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BIOLOGICAL CLASSIFICATION

TWO KINGDOM CLASSIFICATION

This is an older system of classification. It was introduced by Carolus Linnaeus in 1758. He recognised two groups of organisms only- plants and animals. •

The Kingdom Plantae included all the organisms which were fixed in a place, had a spread out appearance, prepared their own food and had a cellulose cell wall. It included all the green plants, mosses, fungi, lichens and bacteria. •

The Kingdom Animalia included all the organisms which could move about, had a compact body, had a heterotrophic nutrition and lacked a rigid cell wall. It included all multicellular forms and unicellular organisms called protozoa.

Kingdom Plantae:

It included all organisms that showed the following features:

•Organisms which were stationary, i.e., fixed at a place.

• Prepared their own food by trapping Sun's energy.

• Had cells with a cell wall.

• Had chlorophyll in the chloroplasts, i.e., to make their food.

• Some could grow indefinitely

Kingdom Animalia:

It included all organisms with the following features:

• Organisms which could move about.

• Could not prepare their food and depend on other plants and animals for food.

• Cells did not have a cell wall.

• Cells did not have chlorophyll.

• Bodies stop growing after attaining a certain size.

Major disputes in placements of some groups

The placement of following groups of organisms was the cause of some of the major disputes among taxonomists

i) Many single celled animals like Euglena have features of both plants and animals. Euglena can propel through water and can take in food like an animal in the absence of light. However it contains chlorophyll and can synthesise its food like higher plants in the presence of light and in the absence of organic matter.

(ii) Some unicellular organisms like slime moulds lack a cell wall in the vegetative stage but develop one during the reproductive stage

(iii) Fungi grow on dead organic matter, and live by decomposing and absorbing organic matter, rather than photosynthesis (they lack chlorophyll).

(iv) Lichens are living organisms and grow on a rock or on the bark of aree and can be mistaken as non-living objects. They consistofasymbiotic associationofa fungus and algae.

(v) Bacteria could not be classified as plants or animals.

They were first observed by a Dutch physician Anton van Leeuwenhoek in 1675 when he studied the teeth scraping under the microscope

Main disadvantages of the two Kingdom Classification

1. Prokaryotes (organisms without true nucleus) like bacteria and blue-green algae and eukaryotes (organisms with true nucleus) had been put together.

2. The non-photosynthetic fungi having chitin in their cell walls had been clubbed together with photosynthetic green plants having

cellulosic cell walls. The classification did not differentiate between the heterotrophic fungi and the autotrophic green plants.

3. Unicellular organisms and multicellular organisms were put together in one group.

Though two kingdom classification was used for a long time, it was found to be inadequate due to the reasons cited above. A need was felt to include not only morphology but other features like (1) cell structure (complexity) (1) nature of cell wall (1) mode of nutrition (iv) evolutionary relationships and (v) methods of reproduction. Hence the classification has undergone several changes over a period of time. Currently we are following a five kingdom classification.

