Characteristics of Different Plants

Everywhere you see, you see a green cover, with different types of plants and trees. Plants and plant products are something very familiar that you use in your everyday life. But, have you ever wondered about the different types of plants and trees? Did you know that the Plant Kingdom is divided into several subgroups, with each one having special features? Delve into the depths of Kingdom Plantae and unearth some of the fascinating facts.

The kingdom Plantae consists of different types of plants that are eukaryotic, multicellular organisms having photosynthetic pigments and cell walls. Based on whether plants have a well-differentiated body and the presence or absence of specialized tissues for transport, and the ability to bear seeds, Kingdom Plantae (Plant Kingdom) is can be classified into different divisions. The features and examples of each division are mentioned hereunder.

Sub-kingdom Cryptogams and Phanerogams

Cryptogams and phanerogams are two sub-kingdoms of the kingdom Plantae. This classification system was introduced by A. W. Eichler in 1883. The main difference between cryptogams and phanerogams is that Cryptogams consist of seedless plants whereas phanerogams consist of seed-bearing plants. Etymologically: Cryptogam was derived from Greek words 'KRYPTO' meaning... 'HIDDEN' and 'GAMEEIN' meaning.... 'TO MARRY' i.e. *'Hidden Reproduction'* referring that no seed is produced. Cryptogams comprise plants like algae, mosses, and ferns. Cryptogams are non-flowering plants, which mainly reproduce by the production of spores. They do not produce fruits. Etymologically, Phanerogam is also derived from Greek words 'PHANEROS' meaning... 'VISIBLE' and 'GAMEEIN' meaning.... 'TO MARRY' i.e. *'Visible Reproduction'*, hence they bear seeds. Phanerogams comprise gymnosperms and angiosperms. Gymnosperms are non-flowering plants with naked-seeds (seeds are not covered by a fruit). Angiosperms are flowering plants that produce seeds covered by a fruit. Angiosperms are the most prominent vegetation on earth.

CRYPTOGAMS

A cryptogam is a plant that reproduces by spores without flowers or seeds. The best-known groups of cryptogams are algae, lichens, Hornworts, Liverworts, mosses and ferns. It also includes non-photosynthetic organisms traditionally classified as plants, such as fungi, slime molds and bacteria.

Sangma IVI-C

PLB III. PLANT DIVERSITY

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Characteristics of Cryptogams

- Cryptogams are group of plants that have no true flowers or seeds and that reproduce by spores as in the ferns, mosses, fungi and algae.
- In cryptogams, reproductive organs are not visible and plants reproduce by formation of spores and do not bear seeds.
- Cryptogams can be further classified into Thallophyta, Pteridophyta and Bryophyta.
- The plant structure of cryptogams is not well-differentiated into stem, leaves and roots.
- The main mechanism of reproduction of cryptogams is the production of spores.
- Cryptogams lack a well-developed vascular system for transport of water, dissolved minerals and conduction of food substances to all parts of the plant.
- Cryptogams require external water for fertilization.
- Cryptogams are considered to be less evolved plants.
- Cryptogams do not have seeds.
- Examples of cryptogams include algae, mosses, liverworts, hornworts and ferns.

PHANEROGAMS

Phanerogams are plants comprising those having reproductive organs, flowers or seeds. In phanerogams, reproductive organs are clearly visible and the plant reproduces by production of seeds where seeds germinate into new plants. Examples include: Conifers, cycads, mango, gnetophytes, banyan dicot and Ginko.

Characteristics of Phanerogams

- Phanerogams are plants comprising those having reproductive organs, flowers or seeds.
- In phanerogams, reproductive organs are clearly visible and the plant reproduces by production of seeds where seeds germinate into new plants.
- Phanerogams can be further classified into gymnosperms and angiosperms.
- The plant structure of phanerogams is well differentiated and possesses well-developed stem, leaves and roots.
- The main mechanism of reproduction is the production of gametes.
- Phanerogams have a well-developed vascular system for transport of water, dissolved minerals and conduction of food substances to all parts of the plant.
- Phanerogams do not require external water for fertilization.

