BIO 206: SEEDLESS PLANT

COURSE OUTLINE

- Morphology and reproduction of Algae, Fungi, Bacteria, Fossil, Bryophytes and Pteridophytes
- Bryophytes as indicator of atmospheric pollution
- Factors affecting the structures and physical properties of Organic Compounds
- Factors affecting the availability of electrons
  - Stereochemistry
  - Methane
  - Energy of activation and free radical substitution reaction in alkanes
  - Functional group chemistry
  - Electrophilic and Nucleophilic substitution reaction rom
  - Aromacity
  - Organic reactions e.g Addition free radical and elimination reaction

Morphology and Reproduction in Algae

- Algae Introduction
- The study of algae known as Phycology.
- Algae are simple, Unicellular, non-jacked sex organ and have no embryo development.
- Algae are aquatic plants they can be present in marine or fresh water.
- All algae are present in Kingdom protista.
- Most live in water attached to rocks for free floating.
- Use sunlight for photosynthesis.
- Main food producers in the oceans.
- Important suppliers of oxygen diatoms used in detergents, paint removers, toothpaste Golden algae.

Types of Algae

The five algal phyla are:

- Bacillariophyta (Diatoms)
- Chlorophyta (Green Algae)
- Cyanopyta (Blue-Green Algae)
- Chrysophyta (Yellow-Green Algae)
- Rhodophyta (Red Algae)

GENERAL STRUCTURE

- Thallic (haploid)

Algae structure

- Unicellular
- Colonial
- Filamentous
- multicellular

- Unicells: single cells, motile with flagellate (like Chlamydomonas and Euglena) or nonmotile (like Diatoms).

- Colonies: Assemblage of individual cells with variable or constant number of cells that remain constant throughout the colony life in mucilaginous matrix (containing an extracellular matrix made of a gelatinous glycoprotein).

- These colonies may be motile (like Volvox and Pandorina) or nonmotile (like Scendesmus and Pediastrum).

- Filaments: Daughter cells remain attached after cell division and form a cell chain adjacent cells share cell wall maybe unbranched such as Zygnema and Ulthrix) or branched such as Cladophora.

Reproduction in Algae

- Sexual: gametes unite to form a zygote (sperm/egg) Most sexual reproduction is triggered by environmental stress. Sexual Reproduction Meiosis Zoospores Plus and minus gametes Zygospore.

- Asexual: No gametes (no union of cells).

- Mitosis (unicellular cell may divide into two new cells).

Asexual Reproduction

- i. Fragmentation
- ii. Spores
- iii. Binary fission

Spirogyra reproduce sexually by conjugation

- Range in size from microscopic to single celled organisms to large seaweed.
- Autotrophic .
- Form the reproductive structures – gametangia or gamete chambers.
- Aquatic and have flagella at some point in life.
- Often contain pyrenoids, organelles that synthesis and store starch.

General Characteristics

- Some algal divisions can also be classified as bacteria, protozoa, but most are classified as protista.
- Only green algae are true plants in the evolutionary sense.
- They are primitive plants No true roots, only attachment structures (Holdfasts).
- Produce spores (not seeds).
- motile or non-motile.
- Most have sexual and asexual reproduction.
- Non-vascular, do not possess an internal transport system.

Economic Importance Algae

- Algae is used in biofuel production.

- Agar-Agar medium is gotten from algae and it is a dried, jelly like, non-nitrogeneous substance which is used as a base of different culture media in laboratory for culturing microorganisms.

- Its food value and ability to afford good range of temperature for culturing .

- Alginates: • The alginates are used in rubber-tyre industry, Paints, ice-creams, and in presentation of flame-proof fabrics and plastic particles.

- Carrageenin
  - It is a carbohydrate mucilage algae extracted from Red algae.
  - It is used as clearing agent in beer preparation.
  - in preparation of tooth-pastes, cosmetics, paints and in pharmaceutical industries iodine.
  - The member of brown algae such as luminaria and focus yield iodine.

- Diatomite
  - It is cell wall material of diatoms.
  - It is variously such as food for many aquatic animals .
  - Used in filtration process in sugar refining and brewing industry as source of food.
  - More than 100 species belonging to green-,brown-,red- algae are used as food by humans because presence of proteins, carbohydrates, minerals and vitamins.

- Antibiotics and Medicines
  - Some algae yield antibiotics e-g, Chlorellin which is obtained from green alga Chlorella, that inhibits the growth of certain bacteria.
  - Brown algae is used in manufacture of various goiter medicines.

- Harmful Aspects of algae

They cause water blooms which leads to:

  - Death of living organisms.

  - Diseases in human beings parasitic activities.

MORPHOLOGY OF FUNGI

- Fungi are eukaryotic organisms.

The vegetative body of a fungus is called thallus which is either unicellular (e.g yeast) or multicellular (e.g molds).

- The fungal cell wall is made up of chitin.
- The plasmalemma covers the cytoplasm and all cell organelles.
- Nucleus is usually small and mitochondria, endoplasmic reticulum and vacuoles are present.
- Fungi contain filaments called the hyphae (singular: Hypha).
- The hyphae have internal cross walls called the septum (singular: Septa).
- Fungi may be septate or aseptate.

- The septa of many species have pores, allowing cytoplasm to flow freely from one cell to the next.
- Cytoplasmic movement within the hypha provides a means to transport of materials.
- The hyphae may be branched.
- A mass of hyphae that is not a reproductive structure is called a mycelium.
- Vegetative mycelium- hyphae that penetrate the supporting medium and absorb nutrients.
- Aerial mycelium- hyphae that projects above the medium and produce reproductive structures called conidia.

Yeasts as unicellular form of fungi

• Yeasts occur in the form of oval or round bodies that reproduce by asexual process called budding. e.g *Saccharomyces cereviseae*.