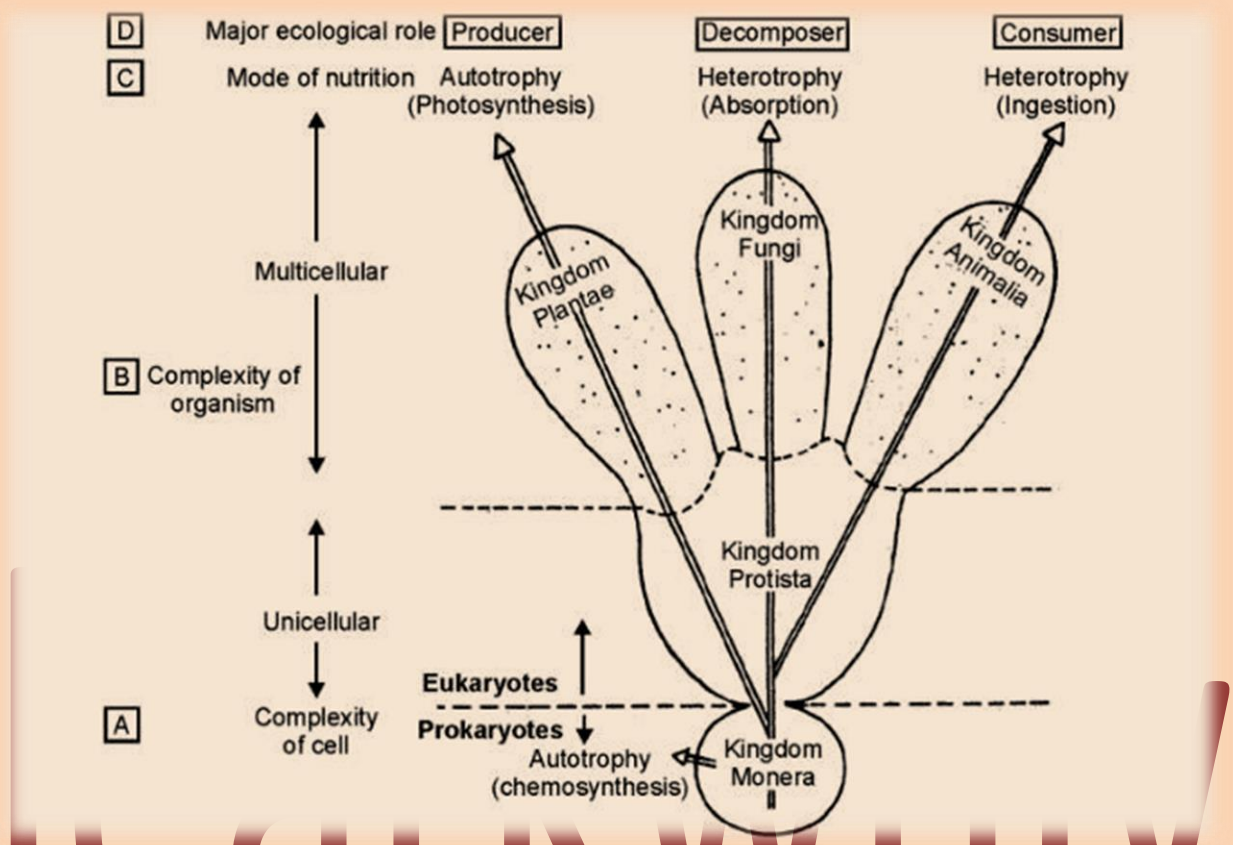
FIVE KINGDOM CLASSIFICATION

Basis of five kingdom classification It was proposed by Whittaker in 1969. The five kingdom classification is based on the following criteria.

1. The complexity of cell structure Prokaryote or Eukaryote Class

2. The complexity of organism's body Unicellular or Multicellular –

3. The mode of obtaining nutrition Autotrophs or Heterotrophs - The five kingdoms are Monera, Protista, Plantae, Fungi and Animalia .



KINGDOM MONERA

Important features

1. Unicellular (single-celled) and Prokaryotic (absence of a true well defined nucleus) organisms. They also lack other membrane-bound organelles.

2. Microscopic organisms. They are the smallest and most plentiful on earth.

3. Most of them have a rigid cell wall.

4. Have a simple structure but are very complex in behaviour.

5. Bacteria as a group show the most extensive metabolic diversity.

6. They are known as the decomposers and mineralizers in the biosphere.

Archaebacteria

(a) Halophiles (extreme salty areas): Can live in strong salt solutions

(b) Methanogens (Marshy areas): Produce methane gas. Found in plenty in marshy areas.

Also found in gut of ruminant animals like cows and buffaloes. Rumen is the first chamber in the stomach of cattle where cellulose is digested. For Class As they are found plentiful in dung, they are used in production of methane (biogas) from dung in rural areas.

(c) Thermoacidophiles (hot springs): Found in hot sulphur springs at high temperature of 80°-100°C.

They are able to survive in extreme conditions due to the presence of a unique cell wall that differs from other bacteria. The cell wall consists of polysaccharides and protein.

Eubacteria

Eubacteria Also referred to as true bacteria, they are present in abundance.

They have been put in two groups,

(i) cyanobacteria and (ii) bacteria.

Cyanobacteria

(i) They are commonly known as blue-green algae. They are supposed to be the earliest oxygenic photosynthesizes.

(ii) They have chlorophyll a similar to green plants and are photosynthetic autotrophs.

(iii) They are unicellular, colonial or filamentous, marine or terrestrial algae.

(iv) Their colonies are generally surrounded by a gelatinous sheath. Heterocyst Mucilaginous sheath

(v) They often form blooms in polluted water bodies.