Reproduction occurs through binary fission, which is the splitting of a bacterial cell after it reaches a certain size. Bacteria reproduce asexually, so the two daughter cells that result from binary fission have the same DNA as the parent cell. However, some bacteria can also exchange genetic material among one another in a process known as **horizontal gene transfer**. This method involves two already existing bacteria; it is not a form of transmission from parent to child.

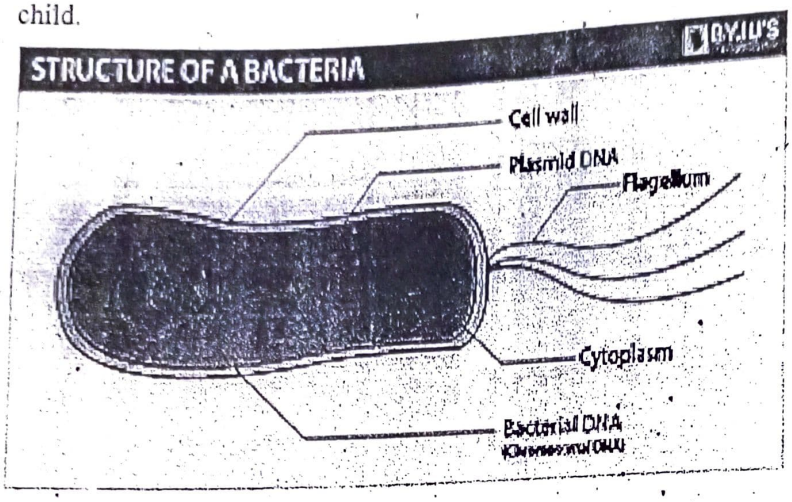


Diagram of a Bacterium Cell

Bacteria Shapes

Bacteria come in a myriad of shapes. The three main shapes of bacteria are **coccus**, **spiral**, and **bacillus**.

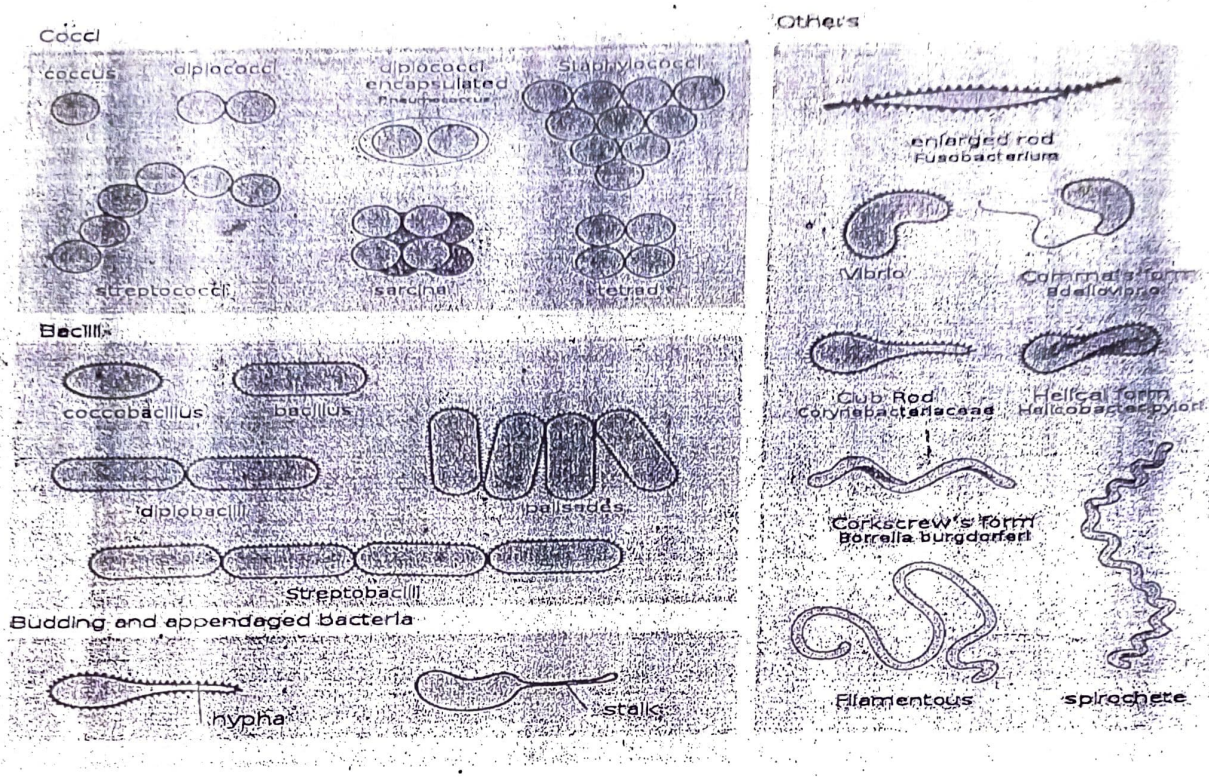
i. Cocci are bacteria that are spherical or ovoid in shape. Some cocci remain attached after binary fission, even though separate cells have been formed. For example, diplococci are cocci in pairs, streptococci are chains, and staphylococci are clusters of multiple cocci. Tetrads are square arrangements of four cocci, while sarcinae are cubes of eight cocci.