• They grow partly as yeast and partly as elongated cells resembling hyphae. e.g Candida albicans

Filamentous fungi

• It consists of Mycelium.

• They reproduce by the formation of spores. e.g *Aspergillus*, *Penicillium*

Dimorphic fungi

• It exhibits yeast form in the host tissue in vitro at 37° C and mycelial form in vitro at 25° C. e.g *Histoplasma capsulatum*

What are Bacteria?

- Bacteria are microscopic organisms that live in the air, soil and water, on surfaces, and in and on the human body.
- They are the smallest free-living organisms, meaning they support their own growth and reproduction.
- These organisms are only about two-thousandth of a millimeter in size.
- Most bacteria are harmless and, in fact, perform useful functions.
- Many of the bacteria in the body protect against the harmful effects of other organisms.
- When they enter internal tissues, however, bacteria can cause disease, discomfort and even death.

Morphology Of Bacteria:

- Size

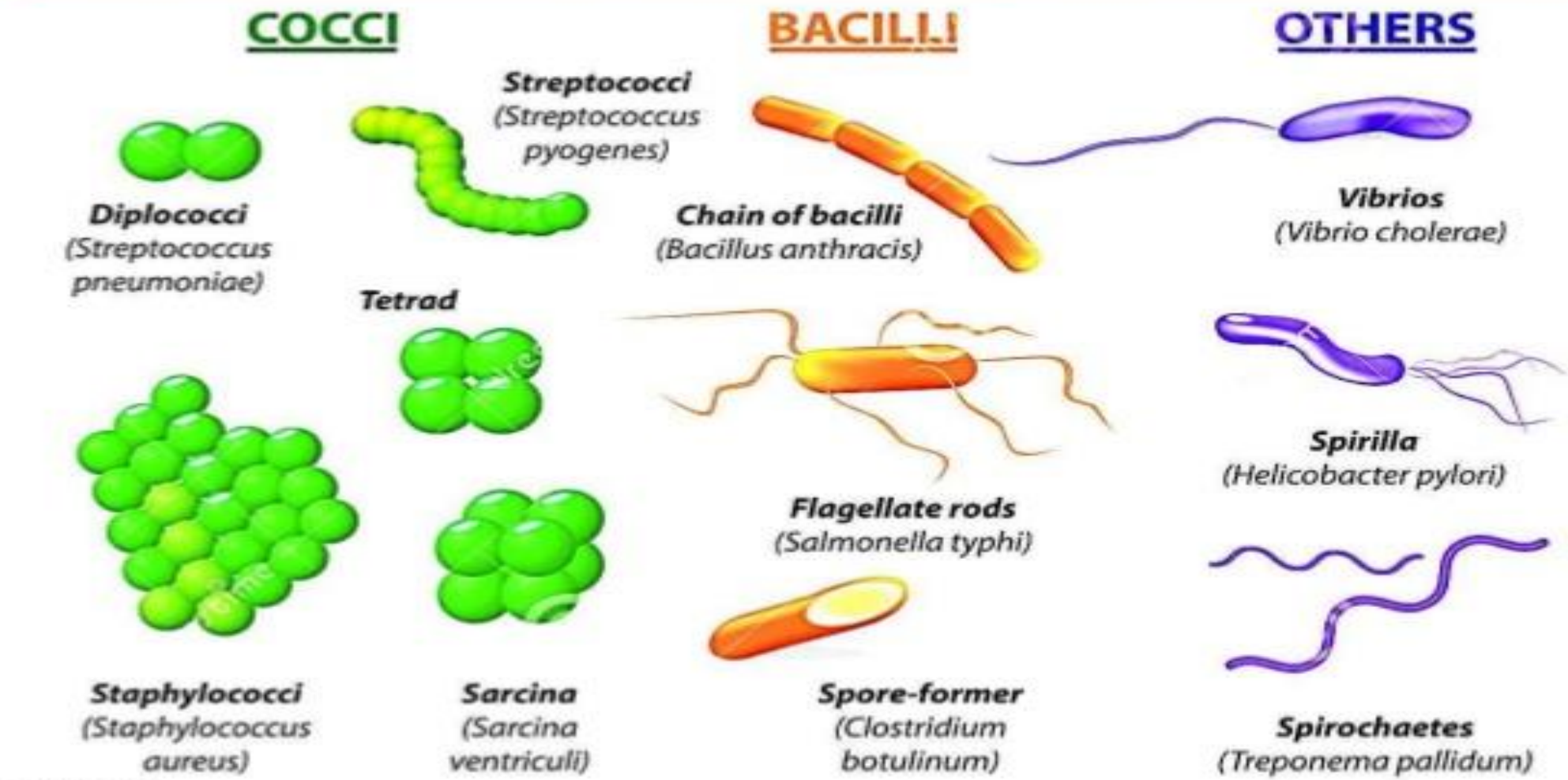
  0.2 µm – 0.1 mm
  Most 0.5 – 5.0 µm

- Shape

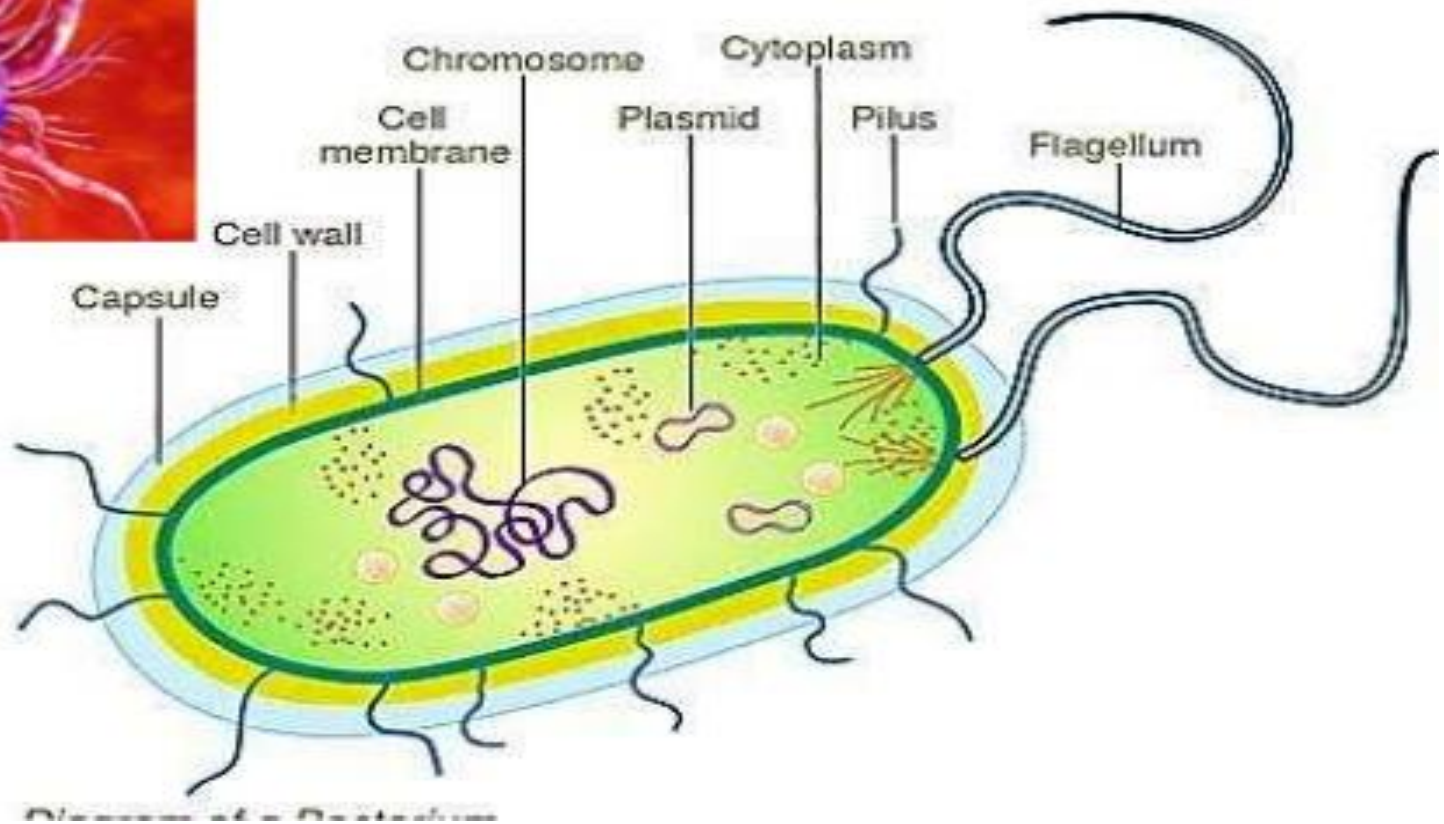
  Coccus shape (cocci); rod shape (bacillus, bacilli); spiral shapes (spirochetes; spirillum, spirilla); filamentous; various odd shapes.



SHAPES OF BACTERIA



An overview of Bacterial cell: *Bacillus species*



Cell wall:

- Outmost portion of the cell.
