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Biological



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Systems of classification

Artificial system

↓

Earliest system of classification.

- Given by Carolous Linneaus.
- used Morphological characters such as habit, colour, no. $ shape of leaves etc.
- Mainly based on vegetative characters or on the androecium str.
- separated closely related species since were based on few characteristics.
- Gave equal weightage to vegetative $ sexual characteristics, is not acceptable ↓ since, we know that often the vegetative characters are more easily affected by env.

Natural system

↓

based on natural affinities among the organisms $ considered both:- external $ internal features.

↓

like ultrastructure, anatomy, embryology and phytochemistry.

- Given by Bentham $ Hooker

Phylogenetic system

↓

MOST ACCEPTABLE SYSTEM

- Based on evolutionary relationships blw the various organisms.
- Assumes that organisms belonging to same taxa have a common ancestor.

New development of taxonomy

(A) NUMERICAL - TAXONOMY :-

↳ carried out by computers $ is based on all observable characters.

- No $ codes → are assigned to all the characters $ the data are then processed.
- given equal importance $ at the same time ↓ 100s of characters can be considered.

(B) CYTOTAXONOMY :- based on cytological information like chromosome no., str., behaviour.

(C) CHEMOTAXONOMY :- based on chemical constituents of the plant.

Algae

GENERAL FEATURES → simple, thalloid, autotrophic, mostly aquatic [fresh, marine]

↓ some occur in Association → with Fungi ↳ (Lichen)

↓ with animals ↳ (sloth bear)

moist soil, damp surface.

- Marine $ massive plant Bodies → kelps

- Size $ Form of Algae :-
- Colonial forms → Volvox
- Microscopic unicellular forms → chlamydomonas.
- Filamentous forms → Ulothrix

↳ REPRODUCTION :-

VEGETATIVE	ASEXUAL	SEXUAL
By fragmentatn ↓ each fragment develops into a thallus.	↓ eg: zoospores ↓ Flagllated (motile) $ on germinatn, give rise to new plants	↓ through Fusion of 2 gametes. 1) Anisogamy → games are dissimilar in size Ex: Chlamydomonas 2) Oogamy → Fusion blw 1 Large non motile Female + 1 motile male gamete Ex: some species of Chlamydomonas 3) Isogamy → Gametes are flagellated $ similar in size Ex: Volvox $ Fucus!

• ECONOMIC IMPORTANCE OF ALGAE

→ Atleast 1/2 of Total CO_2 Fix^n on Earth → is carried out by Algae through Photosynthesis

→ Primary producers of Energy – rich compounds

↓

which forms the basis of the food cycles of all aquatic animals.

• Many Species of :- Porphyra, Laminaria & Sargassum → are used as food.

(Among 70 marine species used as food)

• Marine Brown & Red Algae → Produce large amounts of hydrocolloids (H_2O holding Substances)

Eg: Algin (brown algae)

Carrageen (red algae)

Agar

↓

One of the commercial products obtained from Gelidium & Gracilaria

↓

are used to grow microbes, and in preparat^n of ice-creams & jellies.

Chlorella

↓

Unicellular Algae.

Rich in proteins

* Used by space travellers.

TABLE 3.1 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 *a*, *b*	Starch	Cellulose	2-8, equal, apical	Fresh water, brackish water, salt water
Phaeophyceae	Brown algae	Chlorophyll *a*, *c*, fucoxanthin	Mannitol, laminarin	Cellulose and algin	2, unequal, lateral	Fresh water (rare) brackish water, salt water
Rhodophyceae	Red algae	Chlorophyll *a*, *d*, phycoerythrin	Floridean starch	Cellulose	Absent	Fresh water (some), brackish water, salt water (most)