ii. Spiral bacteria are, as the name suggests, spiral-shaped. Spirillums are thick, tough spirals. Spirochetes are spirals that are thin and flexible. Vibrios are comma-shaped rods with a small twist.

iii. Bacilli are rod-shaped bacteria. Like cocci, bacilli can be solitary or arranged together. Diplobacilli are two bacilli arranged next to each other, and streptobacilli are chains of bacilli.

Assignment - Using the shapes of Bacteria give the distinguishing differences among the bacteria types.

Bacteria can also be other shapes such as filamentous (long and thin), square, star-shaped, and stalked. This diagram depicts the numerous shapes of bacteria.



Bacterial morphology diagram

Types of Bacteria

The cell wall also makes Gram staining possible. Gram staining is a method of staining bacteria involving crystal violet dye, iodine, and the counterstain safranin. Many bacteria can be classified into one of two types: gram-positive, which show the stain and appear violet in colour under a microscope, and gram-negative, which only show the counterstain, and appear red. Gram-positive bacteria appear violet because they have thick cell walls that trap the crystal violet-iodine complex. The thin cell walls of gram-negative bacteria cannot hold the violet-iodine complex, but they can hold safranin. This makes gram-negative bacteria appear red under Gram staining. Gram staining is used for general identification of bacteria or to detect the presence of certain bacteria; it cannot be used to identify bacteria in any specific way, such as at a species level. Examples of gram-positive bacteria include the genera *Listeria*, *Streptococcus*, and *Bacillus*, while gram-negative bacteria include *Proteobacteria*, green sulfur bacteria, and Cyanobacteria.

Other examples of Bacteria include *Escherichia coli*, *Lactobacillus acidophilus*, *Clostridium botulinum* etc. *Clostridium botulintum* is a very dangerous bacteria that causes botulism. It

produces the neurotoxin botulinum, which is responsible for the symptoms of botulism. Symptoms include blurred vision, nausea, trouble breathing, muscle weakness, and paralysis. Botulinum toxin is the deadliest known toxin; just one kilogram of botulinum would be deadly enough to kill the entire human population.

The Algae

The Algae (a member of Thallophytes) is an informal term for a large and diverse group of photosynthetic eukaryotic organisms. It is a polyphyletic grouping that includes species from multiple distinct clades. Included organisms range from unicellular microalgae, such as *Chlorella*, Prototheca and the diatoms, to multicellular forms, such as the giant kelp (*Fucus*), a large brown alga which may grow up to 50 metres (160 ft) in length. They are mostly aquatic free floating organisms. Although, some may be attached to the vegetation (epiphytic algae) or to rock surfaces (epilithic algae). They all posses chlorophyll, some have chlorophyll A and B; but few groups are characterised by having chlorophyll A and C (marine algae, including diatoms and brown algae). Chlorophyll D is quite rare, found only in red algae and cyanobacterium. Other accessory pigments like phycoxanthine and phycoerythrine may also be present.