- 15-30nm in thickness
- 10%-25% of dry weight.

Functions:

- Maintaining the cell's characteristic shape- the rigid wall compensates for the flexibility of the phospholipid membrane and keeps the cell from assuming a spherical shape.
- Play an essential role in cell division.
- Providing attachment sites for bacteriophages

Cell Membrane:

- Site of biosynthesis of DNA, cell wall polymers and membrane lipids.
- Selective permeability and transport of solutes into cells
- Electron transport and oxidative phosphorylation.
- Excretion of hydrolytic exo-enzymes.

Cytoplasm:

- Composed largely of water, together with proteins, nucleic acid, lipids and small amount of sugars and salts
- Ribosomes: numerous, 15-20nm in diameter; distributed throughout the cytoplasm.
- Plasmids: extrachromosomal genetic elements

Pili:

- Pili are hair-like projections of the cell , They are known to be receptors for certain bacterial viruses. Chemical nature is pilin.

- Classification and Function:
  Common pili or fimbriae: fine , rigid numerous, related to bacterial adhesion.
  Sex pili: longer and coarser, only 1-4, related to bacterial conjugation.

Flagellum:

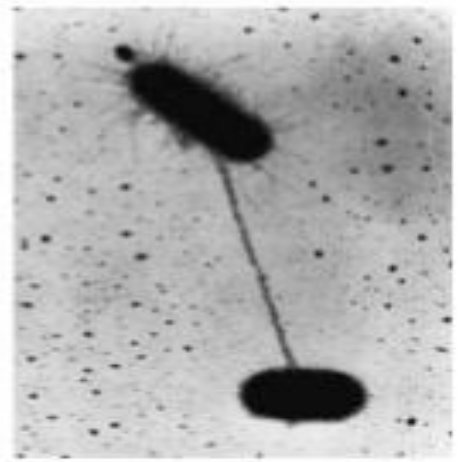
- The primary role of the flagellum is locomotion but it also often has function as a sensory organelle, being sensitive to chemicals and temperatures outside the cell.