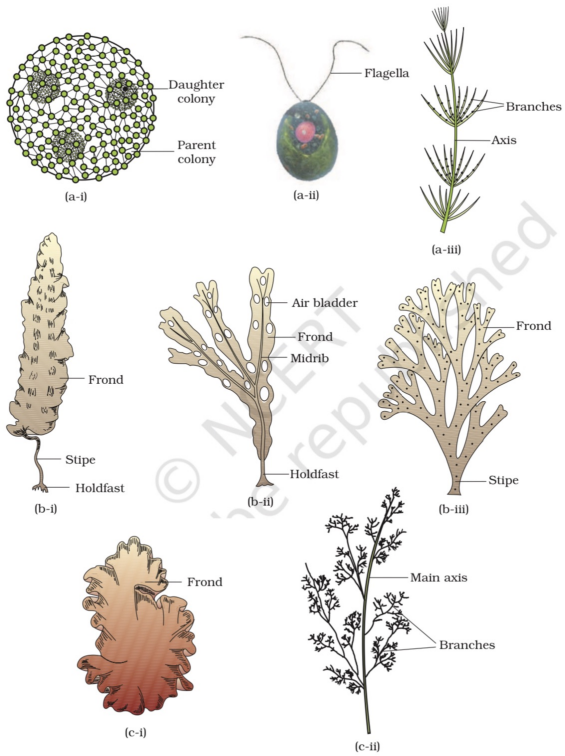

Figure 3.1 Algae : (a) Green algae (i) *Volvox* (ii) *Chlamydomonas* (iii) *Chara* (b) Brown algae (i) *Laminaria* (ii) *Fucus* (iii) *Dictyota* (c) Red algae (i) *Porphyra* (ii) *Polysiphonia*

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Pyrenoids → Protein, Starch, Oil droplets

CHLOROPHYCEAE

[Green Algae]

- Unicellular, colonial, Filamentous.
- Are Grass green → chl. a & b in chloroplast
- can be :- Discoid, Plate like, Reticulate, Cup-shaped, Spiral, ribbon shaped.
- may be unicellular, multi. or Filamentous.
- Rigid cell wall
  - Inner Layer (cellulose)
  - Outer Layer (Pectose)
- Chloroplast have → Storage bodies cla pyrenoids contain Protein
- * Food Storage → oil droplets.

REPRODUCTION

1) Vegetative Repro^{n} :-
→ Fragmentation
→ Spore form^{n}

2) Asexual Repro^{n} :-
→ Zoosporangium
↓
Flagellated zoospore.

3) Sexual Repro^{n} :-
1) isogamous
2) Anisogamous
3) Oogamous

- Common Algae :-
→ Chlamydomonas, Volvox, Ulothrix ; Spirogyra ; chara.

PHAEOPHYCEAE

[BROWN ALGAE]

- Found in marine habits.
- Possess chlorophyll a, c, carotenoids and xanthophill
1) Simple branched, filamentous
↳ Ectocarpus.
- Branched
↳ Kelps [may reach 100m]

** Olive green to various shades of brown
↳ depending on xanthophyll fucoxanthinin.

- FOOD → store in form of complex carbohydrates
  - Laminaria
  - Manitol

* Vegetative cells
↳ cellulosic (covered by Algnin)

On Protoplast
- Plastids
- Central located Vacuole
- Nucleus.

* PLANT BODY
- ↳ Hold fast (to substratum)
- → Stipe (Stalk)
- → Frond (leaf like)

Vegetative Repro^{n} → Fragmentat^{n}

Asexual Repro^{n} ↳ Biflagellated zoospore (Pear shaped, 2 unequal laterally attatched flagella)

Sexual Repro^{n}
- so.
- aniso
- oogamy

* Gametes → Pyriform
↳ bear 2 lateral attatched Flagella.

Ex: Ectocarpus; Dictyota; Laminaria, Sargassum ; Fucus.

FELDS

RHODOPHYCEAE

[RED ALGAE]

- Red pigment (+nt)
↳ cla r-phycoerythrin.
- Marine [max. in warmer area]
- Penetrates great depth in oceans.

* Red Thalli
↳ multicellular
↳ have complex body organisation.

FOOD → Floridian Starch
↓
same as amylopectin & glycogen in structure.

- REPRODUCTION

1) Vegetative Repro^{n} :-
→ Fragmentation

2) Asexually :-
→ Non-motile spores.

3) Sexually :-
→ Non-motile gametes.
↓
oogamus
(complex post fertilisat^{n} events)

Eg: Gracillaria, Porphyra, Gelidium

Bryophytes

→ Mosses
→ Liverworts.

