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CHAPTER NOTES

Plant Kingdom Class 11 Notes | CBSE Biology Chapter 3

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Plant Kingdom Class 11 Notes | CBSE Biology Chapter 3

Plant Kingdom is Chapter 3 of CBSE Class 11 Biology — and it is one of the most fact-loaded, scoring chapters for both your board exam and NEET. It takes you on a journey from the simplest green algae living in pond water all the way up to flowering plants, classifying every group by how it looks, where it lives, and how it reproduces. Learn the patterns here and a whole block of NEET botany questions becomes guaranteed marks.

By the end of these notes you will be able to place any plant into its correct group (algae, bryophytes, pteridophytes, gymnosperms, or angiosperms), recall the diagnostic features and standard examples NEET loves to ask, and confidently explain alternation of generations along with the haplontic, diplontic, and haplodiplontic life cycles. This is a high-weightage chapter carrying roughly 4–6 marks in boards and 2–3 sure-shot questions in NEET, and the foundation for Morphology, Anatomy, and Reproduction in Flowering Plants.

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Key Concepts

1. Classification Systems

Early botanists grouped plants by just one or two visible traits — this is **artificial classification** (e.g., Linnaeus' sexual system based only on stamens). It gives equal weight to vegetative and sexual characters, which often misleads.

Natural classification uses many characters together — internal structure, anatomy, cell features, and reproduction (e.g., Bentham and Hooker's system, the most widely used for flowering plants in India).

Phylogenetic classification is based on evolutionary relationships — organisms grouped by common ancestry.

Numerical taxonomy (using computers, assigning equal weight to many characters) and **cytotaxonomy** (chromosome number, structure, behaviour) and **chemotaxonomy** (chemical constituents) are modern aids.

2. Algae

Algae are chlorophyll-bearing, simple, thalloid (no true root-stem-leaf), autotrophic, largely aquatic organisms. The plant body is a **thallus**. They reproduce by all three methods.

- **Vegetative:** by fragmentation.
- **Asexual:** mainly by zoospores (flagellated, motile spores).
- **Sexual:** isogamous (gametes similar), anisogamous (gametes dissimilar in size), or oogamous (large non-motile female gamete + small motile male gamete).

Algae are economically vital: they carry out at least **half of all photosynthesis (CO₂ fixation) on Earth**, and yield agar (Gelidium, Gracilaria), carrageenan, and food (Porphyra, Laminaria, Sargassum).

The Three Classes of Algae (NEET high-yield)

Feature	Chlorophyceae (Green algae)	Phaeophyceae (Brown algae)	Rhodophyceae (Red algae)
Main pigments	Chlorophyll a, b	Chlorophyll a, c + fucoxanthin	Chlorophyll a, d + r-phycoerythrin
Colour	Grass-green	Brown (olive to dark)	Red
Stored food	Starch	Mannitol & laminarin	Floridean starch
Cell wall	Cellulose	Cellulose + algin	Cellulose + pectin + polysulphate esters
Flagella	2–8, equal, apical	2, unequal, lateral	Absent
Habitat	Mostly freshwater	Mostly marine	Mostly marine (greater depths)
Examples	Chlamydomonas, Volvox, Ulothrix, Spirogyra, Chara	Ectocarpus, Dictyota, Laminaria, Sargassum, Fucus	Polysiphonia, Porphyra, Gracilaria, Gelidium

Memory hook: Red algae live deepest because r-phycoerythrin absorbs the blue light that penetrates deep water.

3. Bryophytes

Bryophytes are the “amphibians of the plant kingdom” — they live on land but still need water for sexual reproduction (the flagellated male gametes swim to the egg). The plant body lacks true roots, stem, and leaves; it has rhizoids, and is the dominant **gametophyte (haploid, n)**.

The main plant body is the photosynthetic gametophyte. Sex organs are multicellular: male is the **antheridium** (produces antherozoids), female is the **archegonium** (flask-shaped, produces one egg). After fertilisation the zygote forms a **sporophyte (diploid, 2n)** that stays attached to and partly dependent on the gametophyte; it produces haploid spores by meiosis.

Two Groups

- **Liverworts** (e.g., *Marchantia*, *Riccia*): grow in moist shady places; thalloid, dorsiventral body; asexual reproduction by fragmentation or by **gemmae** in gemma cups.
- **Mosses** (e.g., *Funaria*, *Sphagnum*, *Polytrichum*): two stages — a creeping branched **protonema** (from spore) and an upright leafy stage bearing sex organs.

Economic importance: *Sphagnum* (peat moss) provides peat as fuel and is used as packing material; mosses are pioneers of plant succession on bare rock and prevent soil erosion.

4. Pteridophytes

Pteridophytes are the first true land plants with **vascular tissue** (xylem and phloem) — hence “ferns and fern allies.”

Examples: *Selaginella*, *Equisetum*, *Pteris*, *Adiantum*, *Lycopodium*, *Salvinia*.