Reproduction in Bacteria:

Bacteria reproduce in two ways:

Asexual mode of reproduction

Sexual mode of reproduction



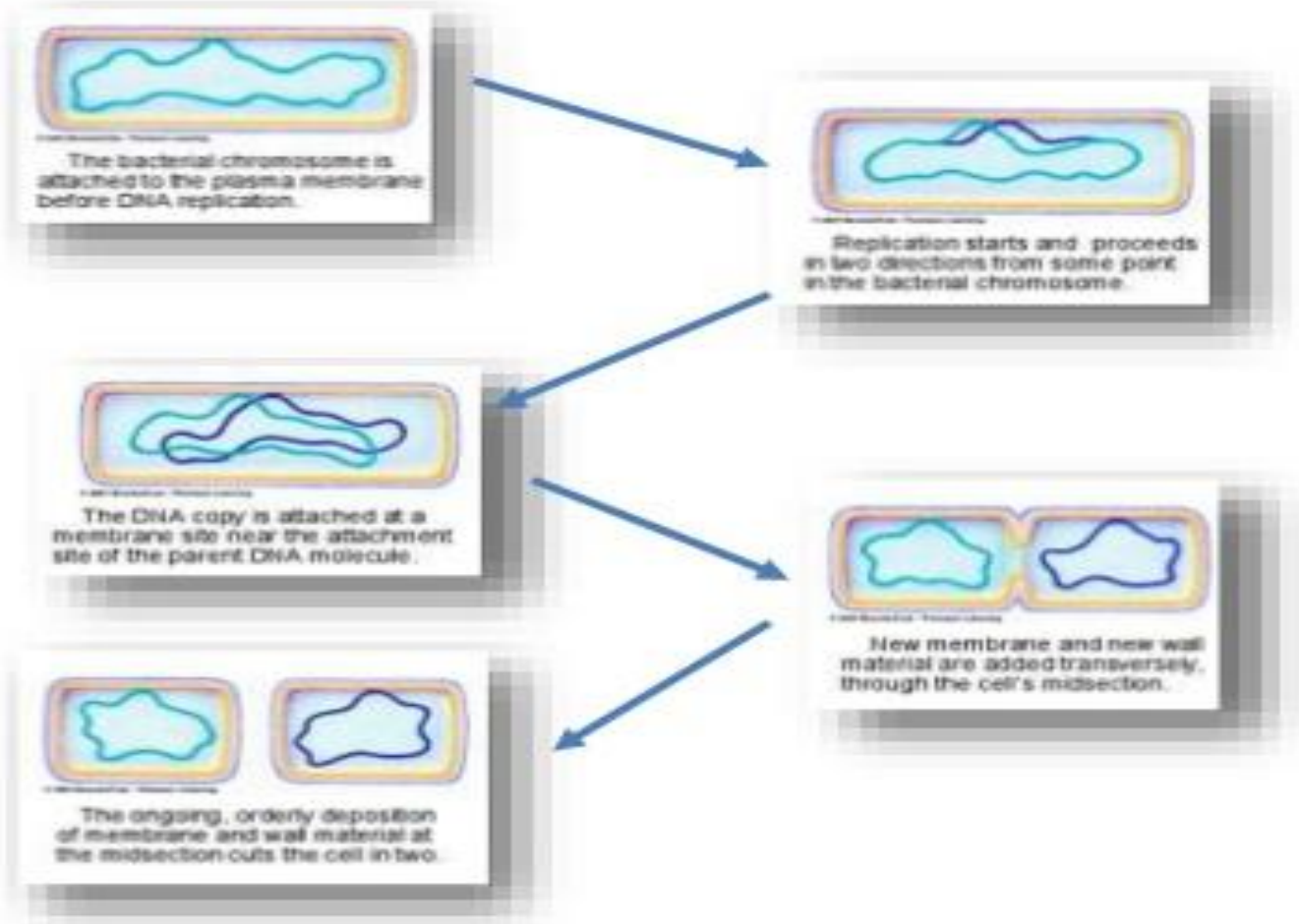
Asexual mode of reproduction:

Binary Fission:
One parent involved
Offspring are identical to parent & each other

Advantages:

- simple: only 1 parent
- offspring are fully formed (no maturation needed)
- very fast (20 min. in ideal conditions)

Binary Fission:



Sexual mode of reproduction:

- Two parents are involved
- Offspring are genetically different to parents & to each other.

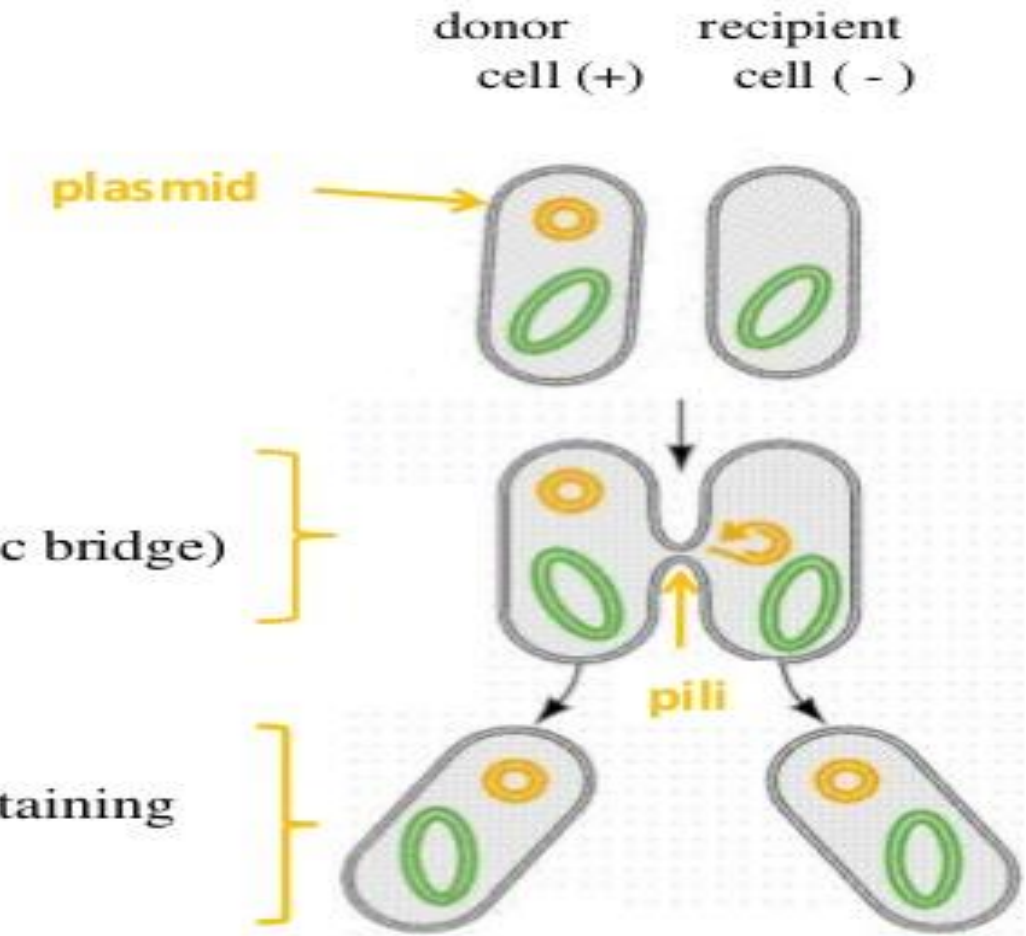
Advantages:

