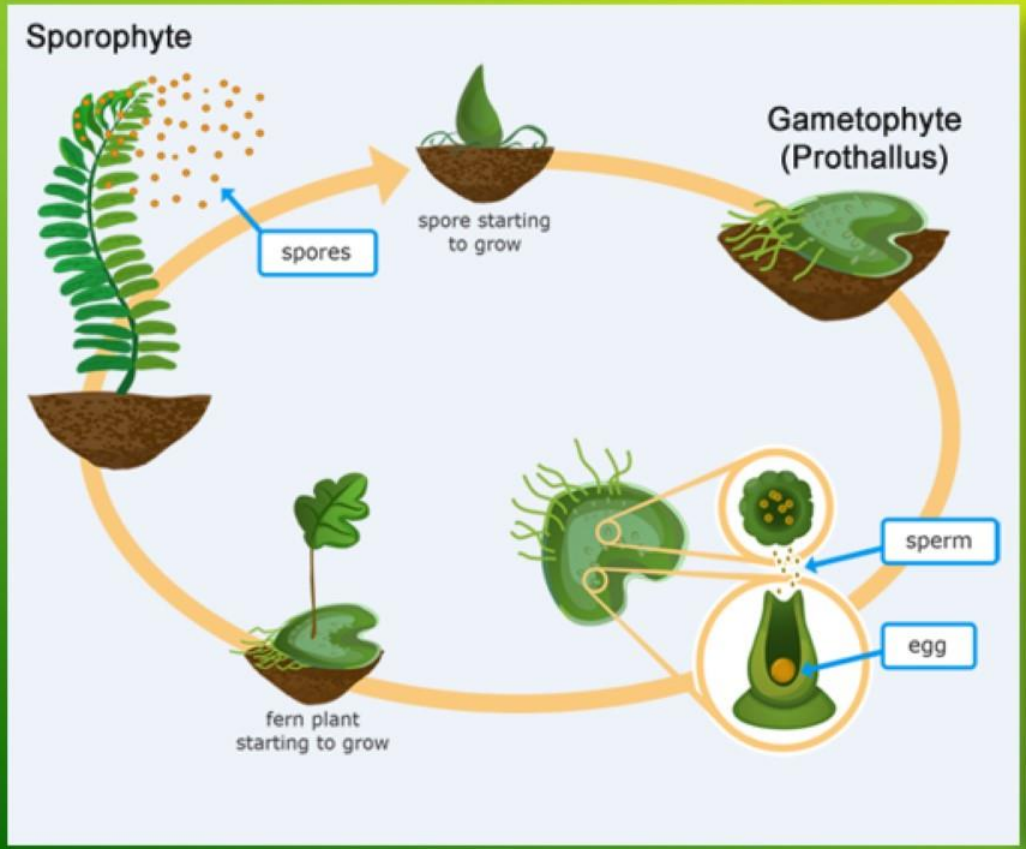
- Sporangia produce **spores** by meiosis in spore mother cells.
- The spores germinate to give inconspicuous, small, multicellular, free-living, mostly photosynthetic thalloid gametophytes called **prothallus.**

PTERIDOPHYTES: REPRODUCTION



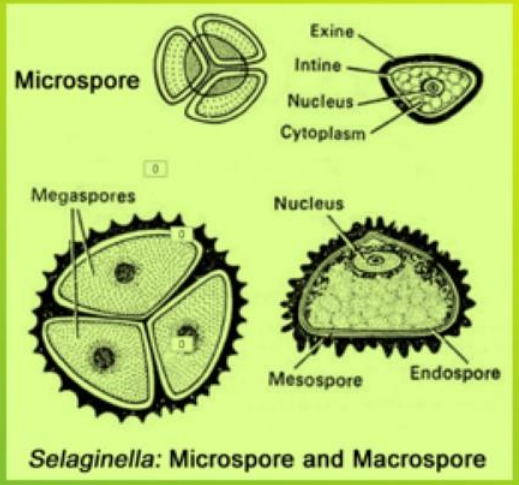
- Prothallus requires cool, damp, shady places to grow. Also, it needs water for fertilization. So, the spread of pteridophytes is limited and restricted to narrow geographical regions.
- The gametophytes (prothallus) bear male and female sex organs called **antheridia** and **archegonia,** respectively.

PTERIDOPHYTES: REPRODUCTION



- Water is needed for transfer of **antherozoids** (male gametes from antheridia) to the mouth of archegonium.
- Antherozoid fuses with the egg in the archegonium to form **zygote.**
- Zygote develops to a multicellular well–differentiated sporophyte.

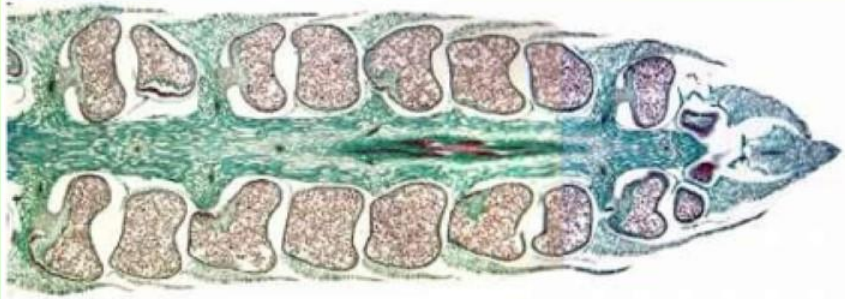
PTERIDOPHYTES: REPRODUCTION



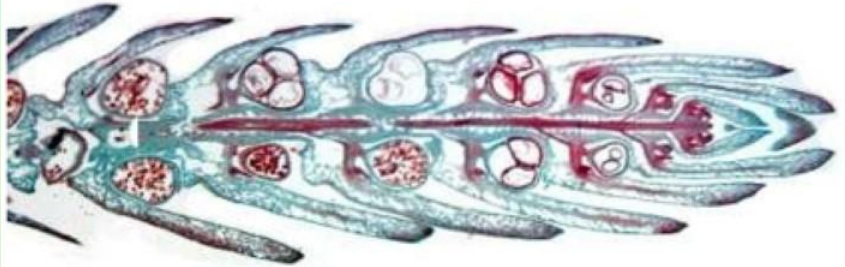
Selaginella: Microspore and Macrospore

- Most of the pteridophytes produce similar kinds of spores **(homosporous plants).**
- Others produce two kinds of spores, **macro (mega) & micro spores.** They are **heterosporous.** E.g. *Selaginella* & *Salvinia.*