Examples: Nostoc, Anabaena (both can fix atmospheric nitrogen), Spirullina (make protein-rich food).

Bacteria

(i) They are microscopic, unicellular, small organisms.

(ii) They vary greatly in shape.

(iii) Bacterial cells are generally surrounded by a capsule or a slime layer under which is present a cell wall.

(iv) Cell wall contains a material murein or peptidoglycan that gives protection against chemical and mechanical injury.

(v) The genetic material is in the form of single circular DNA.

(vi) Cytoplasm appears granular due to the presence of food, lipid and glycogen granules.

(vii) Many bacteria may have flagella.

Autotrophic

Could be photoautotrophic, using sunlight as a source of energy. - Could also be chemosynthetic autotrophic, as they oxidize various inorganic substances like nitrates, nitrites and ammonia and use the released energy for their ATP production.

Heterotrophic:

They are the most abundant and could be saprophytes, symbionts Cas and parasites. Majority are saprophytes. Saprophytes are the major decomposers in nature and play an important role in recycling of nutrients. Symbionts like Rhizobium found in the roots of leguminous plants like pea, fix atmospheric nitrogen. Parasites: A number of them are pathogens, causing damage to human beings, crops, farm animals and pets. They cause a number of diseases.

Reproduction: Bacteria reproduce mainly by binary fission. - Under unfavorable conditions, they reproduce by spore formation.

The bacterial spores can withstand extreme conditions and germinate under favorable conditions and become active cells again. Bacteria show a form of sexual reproduction called conjugation whereby DNA is transferred from one bacterium to the other.

Mycoplasmas

1. Mycoplasmas are the smallest known prokaryotes. They lack a cell wall, hence can change shape easily.

2. They can survive without oxygen.

3. Many mycoplasmas are pathogenic in animals and plants. Pleuropneumonia-like organisms (PPLOS) cause pleuropneumonia in animals and witches' broom in plants.

KINGDOM PROTISTA

Important features

1. Kingdom Protista includes single-celled (unicellular), eukaryotic microscopic organisms. Most of the protista are primarily aquatic.

2. The cells have eukaryotic cell organisation, i.e., have a true well defined nucleus and membrane bound organelles like mitochondria, endoplasmic reticulum, plastid etc

3. Protists exhibit various lifestyles, some resemble the plants, some animal and some fungi. The autotrophic plant-like forms are Protistan algae, the heterotrophic animal-like forms are Protozoan Protists and the decomposer fungi-like forms include slime moulds.

4. They have various modes of nutrition.

(a) Photosynthetic autotrophs:

Known as the chief producers in oceans and in freshwater environments e.g. unicellular algae and diatoms. (All the minute plants floating on the surface are called phytoplanktons). They have a cell wall.

(b) Non-photosynthetic heterotrophs:

These are zooplanktons, the minute animals floating on the surface and protozoans that feed on other protista or particulate food. They do not have a cell wall and have a holozoic kind of nutrition.

5. Protists reproduce asexually by binary fission and sexually by a process involving cell fusion and zygote formation.

Chrysophytes

The group includes diatoms and golden brown algae (desmids).

1. They are microscopic and float passively in water currents and are call phytoplankton's.

2. They are found in freshwater as well as in marine water.

3. In diatoms, the cell walls form two thin overlapping shells, which fit together like a soap box. They have deposits of silica in their cell walls, thus the walls are indestructible

When the diatoms die, they leave behind silica cell walls. This accumulation over billions of years has led to large deposits of silica on ocean floors called diatomaceous earth.

For Examples: Triceratium (diatom), Chrysosphaerella (golden brown algae).

Dinoflagellates

1. They are unicellular, mostly marine and photosynthetic organisms.

2. They are next to diatoms as producers in oceans.

3. They appear yellow, green, brown, blue or red depending upon the main pigment present in their cells. Some are bioluminescent also.

4 .The body is enclosed in stiff cellulose wall divided into plates giving an armoured appearance.

5. Usually have two unequal flagella, one lies longitudinally and the other transversely in a furrow between the wall plates.

6. Very often, red dinoflagellates like Gonyaulax, undergo rapid multiplication and cause blooms that make the sea appear red (red tides). The toxins released by such large number kill marine animals including fish. Examples: Gonyaulax, Glenodinium

Euglenoids

1. They are unicellular and free-living, majority of them are freshwater organisms, found in stagnant water.

2. Instead of a cell wall, they have a protein-rich layer called pellicle which is flexible and allows a change in shape.