Genetic variety i.e. some are able to adapt to unfavourable conditions *(ex: antibiotic resistance)*

Disadvantages:

- More complex: slower because must find a compatible partner.
- No new individuals produced *(i.e. no increase in population)*

Bacterial Conjugation:



- plasmid copies itself
- passes through pili (cytoplasmic bridge) into recipient cell

- cells separate with both cells containing the plasmid

Transformation:

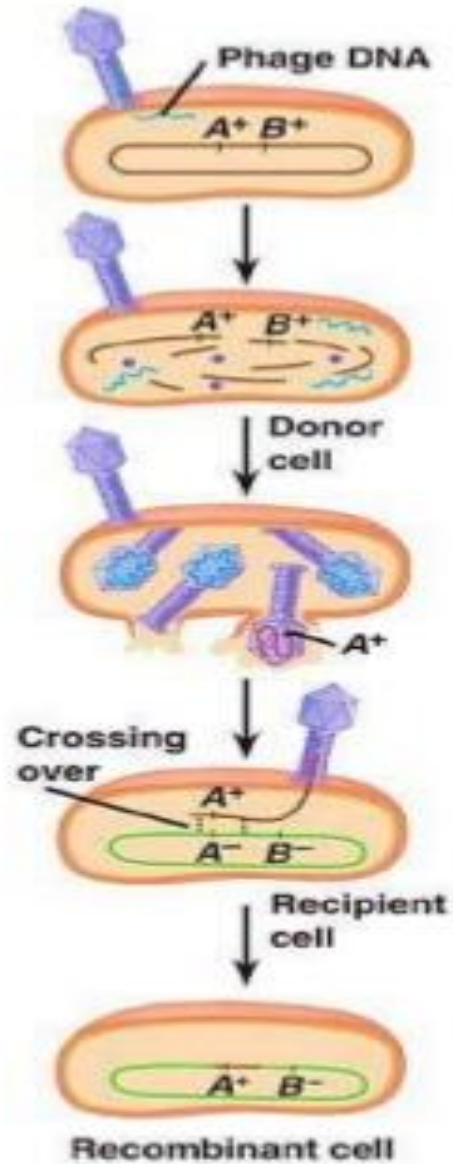
- The alteration of a bacterial cell's genotype and phenotype by the uptake of foreign DNA from the surrounding environment.
- Many bacteria possess cell surface proteins that facilitate transformation in natural populations.

Transduction:

- **Phages** (viruses that infect bacteria) carry bacterial genes from one host cell to another as a result of mistakes in the phage reproductive cycle.

TRANSDUCTION

1. Phage infects a bacterial cell that has alleles A^+ and B^+.
2. Host DNA (brown) is fragmented, and phage DNA and proteins are made. This is the donor cell.
3. A bacterial DNA fragment (in this case a fragment with the A^+ allele) may be packaged in a phage capsid.
4. Phage with the A^+ allele from the donor cell infects a recipient A^-B^- cell, and crossing over (recombination) between donor DNA (brown) and recipient DNA (green) occurs at two places (dotted lines).
5. The genotype of the resulting recombinant cell (A^+B^-) differs from the genotypes of both the donor (A^+B^+) and the recipient (A^-B^-).