The body forms of Algae are diverse; some are unicellular (e.g. *Chlamydomonas*), others are colonial (*Volvox*) while some are filamentous (*Spirogyra*). The filamentous may be branched or un-branched. The single celled are considered as the most primitive. They divide without separation. They form filament and when they are loosely held together with limited cooperation by a gelatinous substance making them appear differentiated and cooperate with one another, they form **colony**. The most advanced are those that have **Siphon** (siphonatious).

There are no supportive tissues; therefore they depend entirely on water for support. Every cell is capable of carrying out photosynthesis to meet its food requirement; therefore no conducting tissue is present. The most advanced member of the group e.g. the Giant Kelp (e.g. *Laminaria*) have a phloem-like tissue in the stipes which grow to several meters long.

The algae are divided into dimensions based mainly on the nature of their pigments and to some extent on their structure. Generally, they can be grouped into two: viz; Prokaryotic (no membrane) and Eukaryotic (having membrane). Example of Prokaryotic is the Cyanophyta which are the Blue-green algae (Cyanobacteria) e.g. *Oscillatoria* and *Nostoc*. The Eukaryotic algae are as follows:

a. Rhodophyta (Red Algae e.g. *Porphyra* and *Polysiphonia*)

b. Bacillariophyta (The Diatoms e.g. *Tabellaria* and *Amphipleura*)
c. Phaeophyta (Brown Algae e.g. *Laminaria* and *Fucus*)
d. Chlorophyta (Green Algae e.g. *Spirogyra* and *Oedogonium*)
e. Euglenophyta (Euglenoid Algae e.g. *Euglena*)
f. Xanthophyta (Yellow-green Algae e.g. *Tribonema*)
g. Chrysophyta (Golden Algae e.g. *Ochromonas* and *Chrysosaccus*)
h. Pyrrophyta (The Dinoflagellates e.g. *Ceratium* and *Oodinium*)

FUNGI

These are non-chlorophyll bearing lower plants but are regarded as plants because they contain cellulose. Fungi generally possess simple plant body which is not differentiated into roots, stems or leaves. The fungi like other thallophytes also lack the typical conducting tissues of the higher plants in the form of xylem and phloem.

Characteristics of Fungi

a. Fungi are achlorophyllous i.e. they lack chlorophyll; hence they are not usually green in colour. Where we have fungi that are green in colour like *Penicillium*, the colour is not due to the presence of chlorophyll.
b. Fungi are non-photosynthetic since they lack chlorophyll, they are heterotrophic (saprophytic or parasitic) in their mode of nutrition.
c. Their vegetative body is made of hyphae which is made up of thread-like filament called mycelium (vegetative body)
d. The hyphae usually contain either cellulose or chitin or both substances
e. In lower fungal groups like *Mucor*, the vegetative body has no cross walls (septa); hence they are non-septate.

Classification of Fungi

Although, there is no unanimous classification of fungi among mycologists, but for the purpose of this class, The division of mycota, or fungi and moulds, includes the true slime moulds (Myxomycetes), the lower fungi (Phycomycetes), and the higher fungi (Eumycetes). The myxomycetes contain about 300 species and are not regarded as true fungi. Their body consists of a naked mass of protoplasm, several nuclei and no cell wall. Therefore, it is referred to as *Plasmodium* with no definite shape. They move by amoeboid movement, engulfing food particles which they come in contact with. These characteristics, including amoeboid movement, absence of

cell wall and taking in of solid food particles could make them to be regarded as animals. However, they are plants because they reproduce by formation of spores with cellulose cell walls. They are mostly saprophytes.

On the Basis of Spore Production

On the basis of the organisation of the vegetative thallus, the morphology of reproductive structures, the way of spores production and particular life cycle involved the kingdom mycota is classified into following divisions.