PTERIDOPHYTES: REPRODUCTION



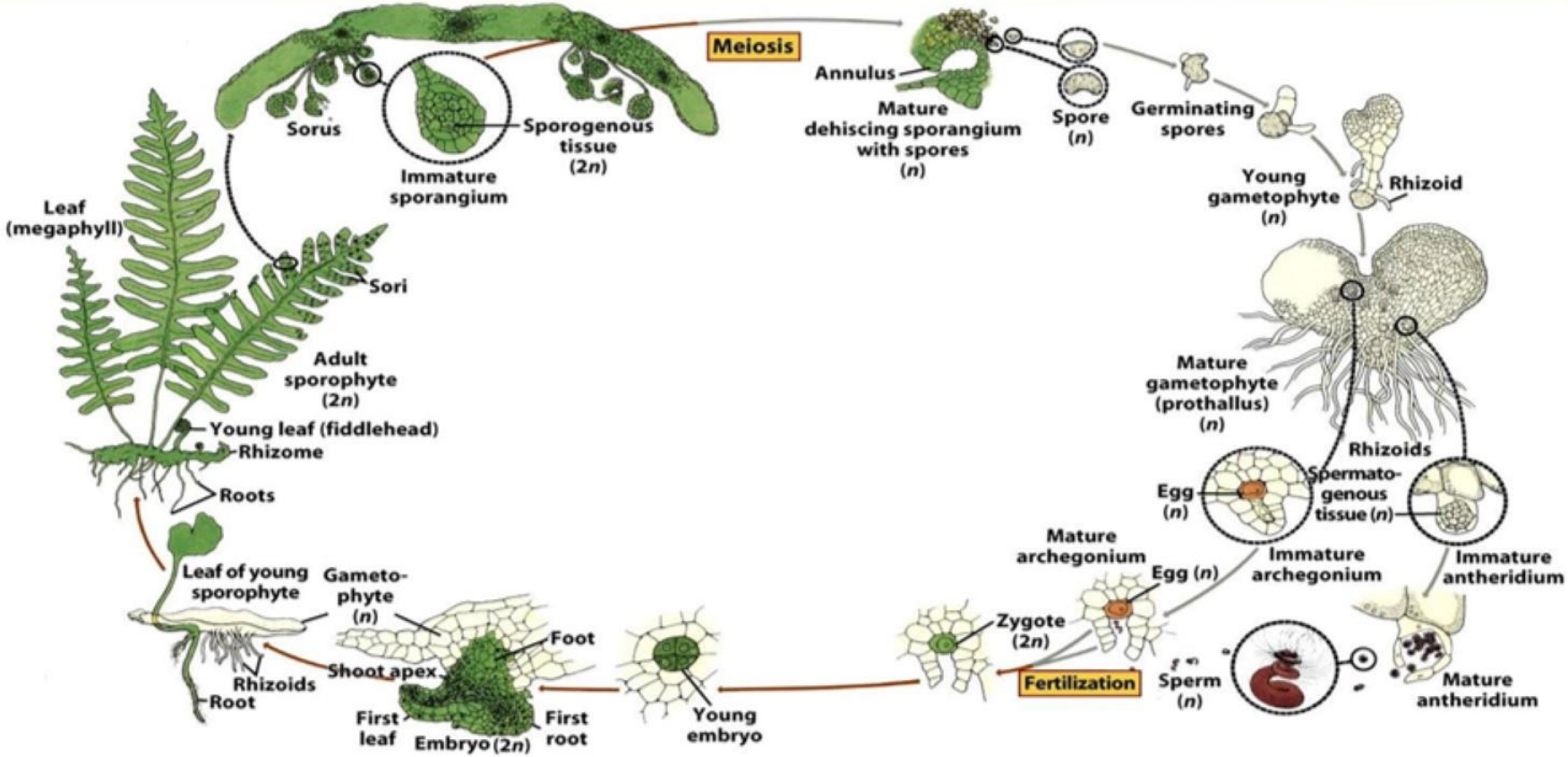
Lycopodium cone is Homosporous



Selaginella cone is Heterosporous

- The **megaspores & microspores** germinate and give rise to female and male gametophytes, respectively. The female gametophytes are retained on the parent sporophytes for variable periods.
- Within female gametophytes, zygotes develop into young embryos. This event is a precursor to the **seed habit.** It is considered as an important step in evolution.

PTERIDOPHYTES: REPRODUCTION



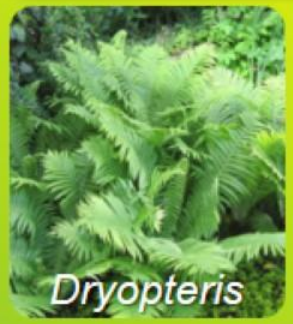
CLASSES OF PTERIDOPHYTES

1 Psilopsida

2 Lycopsida

3 Sphenopsida

4 Pteropsida




GYMNOSPERMS
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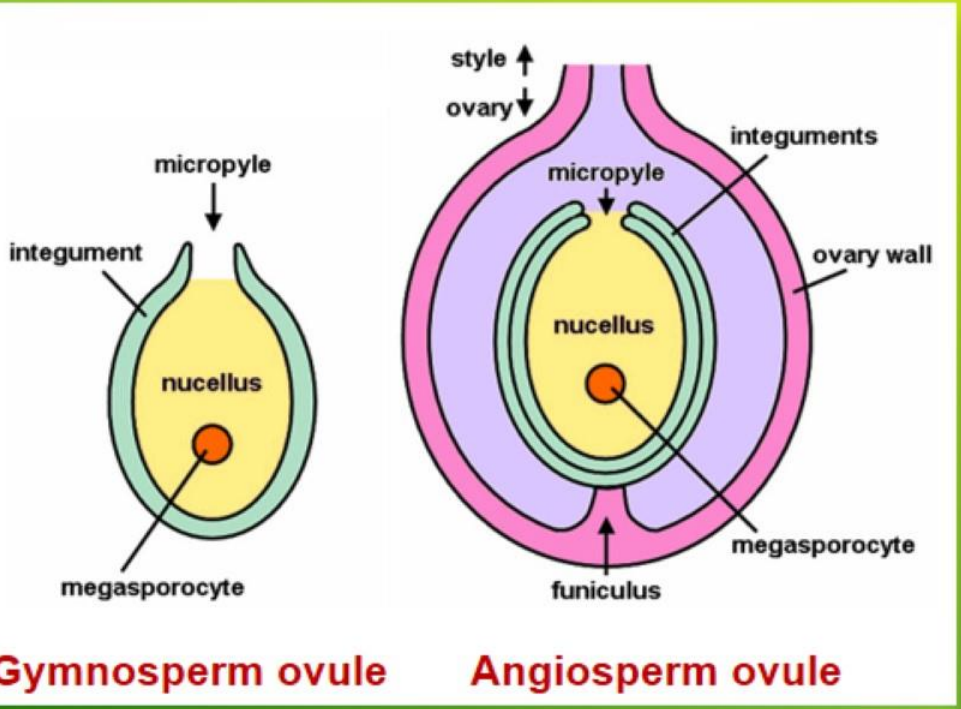
GYMNOSPERMS

- **Gymnosperms** (*gymnos:* naked, *sperma:* seeds) are plants in which the **ovules are not enclosed by ovary wall** and remain exposed before and after fertilization.
- **Seeds** that develop post-fertilization are **not covered (naked).**

GYMNOSPERMS



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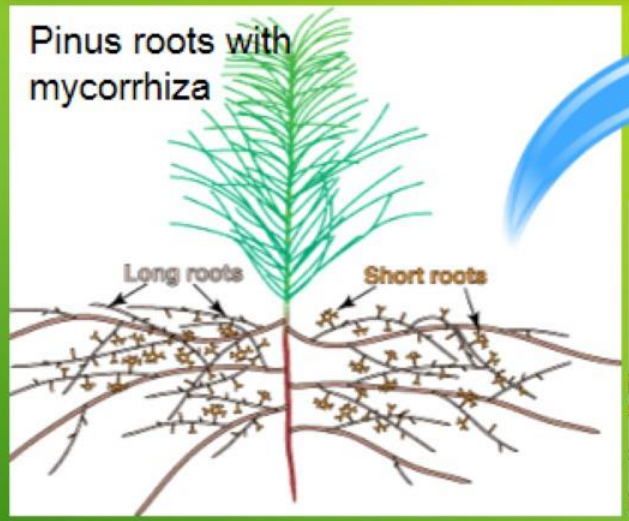
See the comparison of gymnosperm ovule and Angiosperm ovule

GYMNOSPERMS

Sequoia

- They include medium–sized trees or tall trees and shrubs.
- The gymnosperm, **Sequoia (giant redwood)** is the tallest tree species.

GYMNOSPERMS



- The roots are generally **tap roots.**
- Roots in some genera have fungal association in the form of **mycorrhiza** *(E.g. Pinus).*

GYMNOSPERMS

- In plants like *Cycas*, small specialized roots **(coralloid roots)** are associated with **N_2– fixing cyanobacteria.**

GYMNOSPERMS

- Stems are **unbranched** (*Cycas*) or **branched** (*Pinus, Cedrus*).
- Leaves are **simple** or **compound.** They are well-adapted to withstand extreme temperature, humidity and wind.
- In *Cycas,* the **pinnate leaves** persist for a few years.
- In conifers (*Pinus, Cedrus* etc.), the **needle-like leaves** reduce the surface area. Their thick cuticle & sunken stomata also help to reduce water loss.

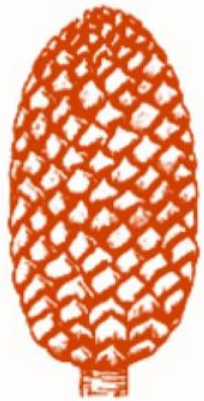
GYMNOSPERMS

Reproduction

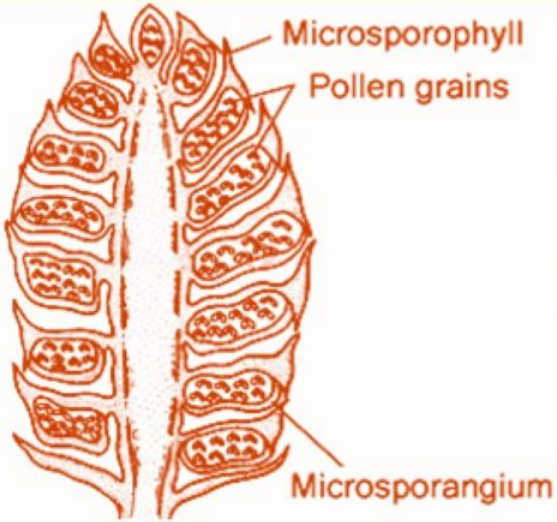
- Gymnosperms are **heterosporous.** They produce haploid **microspores** and **megaspores.**
- Some leaves are modified into **sporophylls.** They are compactly and spirally arranged along an axis to form **lax or strobili or cones.**