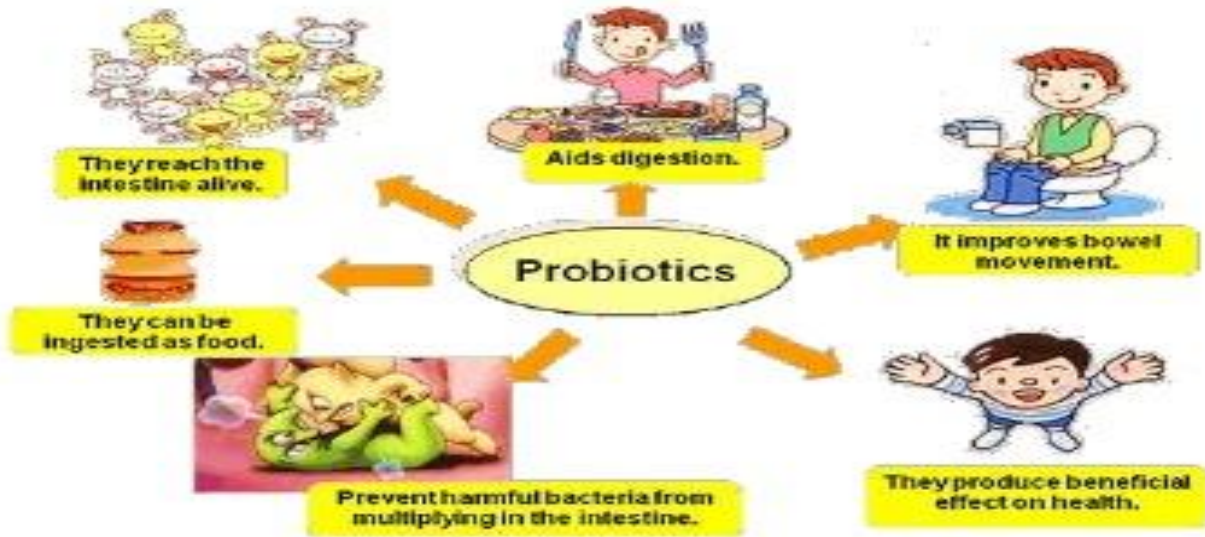


Based on their functions bacteria are divided into two categories:

- Good bacteria (Probiotic bacteria)
- Bad bacteria (Pathogenic bacteria)

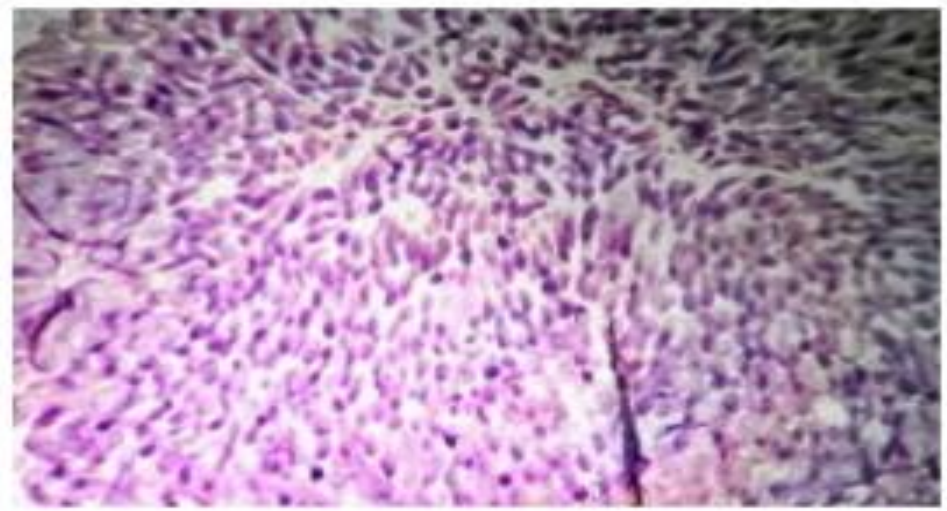
Good Bacteria (Probiotic bacteria):

- Supports a healthy immune system by helping to protect against harmful bacteria.
- Probiotics which are useful in the food digestion; Example: Yoghurt (curd)
- Without the bacteria in the gut one cannot survive.
- The best example for probiotic bacteria is *Lactobacillus* species which can be seen in the yoghurt and curd.



Other good bacteria include:

- *Lactobacillus acidophillus*
- *Lactobacillus rhamnosus*
- *Bacillus coagulans*
- *Lactococcus lactis*
- *Eschericia coli*



Bad bacteria or Pathogenic bacteria:

- These bacteria are very contagious, which means they spread very quickly, or they make a lot of people ill.

- The bad bacteria in the environment cause lots of problems – they can cause waste and disease. If you leave food out in the open, it will begin to rot. This is because bacteria like food too and will eat the food you have left out and make lots more bacteria in the process!

A list of bad bacteria that are pathogenic to humans:

- *Streptococci sps.*
- *Staphylococococci sps.*
- *Clostridia sps.*
- *Bacilli sps.* etc.

- The diseases that are prone to humans due to these bad bacteria are:

Escherichia coli and Salmonella cause food poisoning.
Neisseria gonorrhoeae causes the sexually transmitted disease gonorrhea.
Neisseria meningitidis causes meningitis.
Staphylococcus aureus causes a variety of infections in the body, including pneumonia, and food poisoning.
Streptococcal bacteria cause a variety of infections in the body, including pneumonia, meningitis, ear infections, and strep throat.
Bacterial diseases are contagious and can result in many serious or life-threatening complications, such as blood poisoning (bacteremia), kidney failure, and toxic shock syndrome.

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Bacteria that are important in Food microbiology:

- **Lactic acid – forming bacteria or lactics:**

These bacteria ferment sugars to lactic acid. This may be desirable in making products such as sauerkraut and cheese. But undesirable in terms of spoilage of wines because they usually form acid rapidly.
Ex: *Leuconostoc, Lacto bacillus, Streptococcus* and *Pediococcus*

- Acetic acid forming bacteria or acetics:

Most of the acetic acid belong to two genera *Acetobacter* and *Gluconobacter*. Both oxidize ethyl alcohol to acetic acid, but Acetobacter is capable of oxidizing acetic acid further to CO2.
Ex: *Acetobacter* acetic sub sp. *suboxydans*

- **Butyric acid forming bacteria or butyrics:**

Most bacteria of this group are spore forming anaerobes of the genus *clostridium*.

- **Propionic acid – forming bacteria or propionics:** Ex: *Propionic bacterium*

- **Proteolytic bacteria:**

They produce extracellular proteinases, proteolytic bacteria may be aerobic, facultative, spore forming, anaerobic and spore forming.
Bacillus cereus – Aerobic, spore forming
Pseudomonas fluorescens – Non spore forming and aerobic to facultative.
Clostridum sporogenes – Spore forming and anaerobic other examples are *clostridium, bacillus, proteus*. Acid proteolytic bacteria carry on an acid fermentation and proteolysis simultaneously.