Phycomycetes

- The class Phycomycetes (lower fungi) contains fungi with relatively simple thalli. They possess a vegetative mycelium which is usually non-septate and multinucleate.
- Phycomycetes reproduce by both sexual and asexual methods. Examples include: *Mucor*, *Rhizopus*, *Phytophtora* etc.
- It includes the simplest type of fungi. It is also called as Algae-Fungi because most of the characteristics of them are similar to algae like *Vaucheria*.
- They have simple thallus which is unicellular or coenocytic or aseptate filaments.
- They reproduce asexually by the formation of zoospores or non-motile spores.
- Sexual reproduction is isogamous or heterogamous which takes place by gametangial contact.
- The diploid phase is represented by zygote.
- Phycomycetes has been classified into subclasses: oomycetes and zygomycetes.

Oomycetes

- Oomycetes range from a primitive unicellular thallus to a profusely branched filamentous mycelium.
- They are the common water moulds
- Many members of them are terrestrial and obligate parasites.
- Asexually they reproduce by biflagellate zoospores.
- Sexual reproduction is oogamy that involves the fusion of male and female gametes to form oospore.
- Oospore undergoes meioses to produce haploid biflagellate zoospores.
- Example; *Phytophthora infestans* (causes potato blight)

Ascomycetes

- The species of ascomycetes are called the sac fungi because they produce sexual pores within the sac-like vascus.
- General Characteristics
- Ascomycetes are mostly terrestrial occurring as saprophytes or parasites.
- They have well-developed, branched, septate mycelium except yeast. Yeast is a unicellular fungus.
- Asexually they reproduce by non-motile spores, conidia, oidia or chlamydospores.
- Sexual reproduction takes place by the fusion of gametangia of opposite mating types.
- There is absence of motile cells.
- Examples, Saccharomyces cerevisiae, Penicillium, Aspergillus etc.

Basidiomycetes

- The members of basidiomycetes are saprophytic or parasitic. The group is named basidiomycetes as they produce the basidiospores at the club-shaped basidium during sexual reproduction.

- Mycelium is highly developed, profusely branched and septate.
- The mycelia are differentiated into two mating types; (+ve) and (-ve).
- There are two kinds of mycelium; primary mycelium and secondary mycelium.
- Asexual reproduction takes place by fragmentation, budding, oidia, conidia or chlamydospore.
- The dikaryotic cell is formed during sexual reproduction.
- The absence of motile cell throughout the life cycle.
- Basidiomycetes are the most advanced fungi as their fructifications are often large and prominent.
- Examples; Mushrooms, Puccinia, Ustilago etc.

Deuteromycetes (The Imperfect Fungi)

- Deuteromycetes compromises more than 17000 species of the diverse habits and habitats. It is considered as an artificial class of fungi.
- The fungi are saprophytes as well as parasites.Parasitic fungi cause serious diseases to plants, animals including human beings.
- Some of them are unicellular while others are multicellular.
- They reproduce asexually by conidia along with some other types of spores.
- The sexual reproduction is entirely absent.
- The asexual stage or imperfect stage in Deuteromycetes is well defined. But the sexual or perfect stage is absent in life cycle, therefore, they are called 'Fungi Imperfecti'.
- Example; *Alternaria*, *Fusarium*, *Helminthosporium* etc.

BRYOPHYTA

The term Bryophyta is derived from the Greek words "Bryon" which means **Moss**, and "Phyton" which means **Plant**. The term is now used as a collective one for a group of well defined and easy to recognize lower plants that are commonly referred to as the **amphibians of the plant kingdom**. This group represents the first plant to colonize land. However, they depend on water entirely for their reproduction; hence they are limited to moist habitat or habitat which may be occasionally flooded. They are limited in sizes i.e. they remain very small plants. Their body shows evidence of differentiation or the beginning of it so that the body is divided into leaf-like, stem-like and root-like structure. The sporophyte is either contained inside the gametophyte i.e. completely depend on the gametophyte or attached to it and depend entirely on it. The gametophyte phase (haploid) is therefore the dominant or conspicuous or prominent generation which is always available as the plant. The root-like structure (Rhizoid) is responsible for water absorption to all over the plant body.

Classification of Bryophytes

The bryophytes have been classified into three major classes; i.e. Hepaticae (the Liverwort), Anthocerotae (the Hornworts) and Musci (the Mosses).