GYMNOSPERMS

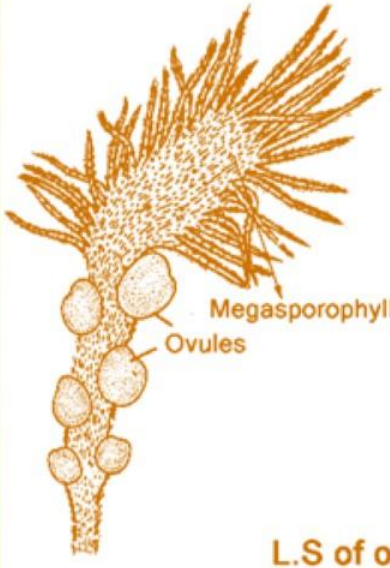
Reproduction



Cycas
Male cone

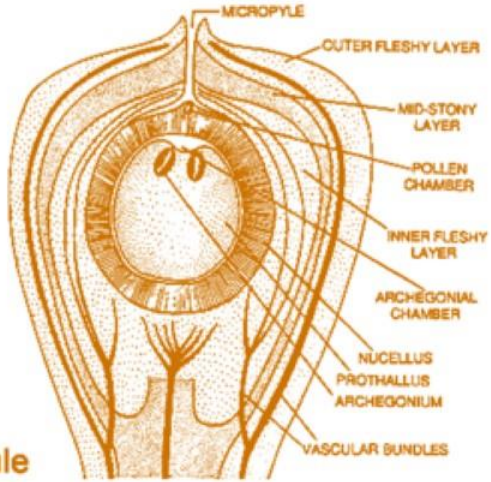


Male cone: Longitudinal section



L.S of ovule

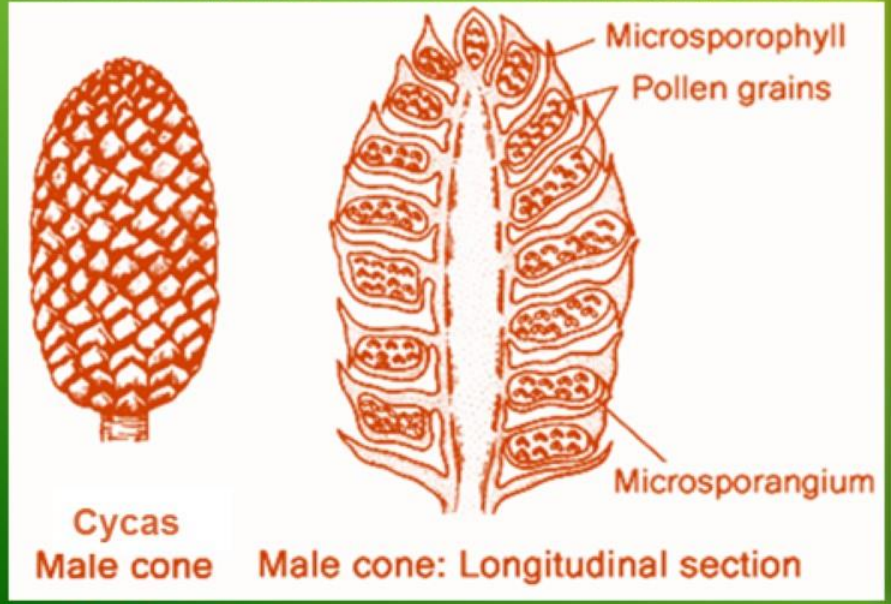
Cycas: Female cone



- Sporophylls bear **sporangia** in which spores are produced.
- Sporophylls are 2 types: **Microsporophylls & Megasporophylls**

GYMNOSPERMS

Reproduction

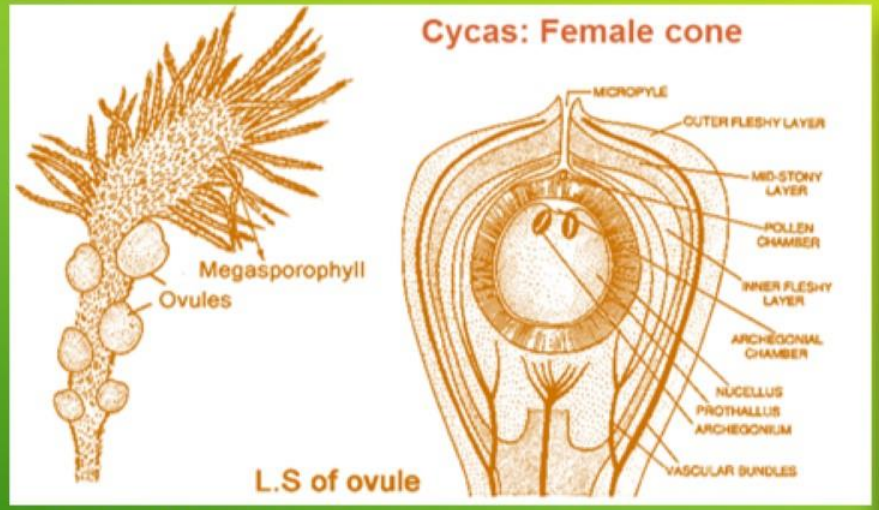


a. Microsporophylls

- They are arranged to **male strobili (microsporangiate).**
- They bear **microsporangia.**
- The microspores develop into male gametophytes. It is highly reduced and confined to only a limited number of cells. This gametophyte is called a **pollen grain.**
- The pollen grains are developed within the microsporangia.

GYMNOSPERMS

Reproduction

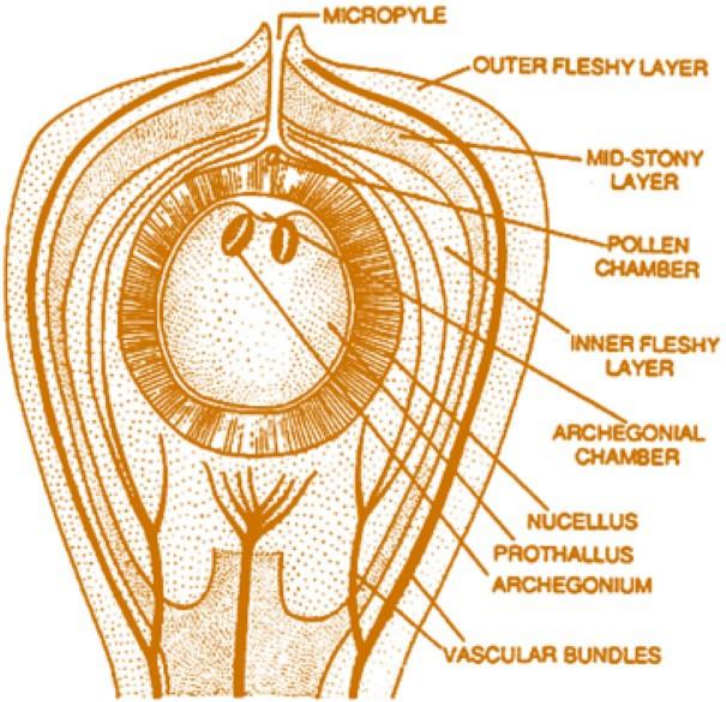


b. Megasporophylls

- They are arranged to female strobili (macrosporangiate).
- They bear megasporangia (ovules).
- Megasporangium mainly consists of a body called **nucellus.** It is protected by envelopes.
- The megaspore mother cell is differentiated from a cell of the nucellus.

GYMNOSPERMS

Reproduction



L.S of ovule

b. Megasporophylls

- Megaspore mother cell undergoes meiosis 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.**
- The multicellular female gametophyte is also retained within megasporangium.