- **Thermophilic Bacteria or Thermophiles:**

Optimum temperature required for these bacteria 45°C - 55°C.
Bacillus stearothermophilus – thermophilic flat sour spoilage of low acid canned foods.

- **Psychotropic Bacteria or psychrotrophs:**

These bacteria are able to grow at commercial refrigeration temperatures. Unlike psychrophiles, psychrotrophs do not have their optimal temperature for growth at refrigeration temperature and their optimum between 25°C and 30°C.

Ex: *Pseudomonas, Flavobacterium, Achromobacter and Alcaligenes, Micrococcus, Lactobacillus* etc.

- **Lipolytic Bacteria:**

This bacteria produce lipases which catalyze the hydrolysis of fats to fatty acids and glycerol. Many of the aerobic, actively proteolytic bacteria also are lipolytic.

Ex: *Pseudomonas fluorescens* – Strongly lipolytic
Pseudomonas, Alcaligenes, Staphylococcus, Serratia and *Micrococcus* are genera that contain lipolytic bacteria.


BRYOPHYTES

Etymology:

Bryophyte is derived from a Greek word 'BRYON' means Mosses and 'Phyca' means Plant.

Major Characteristics:

Oldest land plants on earth and have been around for 400 million years or more

- **Bryophytes do not have true vascular tissues for support and transport of water and nutrients.**

- They lack leaves.
  - However, they have leaf-like scales that contains chloroplasts in which photosynthesis occurs.

They lack true roots.
They anchor themselves in the soil by root-like structures called rhizoids.

Rhizoids are relatively simple, sometimes multicellular filaments of thin-walled cells that extend from the photosynthetic tissue into the soil

- Lack vascular tissues
- No lignified tissues
- Have rhizoids

- Usually small and ground-hugging. Most measure between 2 to 4 inches.

- Lack of true stems.

*Amphibians of plant kingdom,need Water for their fertilization.

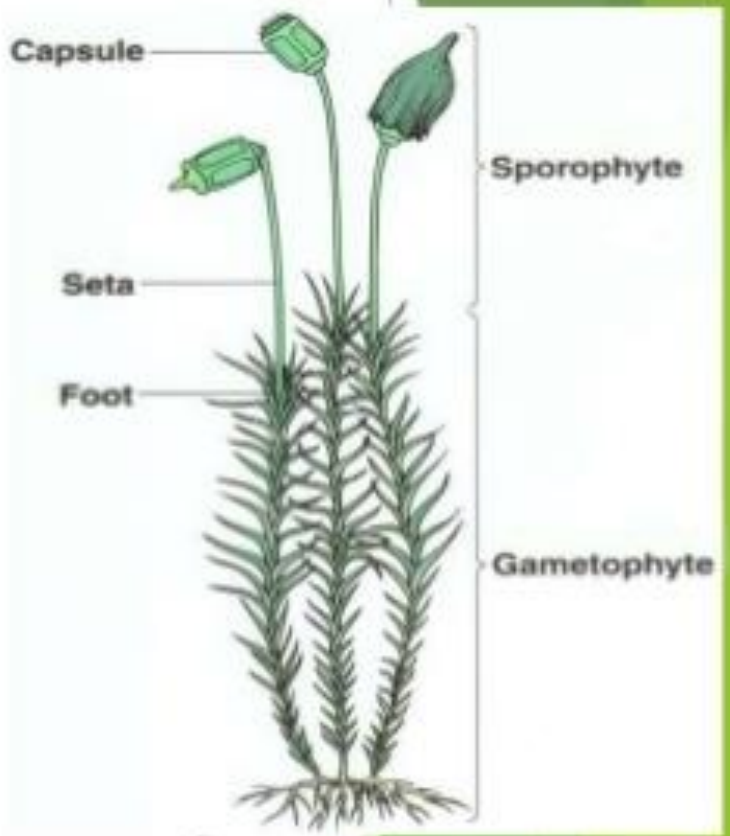
Habitat: lived in moist places and humid environment.

9000genera,24,000species

Mode of nutrition autotrohic as well as saprophytic.

Plant body is thallus (not differentiated into Root,stem and leaf) e.g Marchantia,Anthoceros.

Sporophyte has three parts : foot,seta,capsule.



Classifications

There are 3 classes of bryophytes:

1. *Class Musci (Mosses)*
2. *Class Hepaticae (Liverworts)*
3. *Class Anthocerotae (Hornworts)*

1. Class Musci (Mosses)

- The body of the moss is usually leafy-like

- Most prefer damp, shaded locations in the temperate zone.

Class Hepaticae (Liverworts)

- The name liverwort arose because the lobes of the thallus resemble the lobes of the liver

- Many have a flattened body called thallus, but some have a leafy appearance

Class Anthocerotae (Hornworts)

- The sporophytes of hornworts look like small green broom hancles. Its shape os unique among bryophytes.

- Unlike bryophytes and higher plants most species of hornworts have cells that contain only single chloroplast

Reproduction Of Bryophytes

Reproduction

The bryophytes reproduce by vegetative, sexual and asexual modes of reproduction. The gametophyte reproduces sexually by formation of gametes whereas the sporophyte reproduces by the formation of spores, therefore the mode of reproduction is asexual.