3. They have 2 flagella, short and a long one. The long flagella helps in locomotion.

4. They have chlorophyll, hence can photosynthesize. Though, they are photosynthetic in the presence of sunlight, when deprived of sunlight, they behave like heterotrophs by predating on small organisms.

They reproduce asexually by longitudinal binary fission and by cysts during unfavorable conditions, eg euglena

Slime moulds

1. They are saprophytic protists.

2. The body moves along decaying twigs and leaves engulfing the organic material.

3. Under favorable conditions, they form an aggregation called plasmodium containing thousands of nuclei, which may grow and spread over several feet flowing in a amoeboid manner on the soil of a forest or on dead leaves and stems.

4. During unfavorable conditions, the plasmodium differentiates and forms fruiting bodies bearing spores at their tips. The spores possess true walls.

Example: Dictyostelium.

Protozoans

•It is a diverse group and all protozoans are heterotrophs and live as predators or parasites. Each protozoan is capable of functioning as an independent unit, performing all vital activities of life. They are believed to be primitive relatives of animals.

• They are found in all environments.

There are 4 major groups.

(i) Amoeboid protozoans

(ii) Flagellated protozoans

(iii) Ciliated protozoans

(iv) Sporozoans

1. Amoeboid protozoans

(i) They can be found in freshwater, sea water or moist soil.

(ii) They do not have a definite shape. They have pseudopodia (false feet) by which they move and capture their prey. They can extend pseudopodia in any direction for locomotion and engulfing prey.

iii) Marine forms like Radiolaria have silica shells on their surface.

(iv) Some of the members are parasites in humans and animals. Examples: Amoeba (freshwater form), Entamoeba (a parasite that causes amoebic dysentery in man), Radiolaria (marine form).

2. Flagellated protozoans

(i) They are either free-living or parasitic.

(ii) They have a semi-rigid covering called pellicle that gives flexibility.

(iii) They have flagella that help in locomotion.

(iv) The parasitic forms cause diseases in humans and animals. Example: Trypanosoma (causes sleeping sickness in man).

3. Ciliated protozoans

(i) They have a characteristic shape.

(ii) They are all aquatic, actively moving organisms having cilia all over their body.

(iii) They have an oral groove that leads into a cavity alled gullet.

(iv) The coordinated movement of rows of cilia causes the water laden with food to be steered into gullet. Food is digested in the food vacuole and undigested waste is thrown out from the anal Example: Paramecium pore.

4. Sporozoans

(i) It is a group of mainly parasitic protozoans.

(ii) They have a simple structure because of parasitic mode of life.
(iii) They have an infectious spore-like stage in their life cycle.
Example: Plasmodium (malarial parasite) causes malaria in humans.

KINGDOM FUNGI

Important features

1. The kingdom fungi includes a unique group of heterotrophic and eukaryotic organisms which do not have chlorophyll, hence cannot prepare their food.

2. They show a great diversity in morphology and habitat. They range in size from microscopic yeast to mushrooms and huge puff balls.

3. They have a multicellular body with the exception of yeast which is a unicellular fungus.

4. The mushrooms are reproductive structures arising from filamentous multinucleate mass of vegetative body which is found within the tissues of wood. Body consists of elongated filaments called hyphae which form a network called mycelium.

5. They have rigid cell walls made up of chitin and polysaccharides.

6. Fungi could be parasitic, saprophytic or symbiotic. Mainly they are saprophytic, i.e., they live on dead and decaying organic matter.

Lichens - Association of fungi and algae

Mycorrhizae - Association of fungi and roots of higher plants

7. Fungi reproduce both by asexual and sexual means.

Examples: Yeast (unicellular fungi), Aspergillus, Agaricus (Mushroom), Penicillium, Rhizopus (Bread mould).

Asexual reproduction is by various means like budding, fission and fragmentation and by spores called conidia or sporangiospores or zoospores.

Sexual reproduction is spores are formed in distinct structures called fruiting bodies.

The sexual cycle involves the following three steps:

(i) Fusion of protoplasm's between two motile or non-motile gametes called plasmogamy.

(ii) Fusion of two nuclei called karyogamy.