GENERAL FEATURES

→ Found in most shaded areas in the hills.
(damp, humid & shaded localities)

⇒ c/a Amphibians of the plant kingdom!
↳ can live in soil.
→ dependent on water for sexual repro^n.

• Body → more differentiated than Algae :-
a) Thallus like
b) Prostrate or Erect.
c) Attatched to substratum
↓
by unicellular or multicellular rhizoids.

d) * Lack Leaf & stem but
have leaf like & stem like structures.

• Main plant body ⇒ Haploid
* are Gametophyte (produce gametes)
* Multicellular sex organs (+nt)

Male sex organs → c/a Antheridium
↓
Produce biflagellated Antherozoids

Female sex organs → c/a Archegonium
(Flask shape) ↓
Produce a single egg.

Antherozoids (n) → Zygote (2n) ← Archegonium (n)
[released in H_2O] where they come in contact of

* NO immediate red^n of zygote!

* zygote → sporophyte (multi.; attatched to photosynthetic gametophyte) —red^n→ Haploid Spores (n) is (Gameto-phyte)

• SOME ECONOMIC IMPORTANCE

• Some Mosses Provide Food!

• Sphagnum (moss) ↓ Provide Peat.
For fuel & as packaging material.
b/c have capacity to hold H_2O.

• Are the 1st to colonise along with lichens (decompose rocks)

• Form dense mats on soil → reduce impact of rain fall. → Prevent soil erosion.

Liverworts

moist, shady habitats [bank of streams, marsh ground, damp soil, bark of trees, deep in the woods]

• Thalloid str. Eg. Marchantia.
↳ dorsiventral
↳ closely appressed to substrate.

* Leaf members
↳ have tiny leaf like appendages in 2 rows on stem on the stem like structures.

Asexual Repro^n:-
1) Fragmentation
2) Form^n of Specialised Structures
↓
Gemmae :- Green; Multi.; Asexual Buds.
[on Gemma cup]
↓
Germinate to form new individual

Sexual Repro^n:-
Male sex organ → (+nt) on same of difft. thalli ← Femal sex organ
↓
sporophyte
Foot, Seta, Capsule
Spores are produced.
↓ (Germinate)
Form free living gametophyte.

Mosses

Pre dominant stage is → Gametophyte
↓
[consist 2 stages]

1) Protonema Stage
↳ develops directly from the spore.
* creeping, green, branched & filamentous.

2) Leafy stage → develops as lateral bud.
[bears sex organs]
↳ consist of upright, slender axes bearing spirally arranged leaves.
↓
attatched to the soil through multicellular & branched rhizoids.

Vegetative Repro^n:-
1) Fragmentation.
2) Budding in Secondary Protonema.

Sexual Repro^n:-
Sex organs
Anthero-zoids, Arche-gonia
↓
(+nt) at the apex of leafy shoots.

Sporophyte
↓
Zygote
Foot, Seta, Capsule
Meiosis ↓
Spores → Spore dispersal.

Eg. Funaria; Polytrichum; Sphagnum.

GAMETOPHYTE.

Antheridium → Archaegonium → egg.

Zygote. (2n).

↓

Sporophyte.

Foot (2n

Seta (2n)

capsule (2n)

↓

Spore Mother cells

↓

Spores (n)