Here the dominant, photosynthetic, independent plant body is the **sporophyte (2n)** — differentiated into true root, stem, and leaves. Leaves may be small (**microphylls**, e.g., *Selaginella*) or large (**macrophylls**, e.g., ferns).

The sporophyte bears **sporangia** on leaf-like **sporophylls**; sporangia produce spores by meiosis. Spores germinate into a tiny, free-living, multicellular, often photosynthetic **gametophyte called a prothallus** that needs cool, damp, shady conditions — this limits pteridophytes’ spread.

Homospory vs Heterospory

- **Homosporous:** all spores are of one kind (most pteridophytes, e.g., *Pteris*).
 - **Heterosporous:** two kinds of spores — small **microspores** and large **megaspores** (e.g., *Selaginella*, *Salvinia*). The megaspore retained on the parent and developing into the female gametophyte there is the evolutionary forerunner of the **seed habit** — a key NEET point.
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5. Gymnosperms

Gymnosperms are plants whose **ovules are not enclosed by an ovary wall** — the seeds lie naked on the surface of sporophylls (gymnos = naked, sperma = seed). Examples: *Cycas*, *Pinus*, *Cedrus*, *Ginkgo*, *Ephedra*.

They include medium to tall trees and shrubs; the giant *Sequoia* (redwood) is among the tallest of all plants. Roots may bear fungal **mycorrhiza** (*Pinus*) or N₂-fixing cyanobacteria in **coralloid roots** (*Cycas*).

Gymnosperms are heterosporous: they produce haploid microspores and megaspores. The male and female gametophytes are **not free-living** — they are retained on the sporophyte (within male and female cones/strobili). Pollen grains are carried by wind (pollination), reach the ovule directly, and form a **pollen tube**. **No fruit is formed** because the ovule is not enclosed in an ovary.

6. Angiosperms (Introduction)

Angiosperms are flowering plants in which the seeds are **enclosed inside a fruit** (the ripened ovary). They range from the tiny *Wolffia* to tall *Eucalyptus* trees and dominate today's flora.

The male sex organ is the **stamen** (anther produces pollen via microspores); the female is the **pistil/carpel** (the ovary encloses ovules, each with a megaspore that forms the embryo sac — the female gametophyte). Angiosperms are split into two classes: **dicotyledons** (two cotyledons, reticulate venation, tap root) and **monocotyledons** (one cotyledon, parallel venation, fibrous root).

The hallmark of angiosperms is **double fertilisation**: one male gamete fuses with the egg (forming the $2n$ zygote) and the other fuses with two polar nuclei (forming the $3n$ primary endosperm nucleus, which gives nourishing endosperm). This produces a triploid endosperm and is unique to angiosperms.

7. Plant Life Cycles & Alternation of Generations

In all land plants there is an **alternation of generations**: a haploid, gamete-producing **gametophyte (n)** alternates with a diploid, spore-producing **sporophyte ($2n$)**. Gametes fuse to form a $2n$ zygote (the sporophyte); the sporophyte produces spores by meiosis (the gametophyte). The relative dominance of the two phases differs among groups.

The Three Patterns

Life cycle	Dominant phase	Where meiosis occurs	Examples
Haplontic	Gametophyte (n) is dominant; sporophyte is just the zygote	Zygotic meiosis (zygote divides by meiosis)	Most algae (Spirogyra, Volvox, Chlamydomonas)
Diplontic	Sporophyte ($2n$) is dominant; gametophyte is greatly reduced	Gametic meiosis	Seed plants — gymnosperms & angiosperms (also Fucus)
Haplo-diplontic	Both phases multicellular; alternation of two distinct bodies	Sporic meiosis	Bryophytes (gametophyte dominant), Pteridophytes (sporophyte dominant), Ectocarpus, Polysiphonia, Kelps

[DIAGRAM: Three cycle diagrams — Haplontic (large n gametophyte, tiny $2n$ zygote), Diplontic (large $2n$ sporophyte, tiny n gametes), Haplo-diplontic (two multicellular bodies alternating).]

NEET trend: In bryophytes the gametophyte is dominant; in pteridophytes and all higher plants the sporophyte is dominant. The evolutionary trend on land is towards an increasingly dominant sporophyte and a reduced gametophyte.

Weightage in Board & Entrance Exams

Exam	Typical Weightage	Most-Tested Areas
CBSE Board (Class 11)	4–6 marks	Algae classes, bryophyte/pteridophyte features, alternation of generations
NEET	2–3 questions	Pigments & stored food of algae, examples, life-cycle types, gymnosperm vs angiosperm
State CETs	1–2 questions	Diagnostic features and standard examples of each group

[TABLE: Question-type split — VSA (1 mark): definitions, one-word examples; SA (2–3 marks): comparison of algal classes, bryophyte vs pteridophyte; LA (5 marks): alternation of generations, life-cycle patterns with examples.]