(iii) Meiosis in zygote resulting in haploid spores.

When a fungus reproduces sexually, two haploid hyphae of compatible mating types come together and fuse. In some fungi the fusion of two haploid cells immediately results in diploid cells (2n). However, in other fungi (ascomycetes and basidiomycetes), an intervening dikaryotic stage (n + n, i.e., two nuclei per cell) occurs; such a condition is called a dikaryon and the phase is called dikaryophase of fungus. Later, the parental nuclei fuse and the cells become diploid. The fungi form fruiting bodies in which reduction division occurs, leading to formation of haploid spores.

1 Phycomycetes

(i) The phycomycetes fungi can be found in aquatic habitats on decaying wood in moist and damp places or as obligate parasites on plants.

(ii) The mycelium is aseptate and coenocytic meaning that there are no cross walls. The protoplasm has many nuclei.

(iii) Asexual reproduction takes place by the formation of motile zoospore or by non- motile aplanospores. The spores are produced endogenously in the sporangium.

(iv) Phycomycetes are also called zygomycetes because of the formation of a diploid zygospore during sexual reproduction.

Zygospore is formed by the fusion of two gametes.

Examples: Rhizopus (bread mould), Mucor and Albugo (parasitic fungi on mustard) etc.

2. Ascomycetes

1. They include familiar members like unicellular yeast or multicellular fungi like Penicillium, blue and green moulds of blue cheese and citrus fruits and edible morels.

2. They are mainly saprophytic or parasitic.

3. They have septate and branched hyphae producing the mycelium. The tube-like haploid hyphae have large pores in septa through which nuclei can migrate.

4. Asexual reproduction is by producing asexual spores called conidia produced exogenously on the tips of special hyphae called conidiophores. Conidia on germination produce mycelium.

5. Sexual reproduction occurs by sexual spores called ascospores which are produced endogenously in sac-like structures called asci .

These asci are arranged in different types of fruiting bodies called ascocarps.

Examples: Saccharomyces (Yeast), unicellular fungi

Penicillium, from which antibiotic penicillin is derived

Aspergillus, Claviceps are parasitic fungi,

3. Basidiomycetes

The most commonly known forms of this fungi are mushrooms, bracket fungi or puff balls.

1. They grow in soil, on logs and tree stumps and in living plant bodies as parasites in the form of rusts and smuts.

2. The mycelium is branched and septate.

3. Asexual spores are generally not found, but vegetative reproduction can take place by fragmentation.

4. Sexual reproduction occurs by fusion of two different strains of haploid mycelium giving rise to a dikaryotic mycelium.

5. The common name, club fungi refers to club shaped structures called basidia formed at the end of certain reproductive hyphae.

Examples: Agaricus (mushrooms); Ustilago (smut; a parasitic fungus), Puccinia (rust fungus; a parasitic fungus).

4. Deuteromycetes (Imperfect fungi)

1. They are commonly known as imperfect fungi because only the asexual or vegetative phases of these fungi are known. Sexual reproduction has not been observed so far.

2. They reproduce only by asexual spores known as conidia.

3. The mycelium is septate and branched.

4. Some members are saprophytes, some are parasites while a large number are decomposers of litter and help in recycling of minerals. This group includes a number of human parasites that cause athlete's foot or ringworm.

Example :- Altornaria Colletotrichum Trichoderma

KINGDOM PLANTAE

Important features

1. It includes all eukaryotic coloured photosynthetic plants present on land and in water (sea, lakes and streams).

2. Have a rigid cellulose cell wall that does not allow the cells to contract or relax.

3. They are immotile (fixed at one place) and do not have any locomotory organs.

4. Mostly autotrophic and synthesise food by photosynthesis.

5. Few are heterotrophic and have different modes of nutrition.

6. Life cycle of plants exhibits a phenomenon called alternation of generation. These plants have two distinct phases-the diploid sporophytic phase and haploid gametophytic phase.

KINGDOM ANIMALIA

Important features

1 It includes all multicellular animals known as metazoans

2 Their cells da not have cell wall

3. Generally motile (have locomotory organs)

4. The mobiliny is made possible by development of muscular and nervous system.

higher forms have elaborate sensory and neuromotor mechanism.

5. They directly or indirectly depend on plats for food. They digest their food in an internal cavity (like stomach)a nd store food reserve as glycogen or fat.