↓

Free living gametophyte

Embryo sporophyte parasite to

↓

Female gametophyte

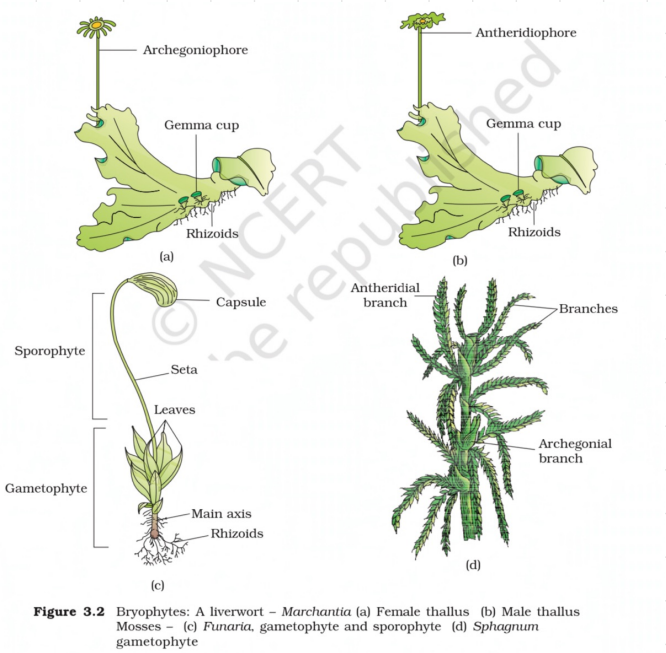

Figure 3.2 Bryophytes: A liverwort – *Marchantia* (a) Female thallus (b) Male thallus Mosses – (c) *Funaria*, gametophyte and sporophyte (d) *Sphagnum* gametophyte

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Pteridophyte

GENERAL FEATURES

- Horsetails & Ferns [+nt]
- as ornamental, medicinal purposes, soil binders & 1st to have vascular Tissues (terrestrials) — Xylem, Phloem
- Lives in :- moist, damp, shady, sometimes in sandy soil condn.

Pteridophytes → main plant body is sporophytic

have true → root, stem & Leaves

- Microphyllus (Selagenella)
- Macro-phyllus (Fern)

* well differentiated vascular tissue.

contains SPOROPANGIA → Subtended by leaf-like sporophylls

- If sporophyll become compact :- then Strobili / cone is formed.

Eg: Selagenella ; Equisteum.

- REPRODUCTION :-

Sporangia contain spore mother cells (2n) —meiosis→ Spore (n) → Prothallus (free living, photosyn-thetic ; multi-, thalloid gametophyte) → require cool, damp, shady places.

bear sex organs → Antheridia, Archegonia

Antheridia have [Anthcrozoids] (H_2O req.) → Archegonia

So, male gamete, Egg → (Zygote) → Multicellular, well differentiated sporophyte.

Spores → same kind (Homospores)
→ difft. kind (Heterosporus)
Eg: Selaginella ; Salvinia

* Megaspores & Microspores
(Female Gametophyte) (Male Gametophyte)

Female Gametophyte → Zygote
* Retains on parent sporophyte

Male gameto. (through H_2O) → Zygote

Zygote → Young embryo (takes place in Female Gameto.)

* this event is Precursor of seed habit considered imp. for evolution

Classes

1) Psilopsida (Psilotum)
2) Lycopsida (Selaginella, Lycopodium)
3) Sphenopsida (Equistem)
4) Pteropsida (Dryopteris, Pteris, Adiantum)



Figure 3.3 Pteridophytes : (a) *Selaginella* (b) *Equisetum* (c) Fern (d) *Salvinia*

Gymnosperm

Naked — Seeds

* Ovules → exposed (no ovary wall)
Seeds → are naked
* include medium sized trees, tall trees & Shrubs!

• Giant Redwood tree → Sequoia (one of the tallest)

• Roots → Tap roots
• Mycorhizza → Pinus (with fungus)
• coralloid roots → Cycas (N_2 fixing) (cyanobacteria)

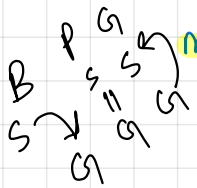
• **Stem**
→ unbranched :- Cycas
→ branched :- Pinus, cedrus

• Leaves :- simple, compound
1) Cycas → Pinnate leaves → persists for few yrs.
• withstand extreme temp., humidity & wind.

• Conifers → have needle like leaves
(reduce the surface area)
their thick cuticle & sunken stomata also help to reduce water loss.

Sporophyllus → arranged spirally → form lax or compact strobili ⇒ Cones
↓
Sporangia
↓
are Heterosporous
↙ ↘
Haploid microspores — Megaspores

• Microsporophyllus or Microsporangia
↓
Microsporangiate
↓
Microspores
↓
Male gametophyte → reduced → Pollen Grain



[Cluster ⇒ Female Cones]
Megasporophyllus or Megasporangia
↓
Mega sporangiate or female strobili
↓
Mega spore mother cell (from nucellus)
↓
Protected by envelops cla Ovule
↓
Meiosis
↓
4 megaspores [retained within mega sporangium]
↓ Any one
into multi female gametophyte
(Bears 2 or more archegonia or female sex organs)

* Male & female gametophyte
↓
NOt independent
↓
retained within Sporangia
↓
On Sporophytes

Microsporangium → release pollen grains
↓ through air currents
come in contact with the opening of the ovules borne on Megasporophylls.