Hepaticae: e.g *Marchantia* a Thalloid Liverwort

These are the most primitive of the group; they grow in moist shady places. The gametophyte, which is a thallus structure which is ribbon shaped, is the dominant phase while the sporophyte is contained within and depend on the gametophyte. The body is a flattened thallus which is green and branches into a number of deeply-lobed dichotomous branches. The upper surface of the thallus is made up of the cells (chloroplasts) that carry out photosynthesis as well as air pores. On the lower surface, it contains a row of single-celled RHIZOID which are for absorption of water and minerals.

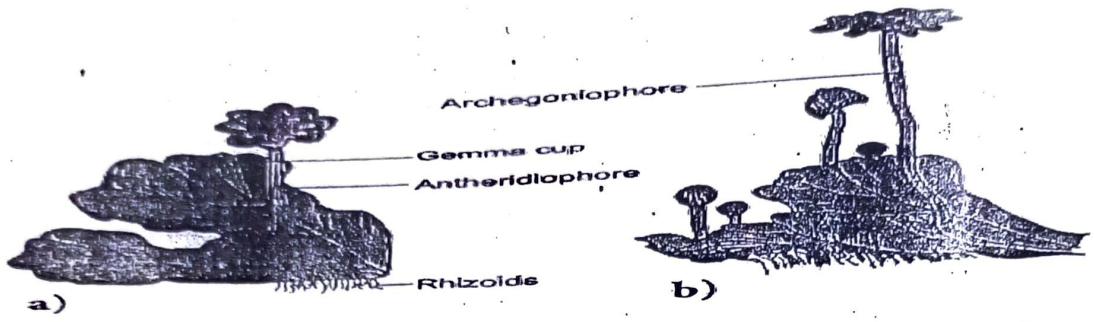
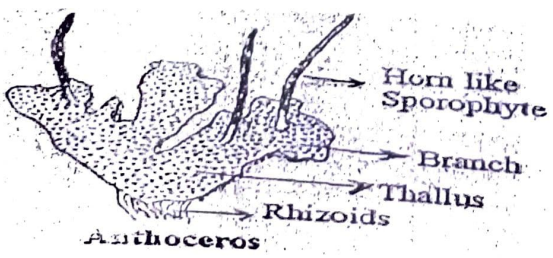


Diagram of *Marchantia*: a is Male Plant, b is Female Plant

Anthocerotae e.g *Anthoceros*

Species of *Anthoceros* are characterized by having a small to medium-sized, green thallus that is more or less lobed along the margins. The sporophytes of *Anthoceros* are larger and much more complex than those of *Riccia*, *Marchantia*, and *Pellia*.The mature sporophyte consist of a bulbous foot, a meristematic region and a smooth, long, slender, cylindrical capsule. Sporogonium appears like a bristle or horn. There is no seta. This hornwort grows in moist clay soils on hills, in ditches, and in damp hollows among rocks. The adult plant body is a gametophyte. Thallus is prostrate, green, fleshy, dorso-ventrally flattened, gametophytic with rare dichotomous branching . it lacks air chambers and scales, it has no well defined mid rib. it has unicellular smooth rhizoids in the ventral region. Thallus is irregularly lobed with folded margins. *Anthoceros* species are host to species of *Nostoc*, a symbiotic relationship in which Nostoc provides nitrogen to its host through cells known as heterocysts, and which are able to carry out photosynthesis.



Musci: Mosses e.g Funaria

Mosses typically form dense green clumps or mats, often in damp or shady locations. The individual plants are usually composed of simple leaves that are generally only one cell thick, attached to a stem-like structure that may be branched or unbranched and has only a limited role in conducting water and nutrients. The stem-like structure bears small spirally arranged green leaf-like structures with upright or vertical branches. The 'leaves' are single celled layer with very thin cell wall through which water and air enters very easily. Water can move up a short stem through capillary actions. Rhizoids are found at the base of the stem which absorbs water and nutrients. Because they grow closely together, this improves their water holding capacity and they can withstand extreme desiccation to a great extent. The gametophyte is the dominant and prominent structure while the sporophyte remains attached and dependent on it for nutrition.