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Biological Classification Class 11 Notes | CBSE Biology Chapter 2

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Biological Classification Class 11 Notes | CBSE Biology Chapter 2

Biological Classification is Chapter 2 of CBSE Class 11 Biology — and one of the most fact-dense, high-scoring chapters in all of NEET Biology. It answers a simple question with huge consequences: how do we sort the millions of living organisms on Earth into orderly groups? The answer evolved from a crude two-kingdom split into R.H. Whittaker's elegant five-kingdom system.

By the end of these notes you will be able to compare every system of classification, list the defining features of all five kingdoms, place tricky organisms like *Euglena*, slime moulds, and *Mycoplasma* in the right group, and answer any board or NEET question on viruses, viroids, prions, and lichens. This is a high-weightage chapter — roughly 4–6 marks in boards and 2–3 NEET questions almost every year — and the foundation for the entire diversity-of-life unit.

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Key Concepts

1. Systems of Classification — From Two Kingdoms to Five

Early biologists simply split all life into two boxes — plants and animals. Linnaeus gave this **two-kingdom system** (Plantae and Animalia), but it was too crude: it lumped bacteria, fungi, and the green alga *Chlamydomonas* together with plants, and ignored differences between prokaryotes and eukaryotes.

As microscopes improved, the cracks showed. The two-kingdom system could not distinguish prokaryotes from eukaryotes, unicellular from multicellular, or photosynthetic green algae from non-photosynthetic fungi. A better basis was needed.

The Five-Kingdom System (R.H. Whittaker, 1969)

Whittaker proposed five kingdoms — **Monera, Protista, Fungi, Plantae, and Animalia**. This is the system you must know for boards and NEET.

His classification used four main criteria: **cell structure** (prokaryotic vs eukaryotic), **body organisation** (unicellular vs multicellular), **mode of nutrition** (autotrophic vs heterotrophic), and **phylogenetic relationships** (evolutionary lineage).

2. Basis of Classification

The five-kingdom system groups organisms using a combination of features rather than a single trait. Knowing these criteria lets you place any organism correctly.

- **Cell structure:** prokaryotic (no true nucleus, Monera) vs eukaryotic (true nucleus, all others).
- **Thallus organisation:** unicellular vs multicellular body.
- **Mode of nutrition:** autotrophic (photosynthetic/chemosynthetic) vs heterotrophic (saprophytic/parasitic).
- **Reproduction** and **phylogenetic relationships**.

[TABLE: Five-kingdom comparison — Monera (prokaryotic, cell wall present, autotroph/heterotroph), Protista (eukaryotic, unicellular), Fungi (eukaryotic, multicellular, chitin wall, heterotroph), Plantae (eukaryotic, cellulose wall, autotroph), Animalia (eukaryotic, no cell wall, heterotroph).]

3. Kingdom Monera — The Prokaryotes

Monerans are the only **prokaryotes** — they lack a true membrane-bound nucleus and organelles. They are the most abundant micro-organisms on Earth, found in extreme heat, ice, deserts, and even inside other organisms.

Bacteria show four shapes: spherical **cocci**, rod-shaped **bacilli**, comma-shaped **vibrio**, and spiral **spirilla**.

Archaeobacteria

These live in the harshest habitats and have a special cell wall structure that lets them survive there. Three groups: **halophiles** (salty areas), **thermoacidophiles** (hot springs), and **methanogens** (marshy areas and the gut of ruminants, where they produce methane / biogas).

Eubacteria ("True Bacteria")

These have a rigid cell wall and, if motile, a flagellum. **Cyanobacteria (blue-green algae)** are photosynthetic eubacteria with chlorophyll-a; many fix atmospheric nitrogen in specialised cells called **heterocysts** (e.g., *Nostoc*, *Anabaena*).

Chemosynthetic autotrophic bacteria oxidise inorganic substances (nitrogen, iron, sulphur) and recycle nutrients.

Heterotrophic bacteria are mostly decomposers — important in making curd, antibiotics, and nitrogen fixation in legume roots.