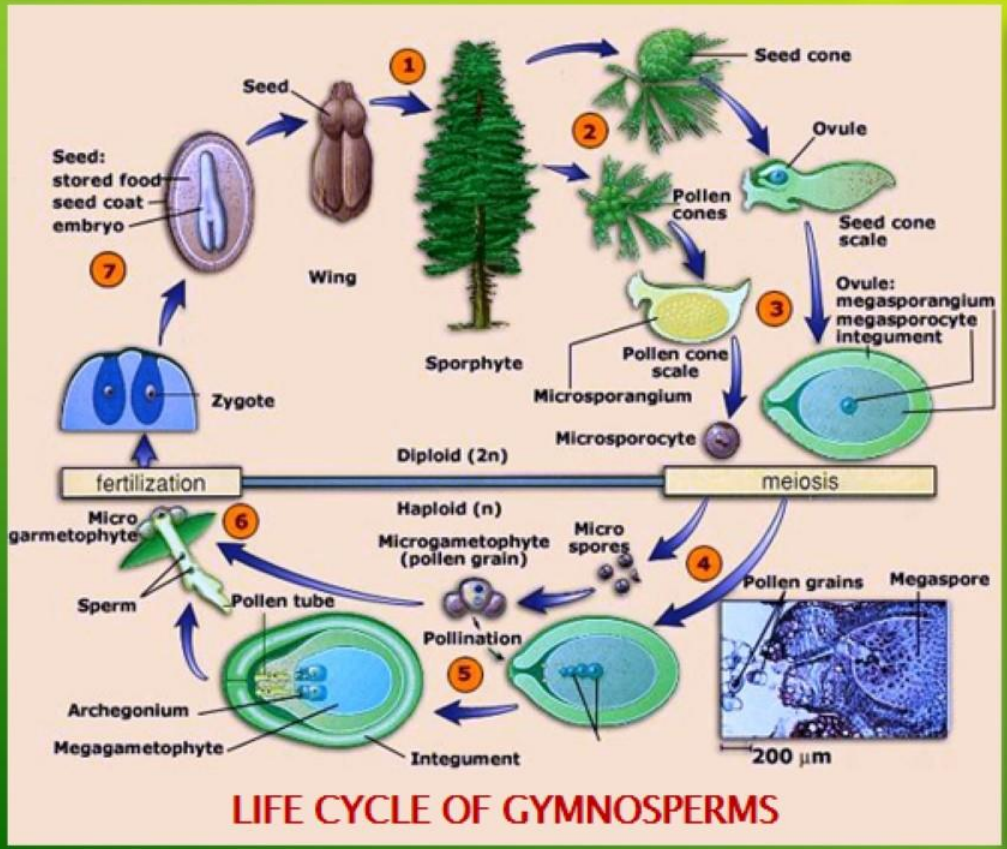
GYMNOSPERMS

Reproduction

- The male or female cones may be borne on the same tree (*Pinus*) or on different trees (*Cycas*).
- 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.

GYMNOSPERMS

Reproduction



- The pollen grain released from the microsporangium are carried in air currents and meet the opening of the ovules.
- The pollen tube carrying the male gametes grows towards archegonia in the ovules and discharges their contents near the mouth of the archegonia.
- After fertilization, zygote develops into an embryo and the ovules into seeds.


ANGIOSPERMS
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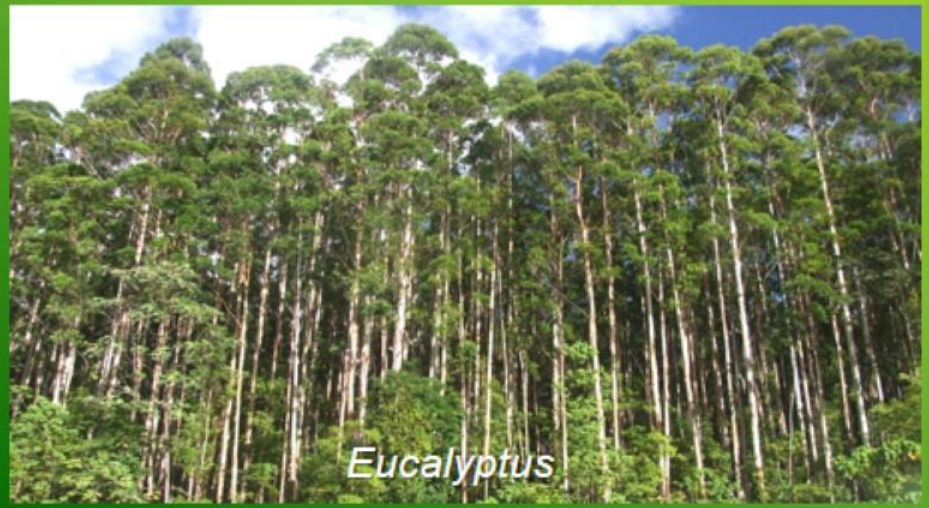
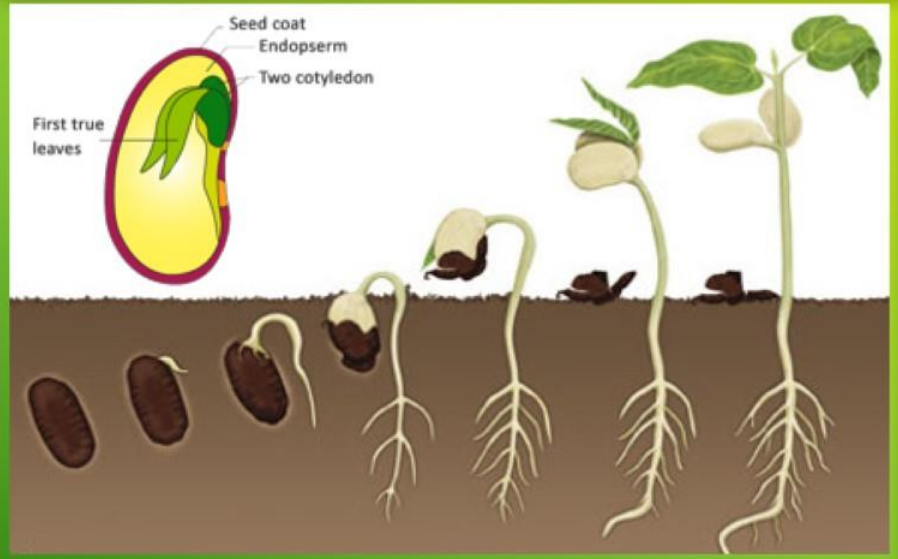
ANGIOSPERMS (FLOWERING PLANTS)



- Exceptionally large group of plants.
- They range in size from tiny, almost microscopic *Wolffia* to tall trees of *Eucalyptus* (over 100 metres).
- They are divided into two classes:
  - Dicotyledons
  - Monocotyledons

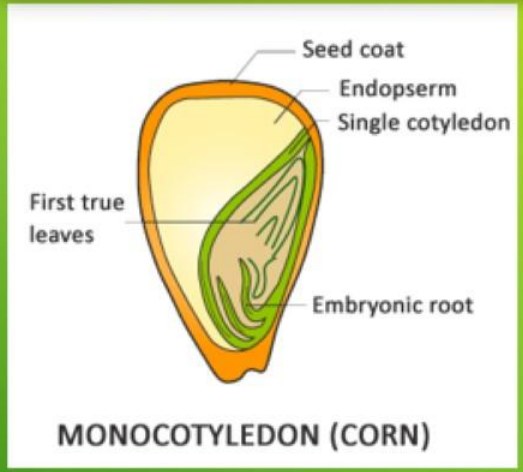
ANGIOSPERMS (FLOWERING PLANTS)

Dicotyledons



- Have 2 cotyledons in seeds.
- Reticulate venations in leaves.
- Tetramerous or pentamerous flowers (4 or 5 members in each floral whorl).

ANGIOSPERMS (FLOWERING PLANTS) Monocotyledons

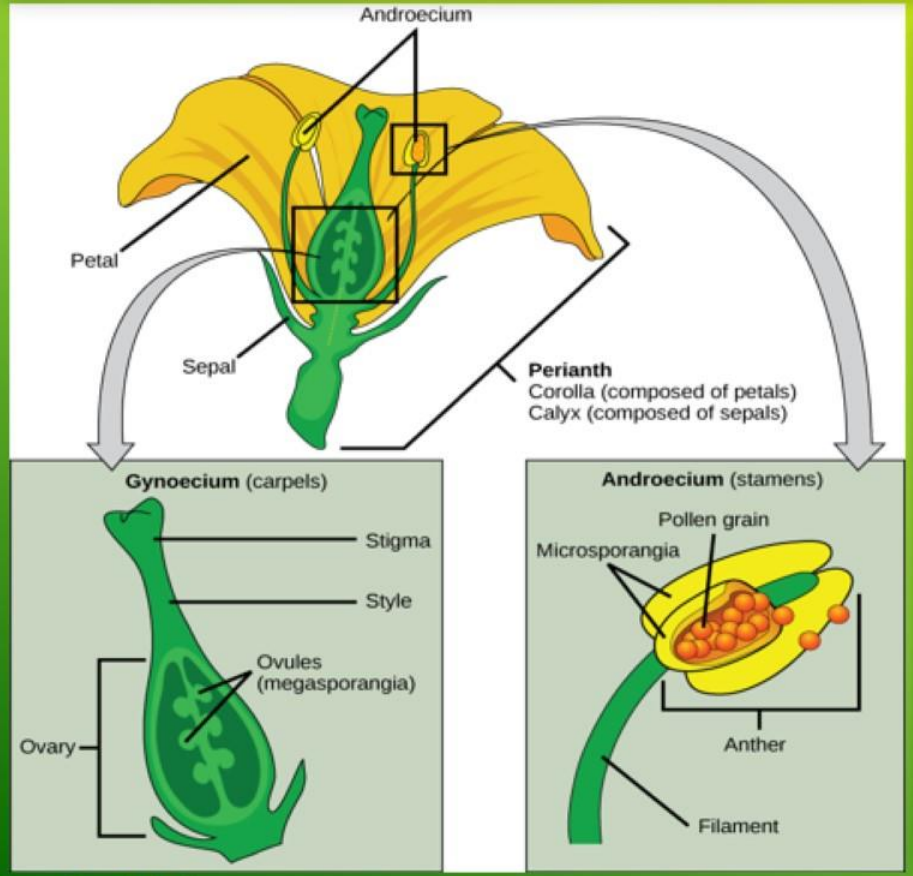


MONOCOTYLEDON (CORN)

- Have only one cotyledon.
- Parallel venation in leaves.
- Trimerous flowers (3 members in each floral whorl).