Important Definitions

Term	Definition
Thallus	A plant body not differentiated into true root, stem, and leaf (as in algae)
Gametophyte	The haploid (n), gamete-producing phase of the plant life cycle
Sporophyte	The diploid (2n), spore-producing phase of the plant life cycle
Alternation of generations	The regular alternation of a haploid gametophyte and a diploid sporophyte
Isogamy / Oogamy	Fusion of morphologically similar gametes / fusion of a large non-motile egg with a small motile sperm
Prothallus	The small, free-living, photosynthetic gametophyte of pteridophytes
Heterospory	Production of two kinds of spores — microspores and megaspores
Gymnosperm	A seed plant with naked ovules/seeds not enclosed in an ovary
Double fertilisation	One male gamete fertilises the egg, the other fuses with polar nuclei (angiosperms)
Coralloid roots	N ₂ -fixing, cyanobacteria-containing negatively geotropic roots of Cycas

Solved Examples & Concept Application

Example 1

An alga shows chlorophyll a and d, r-phycoerythrin, and stores floridean starch. Name its class and one example.

Answer: These are the diagnostic features of **Rhodophyceae (red algae)**. Example: *Polysiphonia* or *Porphyra*.

Example 2

Why are bryophytes called the “amphibians of the plant kingdom”?

Answer: Like amphibians, they live on land but still need **water for sexual reproduction** — the flagellated antherozoids must swim through a film of water to reach the egg in the archegonium.

Example 3

In which group does the megaspore first stay on the parent plant, hinting at the origin of the seed habit?

Answer: In heterosporous **pteridophytes** such as *Selaginella* and *Salvinia*, the megaspore is retained on the parent and the female gametophyte develops there — the precursor to the seed habit.

Example 4

A plant bears naked seeds on the surface of sporophylls and produces no fruit. To which group does it belong, and give one example.

Answer: Naked seeds with no ovary wall and no fruit define a **gymnosperm**. Example: *Cycas* or *Pinus*.

Example 5

Spirogyra and a fern show different dominant phases. Identify the life cycle of each.

Answer: *Spirogyra* is **haplontic** (gametophyte dominant, zygotic meiosis). A fern (pteridophyte) is **haplo-diplontic** with a dominant sporophyte.

Example 6

What is the ploidy of the zygote, the spore, and the primary endosperm nucleus in an angiosperm?

Answer: Zygote = **2n (diploid)**; spore (microspore/megaspore) = **n (haploid)**; primary endosperm nucleus = **3n (triploid)**, formed by triple fusion in double fertilisation.

Important Questions for Board Exams

1-Mark Questions (VSA)

1. Name the pigment that lets red algae photosynthesise at great ocean depths.
2. What is the stored food of Phaeophyceae?
3. Give one example each of a liverwort and a moss.
4. Name the free-living gametophyte of a pteridophyte.
5. Why do gymnosperms not form fruits?

2–3-Mark Questions (SA)

1. Compare Chlorophyceae, Phaeophyceae, and Rhodophyceae on the basis of pigments, stored food, and one example each.
2. Differentiate between the gametophyte and the sporophyte phases, naming the dominant phase in bryophytes and in pteridophytes.
3. Distinguish between homosporous and heterosporous pteridophytes with one example of each.
4. Explain double fertilisation in angiosperms and state the ploidy of the products.

5-Mark Questions (LA)

1. Describe alternation of generations and explain haplontic, diplontic, and haplo-diplontic life cycles with one example of each.
 2. Give an account of the general characters and reproduction of bryophytes, with the salient features of liverworts and mosses.
 3. Compare gymnosperms and angiosperms with respect to ovule, seed, gametophyte, and fruit formation.
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Quick Revision Points

- Algae = thalloid autotrophs; do ~50% of Earth's CO₂ fixation
- Chlorophyceae → starch, green; Phaeophyceae → mannitol/laminarin, brown; Rhodophyceae → floridean starch, red (deepest)
- Bryophytes = amphibians of plant kingdom; gametophyte (n) dominant; antheridium + archegonium; liverworts & mosses
- Pteridophytes = first vascular plants; sporophyte (2n) dominant; gametophyte = prothallus; heterospory hints at seed habit
- Gymnosperms = naked seeds, no fruit, no ovary wall; Cycas coralloid roots, Pinus mycorrhiza; Sequoia tallest
- Angiosperms = seeds enclosed in fruit; double fertilisation → 2n zygote + 3n endosperm; dicots vs monocots
- Alternation of generations: gametophyte (n) ⇌ sporophyte (2n)

- Haplontic → gametophyte dominant (most algae); Diplontic → sporophyte dominant (seed plants); Haplo-diplontic → both multicellular (bryophytes, pteridophytes)
 - Evolutionary trend on land: sporophyte becomes dominant, gametophyte reduces
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Next Chapter: Chapter 4 — Animal Kingdom



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