Mycoplasma

The smallest living cells known, mycoplasmas **completely lack a cell wall**, can survive without oxygen, and are the simplest free-living organisms. Many are pathogenic.

4. Kingdom Protista — The First Eukaryotes

Kingdom Protista contains all **single-celled eukaryotes**. It forms a link between Monera on one side and Fungi, Plantae, and Animalia on the other. Members have a well-defined nucleus and membrane-bound organelles; most are aquatic.

Chrysophytes (Diatoms and Golden Algae)

Found in fresh and marine water, these are microscopic floaters (plankton). **Diatoms** have indestructible cell walls of silica that fit like a soap-box; their cell-wall deposits over billions of years form **diatomaceous earth**, used in polishing and filtration. Diatoms are the chief producers in the oceans.

Dinoflagellates

Mostly marine and photosynthetic, with a stiff cellulose cell wall and two flagella. Rapid multiplication of red dinoflagellates (e.g., *Gonyaulax*) causes **red tides**; toxins released can kill marine animals.

Euglenoids

Freshwater organisms with a flexible protein-rich layer called a **pellicle** instead of a cell wall. *Euglena* is the classic mixotroph: it photosynthesises in sunlight but feeds heterotrophically (like an animal) in the dark. Their pigments are identical to those of higher plants.

Slime Moulds

Saprophytic protists. Under suitable conditions they form an aggregation called a **plasmodium** that may grow and spread over several feet; during unfavourable conditions it forms fruiting bodies bearing spores with true walls.

Protozoans

All are heterotrophs (predators or parasites). Four groups: **Amoeboid** protozoans (e.g., *Amoeba*, *Entamoeba* — move by pseudopodia), **Flagellated** protozoans (e.g., *Trypanosoma*, causes sleeping sickness), **Ciliated** protozoans (e.g., *Paramecium* — move by cilia), and **Sporozoans** (e.g., *Plasmodium*, the malarial parasite).

5. Kingdom Fungi — The Decomposers

Fungi are **heterotrophic eukaryotes** with a cell wall made of **chitin**. Except yeasts (which are unicellular), the fungal body is a network of thread-like **hyphae** that together form the **mycelium**. Hyphae may be aseptate and multinucleate (**coenocytic**) or divided by cross-walls (septate).

Their nutrition is absorptive: **saprophytes** feed on dead matter, **parasites** on living hosts, and **symbionts** live in mutualistic partnerships (lichens, mycorrhiza). Reproduction is by spores — asexual (conidia, sporangiospores, zoospores) and sexual (oospores, ascospores, basidiospores).

Classes of Fungi

Class	Common name	Sexual spore	Examples
Phycomycetes	Lower fungi	Zygospore (coenocytic, aseptate hyphae)	<i>Mucor</i> , <i>Rhizopus</i> (bread mould), <i>Albugo</i>
Ascomycetes	Sac fungi	Ascospores (in sac-like asci)	<i>Aspergillus</i> , <i>Penicillium</i> , <i>Neurospora</i> , yeast, morels
Basidiomycetes	Club fungi	Basidiospores (on club-shaped basidia)	Mushrooms, <i>Agaricus</i> , puffballs, rusts, smuts
Deuteromycetes	Fungi imperfecti	None known (only asexual reproduction)	<i>Alternaria</i> , <i>Colletotrichum</i> , <i>Trichoderma</i>

Note: Deuteromycetes are “imperfect fungi” — only their asexual stage is known. When the sexual stage is discovered, they are reclassified into Ascomycetes or Basidiomycetes.

6. Kingdom Plantae — Overview

Kingdom Plantae includes all **eukaryotic, multicellular, chlorophyll-containing autotrophs** — algae, bryophytes, pteridophytes, gymnosperms, and angiosperms. Their cells have a cell wall of **cellulose**.