ANGIOSPERMS (FLOWERING PLANTS)

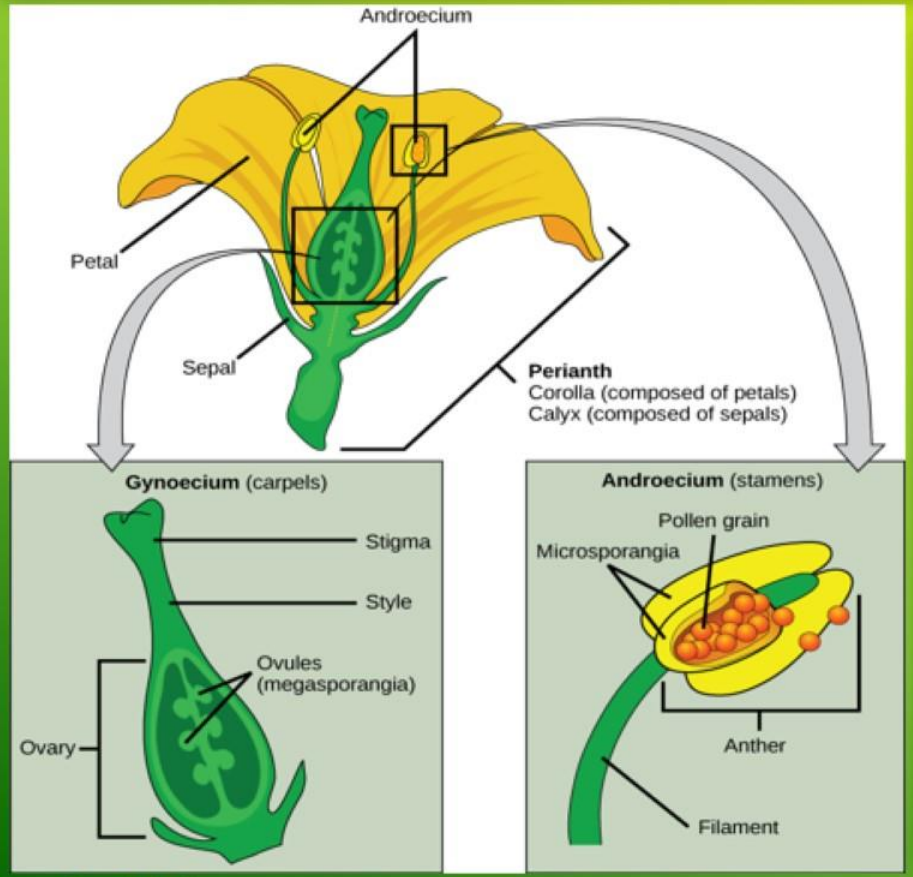
Reproduction



- Flower is the reproductive structure.
- Male sex organ in a flower is the stamen.
- Each stamen consists of a filament with an anther at the tip.
- Within the anthers, the pollen mother cell divides by meiosis to produce microspores which matures into pollen grains.

ANGIOSPERMS (FLOWERING PLANTS)

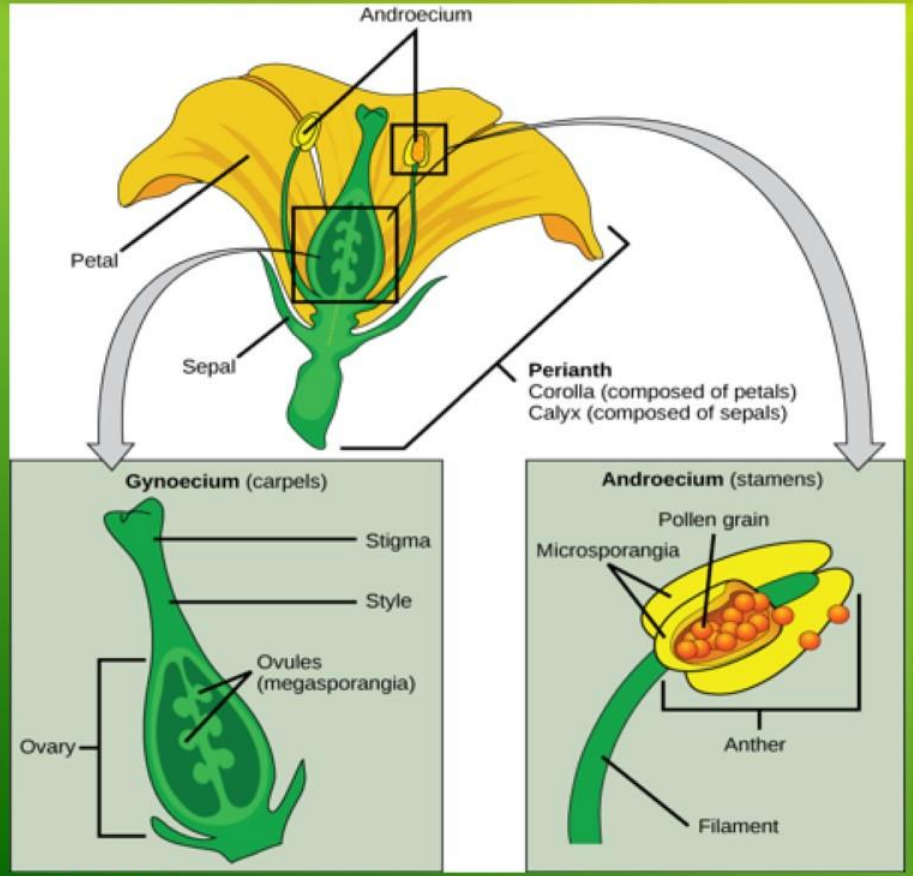
Reproduction



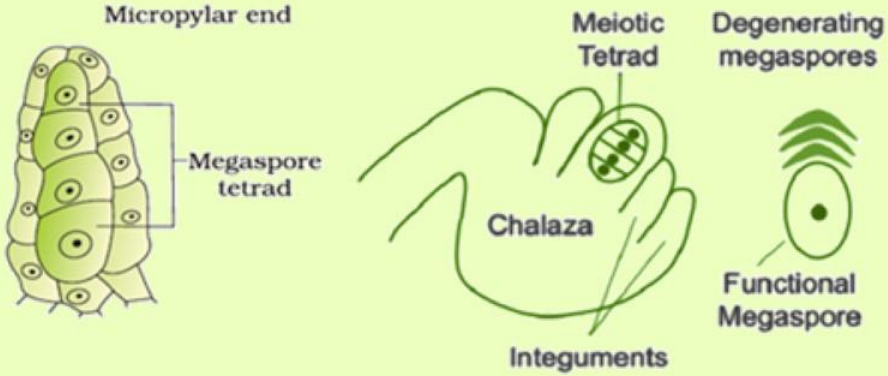
- Female sex organ in a flower is the pistil.
- It consists of a swollen ovary at its base, a long slender style & stigma.
- Ovary contains ovules.

ANGIOSPERMS (FLOWERING PLANTS)