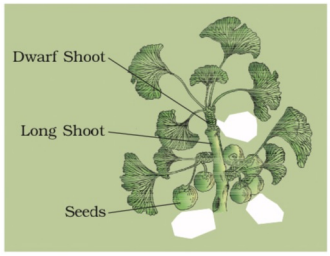
Fertilisation → Zygote → Embryo.
& ovules → seeds (not covered)*



(a)



(b)



(c)

Figure 3.4 Gymnosperms: (a) *Cycas* (b) *Pinus* (c) *Ginkgo*

Angiosperms (Flowering Plants)

Seeds are enclosed by fruits

Pollen grains & ovules → are developed in specialized str. called Flowers

(+nt) in wide range of Habitats.

- smallest angiosperm :- Wolfia
- tallest angiosperm :- Eucalyptus →[over 100m]

- provide us with food, fodder, fuel, medicines & several other commercially imp. products.

Divided into 2 classes :- 1) Dicotyledons → have 2 cotyledons
2) Monocotyledons → have 1 cotyledon.

- male sex organ in flower → Stamen
  - Each consist of slender filament with an anther at the tip.
    - meiosis
      - Produced pollen grains.

- Female sex organ in flower → Pistil or Carpel
  - consist of ovary enclosing 1 to many ovules.
    - within ovules, highly reduced female gametophyte → (+nt) [embryo sacs]
      - its Formⁿ preceeded by meiosis
      - Hence, each cell of an embryo sac is Haploid.
  - Embryo Sac → has 3 celled egg Apparatus
    - one egg cell has 2 synergids, 3 antipodal cells & 2 polar nuclei.
      - eventually fuse to produce diploid secondary nucleus.

- Pollen Grain after dispersal from anthers, carried out by wind or various other agencies to stigma & style → & reach to ovule.

DOUBLE FERTILISATION

Male gamete —fuses with→ egg cell → Form → Zygote (2n) [syngamy]

- Other male gamete → fuse with diploid secondary nucleus → Produce → Triploid primary endosperm nucleus (PEN)

↳ This process is cla TRIPLE FUSION

DEVELOPMENT OF ZYGOTE

zygote develops into → Embryo (with 1 or 2 Cotyledons)

& (PEN) develops into → Endosperm (which provide nourishment to the developing embryo)

- Synergids & antipods degenerate after fertilisation.

& Ovule develops into → Seeds & Ovaries → Fruit

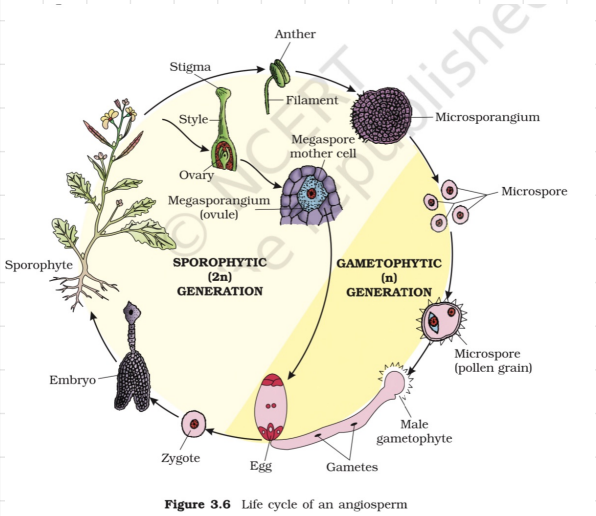


Figure 3.6 Life cycle of an angiosperm

Plant life cycles

Both Haploid & Diploid cells can divide by mitosis

- Haploid → Haploid → Gametophyte
- Diploid → Diploid body → Zygote → Sporophyte → Haploid spores by meiosis → (by mitosis) → Haploid Plant.