A few plants are partly heterotrophic: insectivorous plants like *Venus flytrap* and *Bladderwort*, or parasites like *Cuscuta*. Plant life cycles show an **alternation of generations** between a diploid sporophyte and a haploid gametophyte.

7. Kingdom Animalia — Overview

Kingdom Animalia includes all **eukaryotic, multicellular, heterotrophic** organisms whose cells **lack a cell wall**. They are holozoic — they ingest food and digest it internally.

Most show clear division of labour through tissues and organs, a definite growth pattern that stops at adulthood, and sensitivity to stimuli through nervous coordination. Reproduction is mostly sexual.

8. Viruses — Living or Non-living?

Viruses are not placed in any of the five kingdoms because they are **obligate intracellular parasites** — non-cellular, inert outside a host, but able to replicate inside a living cell. The name (Latin *virus* = poison) was given by Pasteur; D.J. Ivanowsky and M.W. Beijerinck did the early work on tobacco mosaic disease, and W.M. Stanley crystallised viruses.

A virus is a nucleoprotein: a genome of either **DNA or RNA** (never both) enclosed in a protein coat called the **capsid** (made of subunits, the capsomeres). Plant viruses usually have **ssRNA**; animal viruses have ssRNA or dsDNA; bacteriophages are usually **dsDNA**. Viruses cause mumps, smallpox, herpes, influenza, AIDS, and mosaic diseases in plants.

9. Viroids and Prions

Viroids (discovered by T.O. Diener) are even simpler than viruses — a **free, naked RNA** of low molecular weight with no protein coat. They cause potato spindle tuber disease.

Prions are infectious **protein particles** (no nucleic acid at all). They cause neurological diseases such as bovine spongiform encephalopathy (BSE, “mad-cow disease”) and its human form, CJD.

10. Lichens

Lichens are a **symbiotic (mutualistic) association** between an alga and a fungus. The algal partner (**phycobiont**) is autotrophic and prepares food; the fungal partner (**mycobiont**) is heterotrophic and provides shelter, water, and minerals.

Lichens are excellent **pollution indicators** — they do not grow in polluted cities because they are very sensitive to sulphur dioxide. They are also pioneers of ecological succession on bare rock.

Weightage in Board & Entrance Exams

Exam	Typical Weightage	Most-Tested Areas
CBSE Board (Class 11)	4–6 marks	Five-kingdom criteria, fungal classes, Monera, viruses vs viroids
NEET	2–3 questions	Protista examples, archaebacteria, fungal spores, lichens, prions
CUET / State CETs	1–2 questions	Whittaker’s criteria, diatoms, dinoflagellates, mycoplasma

[TABLE: Question-type split — VSA (1 mark): definitions, examples, “name the...” facts; SA (2–3 marks): compare two kingdoms/spore types, four criteria of classification; LA (5 marks): five-kingdom system with merits, kingdom Fungi classes with examples.]

Important Definitions

Term	Definition
Five-kingdom system	Whittaker's (1969) classification into Monera, Protista, Fungi, Plantae, Animalia
Prokaryote	Organism lacking a true membrane-bound nucleus (Kingdom Monera)
Heterocyst	Specialised cyanobacterial cell that fixes atmospheric nitrogen
Mycoplasma	Smallest living cell; lacks a cell wall; can survive without oxygen
Diatomaceous earth	Silica cell-wall deposits of diatoms used in filtration and polishing
Red tide	Sea reddening from rapid multiplication of dinoflagellates like <i>Gonyaulax</i>
Pellicle	Flexible protein-rich layer covering euglenoids instead of a cell wall
Mycelium	Network of thread-like hyphae forming the body of a fungus
Lichen	Symbiotic association of an alga (phycobiont) and a fungus (mycobiont)
Viroid	Infectious free RNA with no protein coat (causes potato spindle tuber disease)
Prion	Infectious protein particle with no nucleic acid (causes BSE / CJD)

Illustrative Examples

Example 1

Why is *Euglena* hard to place in a single kingdom of the older two-kingdom system?