Reproduction

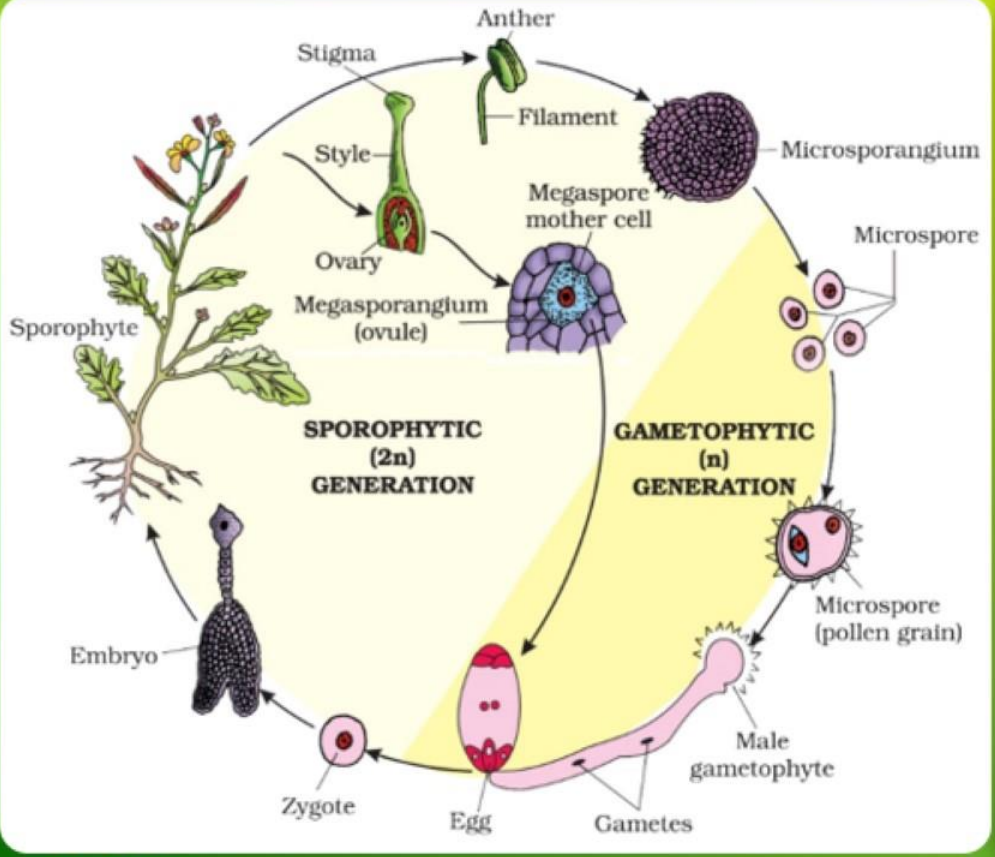


- An ovule has a megaspore mother cell that undergoes meiosis to form 4 haploid megaspores.
- 3 of them degenerate and one divides to form embryo sac.

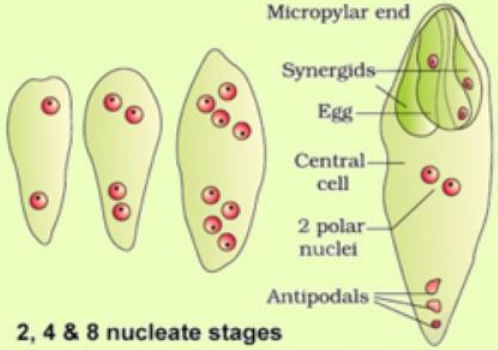


ANGIOSPERMS (FLOWERING PLANTS)

Reproduction



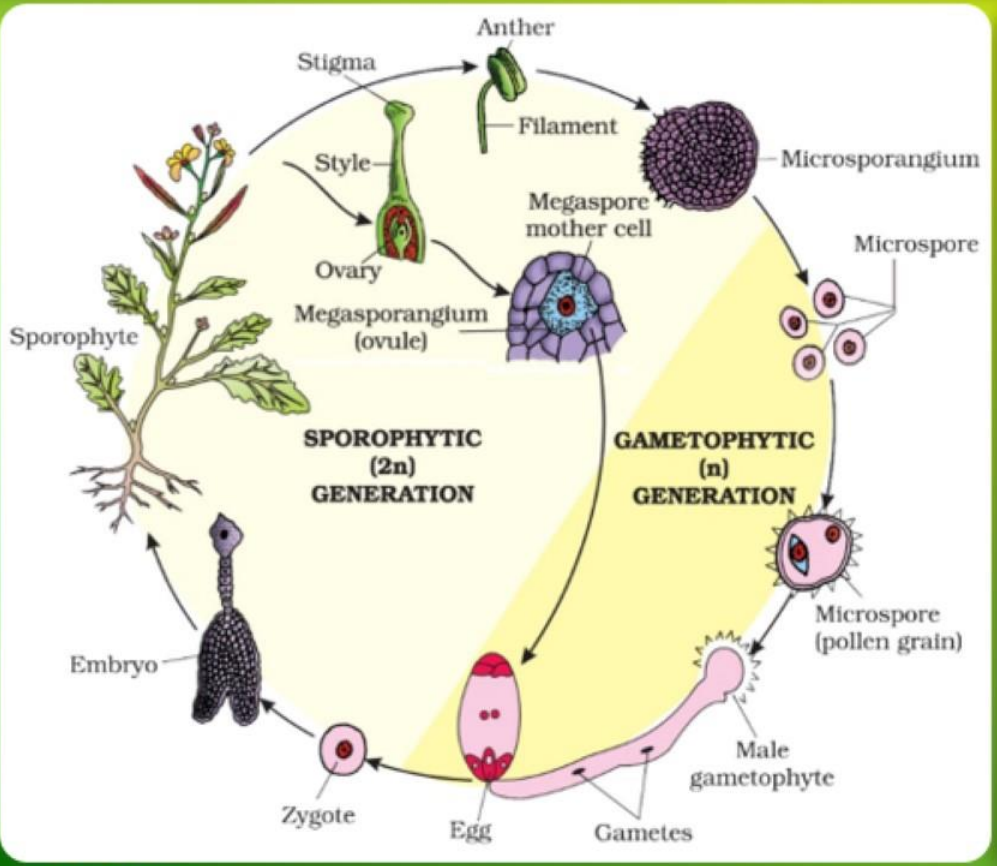
- Each embryo-sac has a three-celled egg apparatus (one egg cell & two synergids), three antipodal cells and two polar nuclei.
- The polar nuclei eventually fuse to produce a secondary nucleus (2n).



2, 4 & 8 nucleate stages
embryo sac & a mature embryo sac

ANGIOSPERMS (FLOWERING PLANTS)

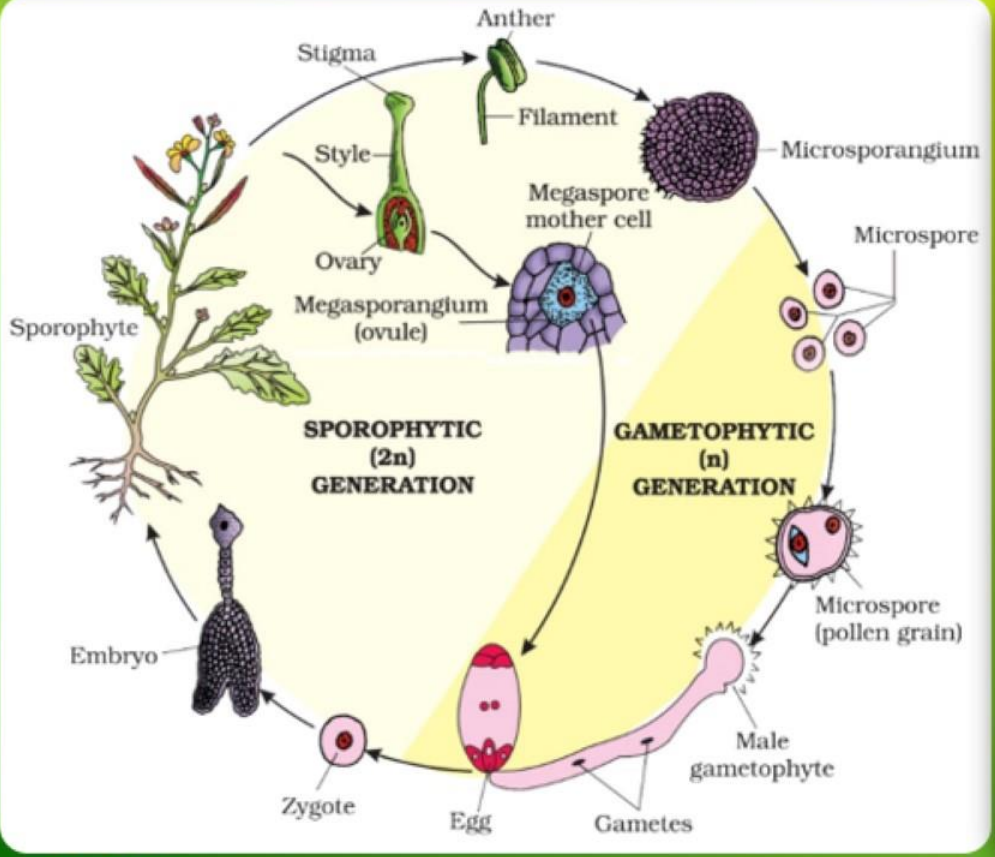
Reproduction



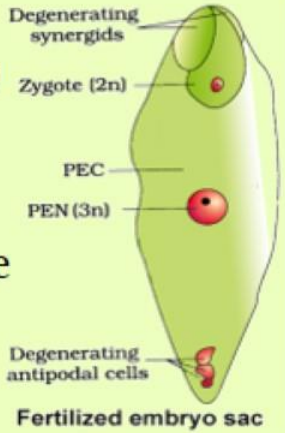
- Pollen grains are dispersed from the anthers and carried by wind or other agencies to the stigma of a pistil. It is called pollination.
- The pollen grains germinate on the stigma and the resulting pollen tubes grow through the tissues of stigma and style and reach the ovule.