HAPLONTIC LIFE CYCLE

(n) Sporophyte → zygote (2n)
(Not free living)
↓ (Meiosis)
Haploid spores
↓ (Mitosis)
Gametophyte
↳ Dominant, Photosynthetic

Ex: Volvox, Spirogyra, Some species of chlamydomonas

DIPLONTIC LIFE CYCLE

- Sporophyte → Dominant, photosynthetic, independent.
- Gametophyte → single to few celled.

Ex: Fucus, Gymnosperms, Angiosperms
↳ have few to multi-celled gametophyte.

HAPLO-DIPLONTIC LIFE CYCLE

Bryophytes & Pteridophytes ⇒ both phases are multicellular
↓
but differ in dominant phases.

Bryophytes
Dominant, independent, thalloid or erect.
↓
Haploid Gametophyte
↓
alternates with Sporophyte
↳ (short lived multicellular)
totally or partially dependent on Gametophyte : for anchorage & nutrition.

- **Pteridophytes** → diploid sporophyte.
  ↳ dominant, independent, photosynthetic, vascular plant body.
  ↓
  alter with gametophyte

SOME EXAMPLES

- Algae → Haplontic
- Ectocarpus, Polysiphonia, Kelps → Haplo-diplontic
- Fucus → Diplontic

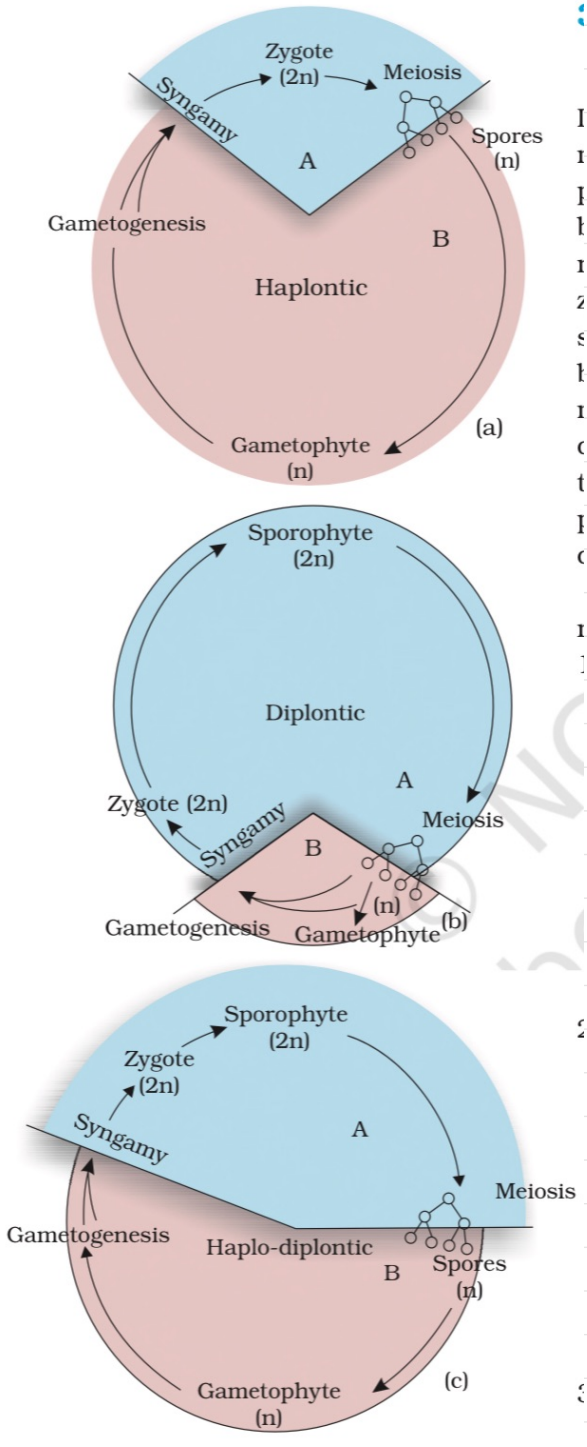


Figure 3.7 Life cycle patterns : (a) Haplontic (b) Diplontic (c) Haplo-diplontic