6. they have hetrotropic mode of nutrition.

a) Most are free living and have a holozoic form of nutrition that includes ingestion, digestion, absorption, assimilation and egestion.

(b) Some are parasitic on other metazoans and plants.

(c) A few are symbiotic which live in association with other photosynthetic protists.

7. They follow a definite growth patterns and grow into adults.

8. They are the basic consumers on earth and form links in various food chains and food webs.

9. The sexual reproduction is by fusion of gametes, followed by embryological development.

VIRUSES

Important features

Viruses are unique in so many ways.

1. They cannot be termed as prokaryotes or eukaryotes as they do not have a cellular structure. They contain hereditary material in the form of DNA or RNA forming a core enclosed in a protein coat called capsid.

2. They exhibit properties of both living and non-living things. A virus has no metabolic activity of its own. It becomes active and multiplies when it infects (attacks) a specific living host cell. When removed from a cell, it can be stored as a crystal in a bottle for several years. A virus can survive as a parasite only inside a living cell. So they are said to be intracellular obligate parasites.

3. Viruses are much smaller than bacteria. They are considered to be smallest living organisms. The size is about 20 nm to 300 nm, which is about 50 times smaller than bacteria.

4. Biologists are not clear so far whether they are early primitive forms of living things or are highly evolved super parasites.

5. Viral genomes are small and contain the information to code for a few proteins only. Viruses make use of the host machinery like enzymes, ribosomes and other components to form more of viral particles rather than the host cell constituents.

6. The genetic material of viruses could be DNA or RNA. No virus contains both DNA and RNA. For example

Influenza virus and smallpox virus contain DNA. - Bacterial viruses (bacteriophages contain double-stranded DNA. Mumps virus, measles virus AIDS virus, Hepatitis B virus, herpes virus contain single or double-stranded RNA.

7. The viruses are very specific about the host they infect. They have been classified into three categories according to the hosts they live in. These are bacterial viruses also called bacteriophages (or phages) that infect bacterial cells, plant viruses that infect plant cells and animal viruses that infect animal cells.

8. When a virus infects a cell, it disrupts the host's metabolism. The virus makes use of the metabolic machinery of the cell to replicate its own kind. The diseased host cell ultimately bursts open, releasing new viruses.

Structure of a virus

Viruses do not have a cellular structure. They basically contain the genetic material, either DNA or RNA forming a core, surrounded and protected by a protein coat called capsid.

Some viruses like herpes or influenza viruses have an additional membranous envelope made up of lipoproteins.

A viruses is a nucleoprotein and the genetic material is infectious.

In general the viruses that infect plants have single-stranded RNA and that infect animals have either single or double-stranded RNA or double-stranded DNA.

Bacteriophages usually have double-stranded DNA. The protein coat called capsid is made up of small subunits called capsomeres. The capsomeres are arranged in a helical or polyhedral geometric form.

Diseases caused by viruses

Viruses cause a number of diseases in animals including humans and plants.

Diseases in humans: Mumps, small pox, chicken pox, herpes, influenza, swine flu (by H,N, virus), common cold, AIDS etc.

Diseases in plants: Viruses cause a number of diseases in pänts which are visible in the form of mosaic pattern on leaves, leaf rolling and curling, yellowing and vein clearing, dwarfing and stunted growth.

VIROIDS

1. These are even smaller than viruses. They were discovered by T.O. Diener in 1971 as a new infectious agent that caused potato spindle tuber disease.

2. They consist of free RNA molecule. They lack the protein coat found in viruses, hence they are called viroids.

3. The RNA of the viroids is of low molecular weight.

LICHENS

Important features

These are composed of a symbiotic association of the fungus with an algae or cyanobacterium.

The fungus is an ascomycetes or basidiomycetes. There are about 400 genera and 15,000 species of lichens that have been identified.

The plant body of a lichen is small and does not resemble the either partner. It consists of a mass of fungal hyphae among which the algal cells are scattered.

In this association, both organisms benefit each other. The fungus absorbs water and minerals from the surface and alga in turn prepares food by photosynthesis.

Morphologically the lichens are of three types

(i) Crustose: Spread as hard, granular crust.

(ii) Foliose: Resemble flattened leathery leaves.

(iii) Fruticose: Look like a network of slender branches.

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