ANGIOSPERMS (FLOWERING PLANTS)

Reproduction

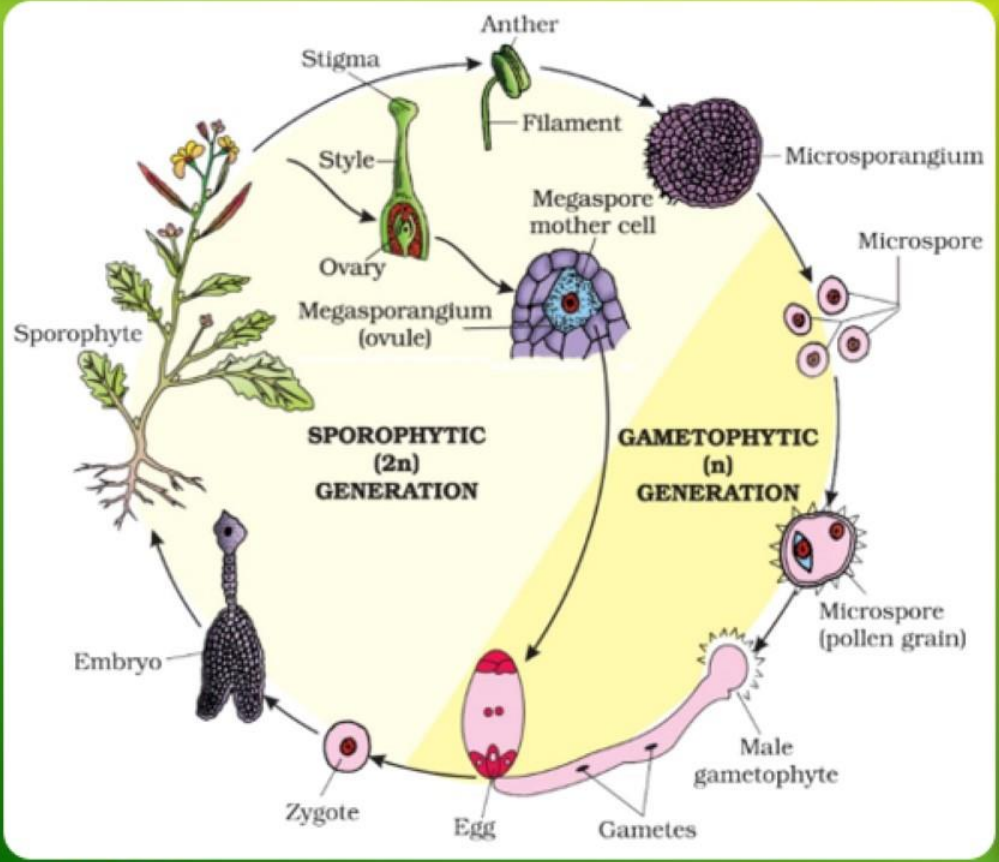


- The pollen tubes enter the embryo sac where two male gametes are discharged. One male gamete fuses with egg cell to form zygote (syngamy).
- The other male gamete fuses with diploid secondary nucleus to produce triploid primary endosperm nucleus (PEN).



ANGIOSPERMS (FLOWERING PLANTS)

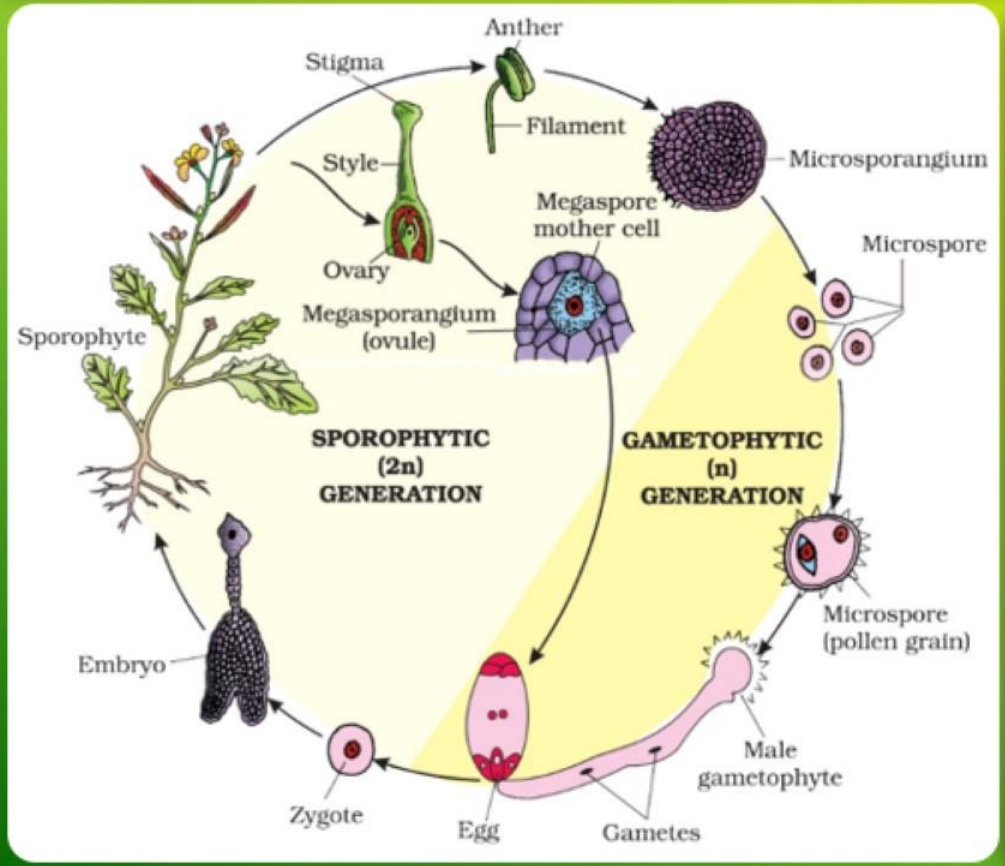
Reproduction



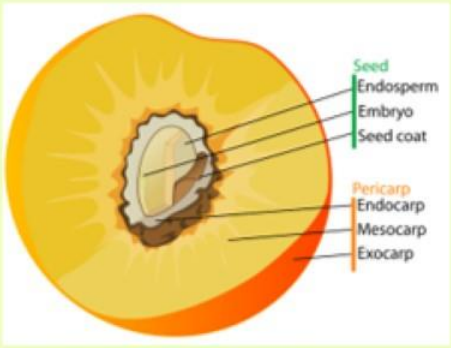
- Because of the involvement of two fusions, this event is called double fertilisation. It is an event unique to angiosperms.
- Zygote develops into an embryo (with 1 or 2 cotyledons).
- PEN develops into endosperm which provides nourishment to the developing embryo.
- Synergids & antipodals degenerate after fertilization.

ANGIOSPERMS (FLOWERING PLANTS)

Reproduction



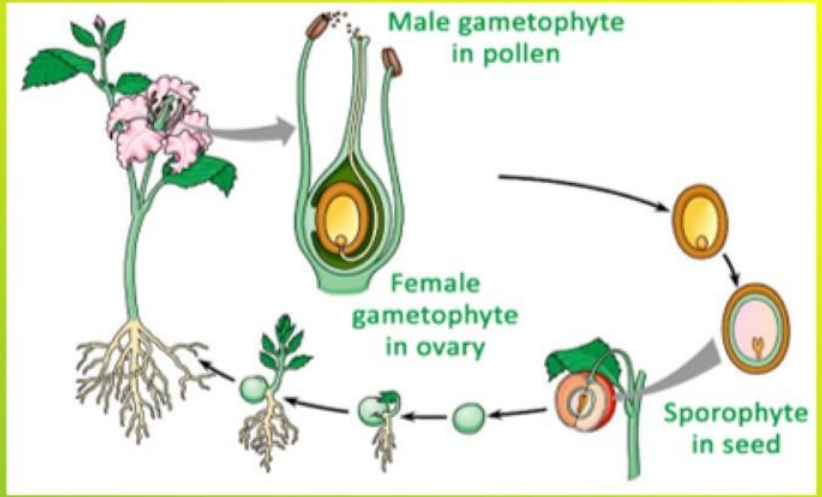
- During these events, ovules develop into seeds and ovaries develop into fruit.
- The seeds are enclosed by fruits.