Answer: *Euglena* photosynthesises in light (plant-like) but feeds heterotrophically in the dark (animal-like). This mixotrophic, unicellular eukaryote fits neither Plantae nor Animalia, which is why Whittaker placed it in **Protista**.

Example 2

An organism is the smallest known living cell, lacks a cell wall, and can survive without oxygen. Identify it and its kingdom.

Answer: It is **Mycoplasma**, belonging to **Kingdom Monera** (a wall-less prokaryote).

Example 3

Classify these by sexual spore: *Rhizopus*, *Penicillium*, *Agaricus*.

Answer: *Rhizopus* → zygospore (Phycomycetes); *Penicillium* → ascospore (Ascomycetes); *Agaricus* → basidiospore (Basidiomycetes).

Example 4

Differentiate a virus from a viroid in one line each.

Answer: A **virus** has a nucleic acid (DNA or RNA) enclosed in a protein coat (capsid). A **viroid** is a free, naked RNA with no protein coat.

Example 5

Why are lichens absent in heavily polluted industrial cities?

Answer: Lichens are extremely sensitive to air pollutants, especially **sulphur dioxide**, so they act as natural pollution indicators and cannot survive in polluted air.

Example 6

Name the protozoan groups responsible for: (a) malaria, (b) sleeping sickness, (c) amoebic dysentery.

Answer: (a) Sporozoan — *Plasmodium*; (b) Flagellated protozoan — *Trypanosoma*; (c) Amoeboid protozoan — *Entamoeba*.

Important Questions for Board Exams

1-Mark Questions (VSA)

1. Who proposed the five-kingdom system of classification and in which year?
2. Name the specialised cells in cyanobacteria that fix atmospheric nitrogen.
3. What is diatomaceous earth and where is it used?
4. Which kingdom does *Paramecium* belong to, and how does it move?
5. Name the infectious agent that contains only protein and no nucleic acid.

2–3-Mark Questions (SA)

1. State the four main criteria used by Whittaker for his five-kingdom classification.
2. Differentiate between archaebacteria and eubacteria with one example each.
3. Distinguish between Phycomycetes, Ascomycetes, and Basidiomycetes on the basis of their sexual spores.
4. Explain why viruses are regarded as being on the borderline between living and non-living.

5-Mark Questions (LA)

1. Describe the five-kingdom system of classification, giving the main features and one example of each kingdom.
2. Give an account of Kingdom Protista, describing its major groups with examples.

3. Classify Kingdom Fungi into its four classes, stating the type of hyphae, the sexual spore, and an example for each.

Quick Revision Points

- Two-kingdom (Linnaeus) → five-kingdom (Whittaker, 1969): Monera, Protista, Fungi, Plantae, Animalia
 - Criteria: cell structure, body organisation, mode of nutrition, phylogeny
 - Monera = only prokaryotes; archaebacteria (halophiles, thermoacidophiles, methanogens); eubacteria include cyanobacteria (heterocysts fix N_2)
 - Mycoplasma = smallest cell, no cell wall, survives without O_2
 - Protista (unicellular eukaryotes): chrysophytes (diatoms — silica walls), dinoflagellates (red tides, *Gonyaulax*), euglenoids (pellicle, mixotroph), slime moulds (plasmodium), protozoans
 - Protozoan groups: amoeboid, flagellated (*Trypanosoma*), ciliated (*Paramecium*), sporozoan (*Plasmodium*)
 - Fungi = chitin wall, mycelium of hyphae; classes by spore — Phycomycetes (zygospore), Ascomycetes (ascospore), Basidiomycetes (basidiospore), Deuteromycetes (asexual only)
 - Plantae = cellulose wall, autotroph; Animalia = no cell wall, heterotroph, holozoic
 - Virus = DNA or RNA + protein capsid; viroid = free RNA only; prion = protein only
 - Lichen = alga (phycobiont) + fungus (mycobiont); pollution indicator (SO_2 sensitive)
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Next Chapter: Chapter 3 — Plant Kingdom



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