Plant life cycles & Alternation of Generations

PLANT LIFE CYCLES & ALTERNATION OF GENERATIONS

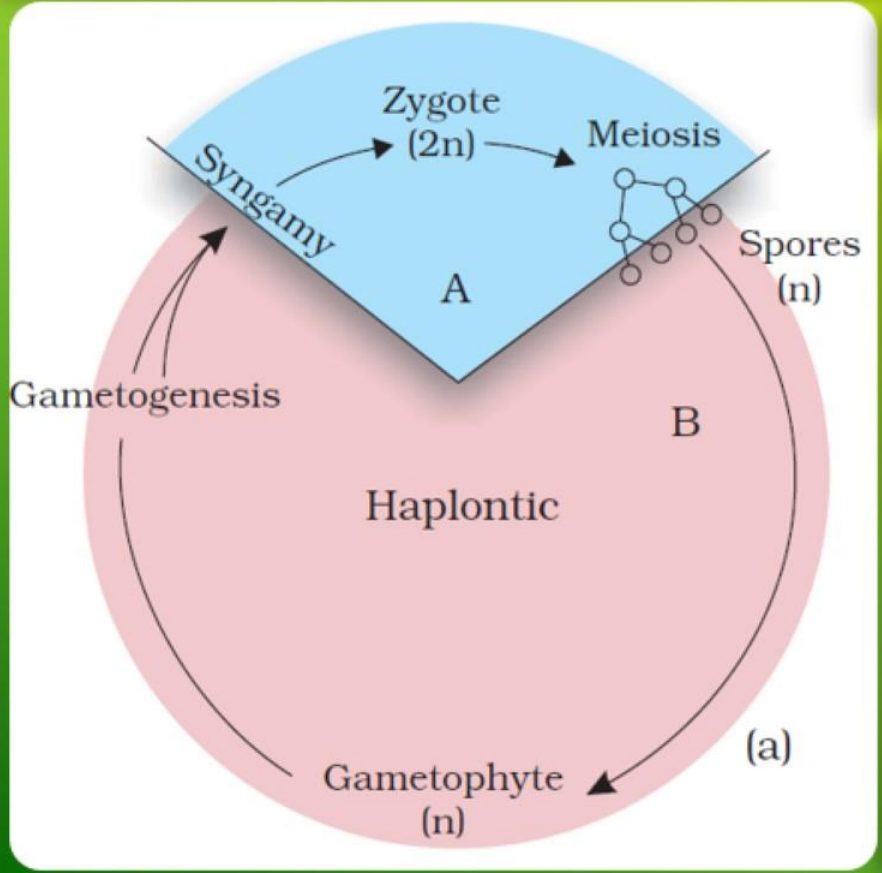
- In plants, both haploid & diploid cells can divide by mitosis. This forms haploid and diploid plant bodies.
- Haploid plant body **(gametophyte)** produces **gametes** by mitosis.
- After fertilization, the zygote also divides by mitosis to produce diploid plant body **(sporophyte)**. This produces haploid **spores** by meiosis. Spores divide by mitosis to form a haploid plant body.
- Thus, during the life cycle of any sexually reproducing plant, there is an **alternation of generations** between **gametophyte (n)** and **sporophyte (2n)**.



Patterns of Plant life cycles

- Haplontic
- Diplontic
- Haplo–diplontic

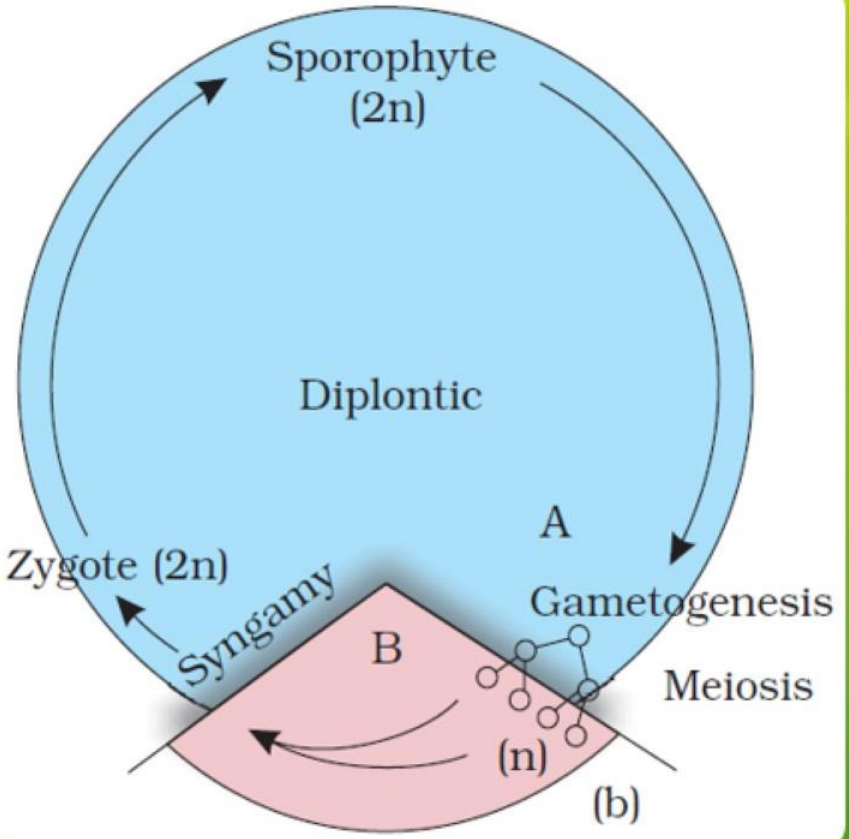
PLANT LIFE CYCLES & ALTERNATION OF GENERATIONS



1. Haplontic

- In this, **sporophytic** generation is represented only by the **zygote.**
- Zygote undergoes **meiosis** to form **haploid spores.** They divide mitotically to form **gametophyte.**
- The dominant, photosynthetic phase is the free-living gametophyte.
- E.g. Algae such as ***Volvox, Spirogyra*** and some species of ***Chlamydomonas.***

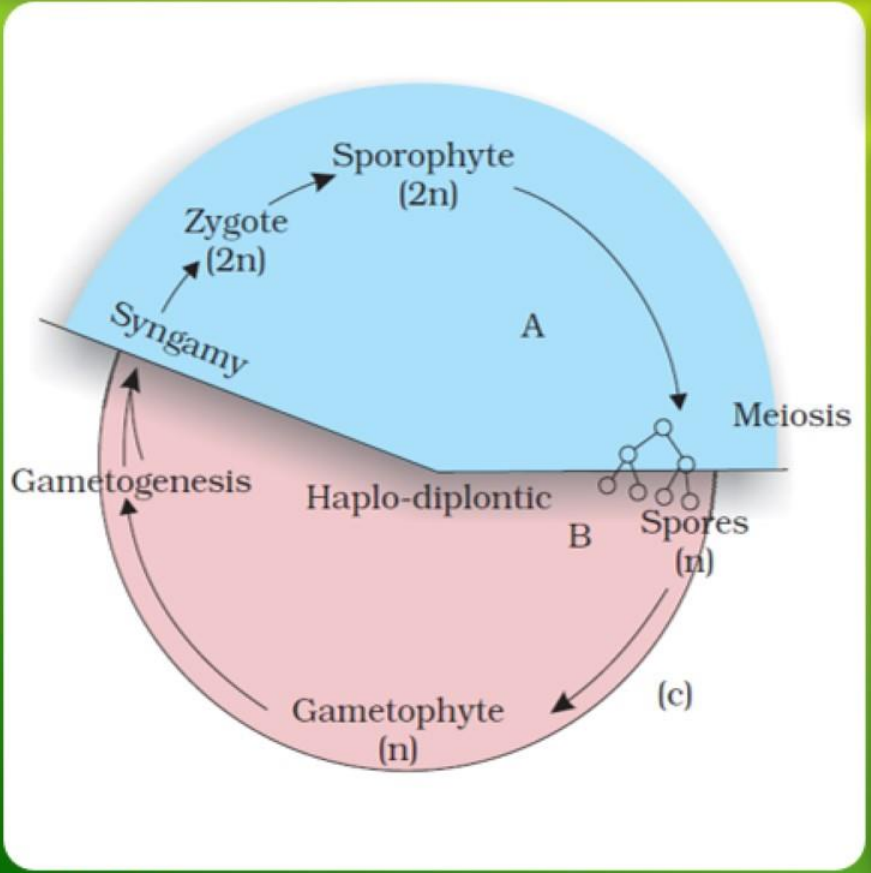
PLANT LIFE CYCLES & ALTERNATION OF GENERATIONS



2. Diplontic

- In this, the diploid **sporophyte** is the dominant, photosynthetic, independent phase.
- **Gametophytic** phase is represented by the single to few-celled haploid gametophyte.
- E.g. An alga, *Fucus* sp., all seed bearing plants (gymnosperms & angiosperms – the gametophytic phase is few to multi-celled).).

PLANT LIFE CYCLES & ALTERNATION OF GENERATIONS



3. Haplo–diplontic

- It is the intermediate condition between haplontic & diplontic.
- Both gametophyte and sporophyte are multicellular and often free–living.
- But they have different dominant phases.
- E.g. Bryophytes & Pteridophytes.