Types Of Reproduction

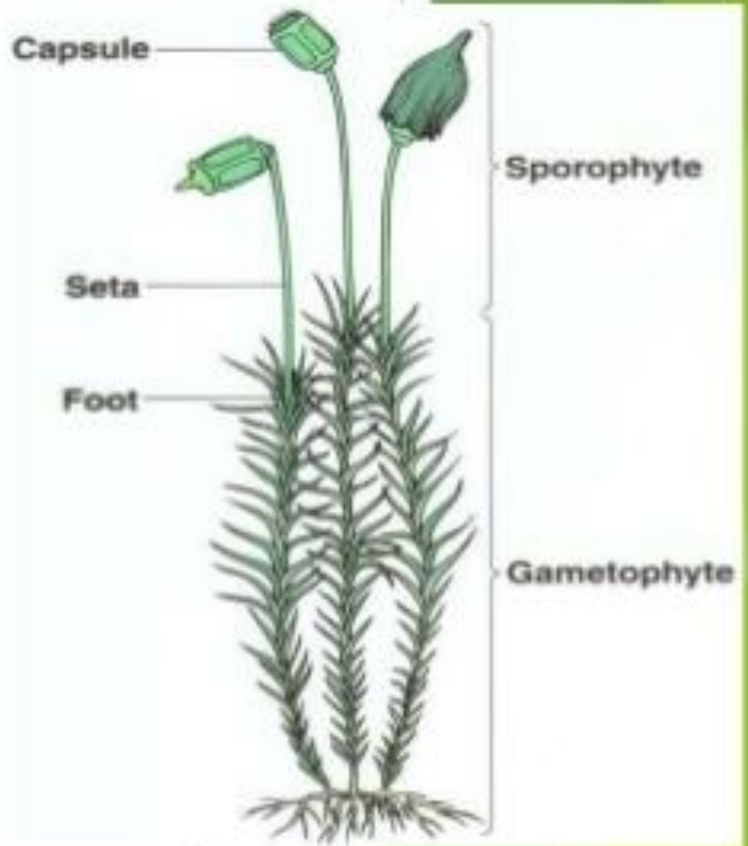
1=Vegetative reproduction
2=Asexual reproduction
3=Sexual reproduction

Vegetative Reproduction

In some species asexual reproduction takes place by the vegetative methods of fragmentation and genome. However asexual spores like endospores or akinetes produced in algae are absent.

Asexual Reproduction

A mature sporogonium consists of a basal swollen foot, a stalk or seta, and a spore-producing structure, the capsule. The capsule comprises of sporogenous cells surrounded by a layers of sterile cells. These cells undergo divisions repeatedly and last generation of cells is called spore mother cells which undergo meiosis to produce tetrads of haploid spores. The spores are non motile, cutinized, wind disseminated and alike, therefore the bryophytes are homosporous. In most cases, e. g., *Riccia* and *Marchantia*, sterile cells called elators are also produced along with spores.

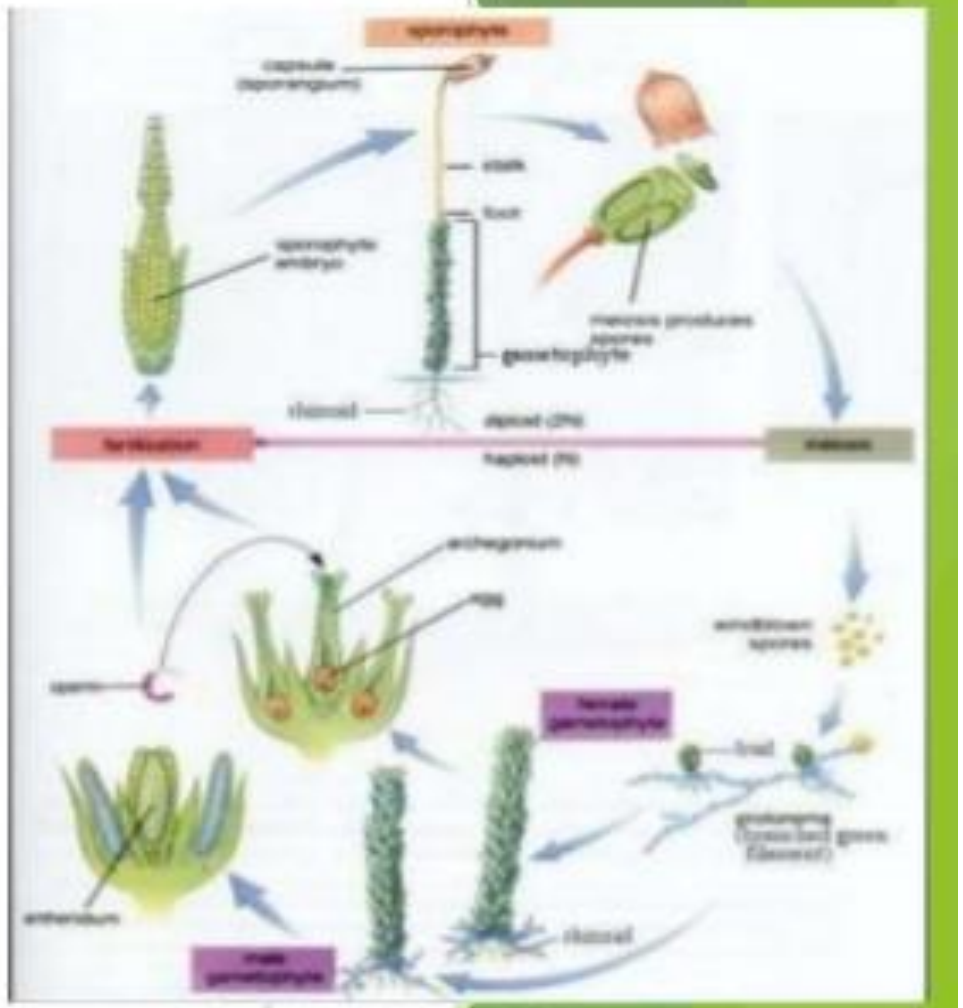


Sexual Reproduction:

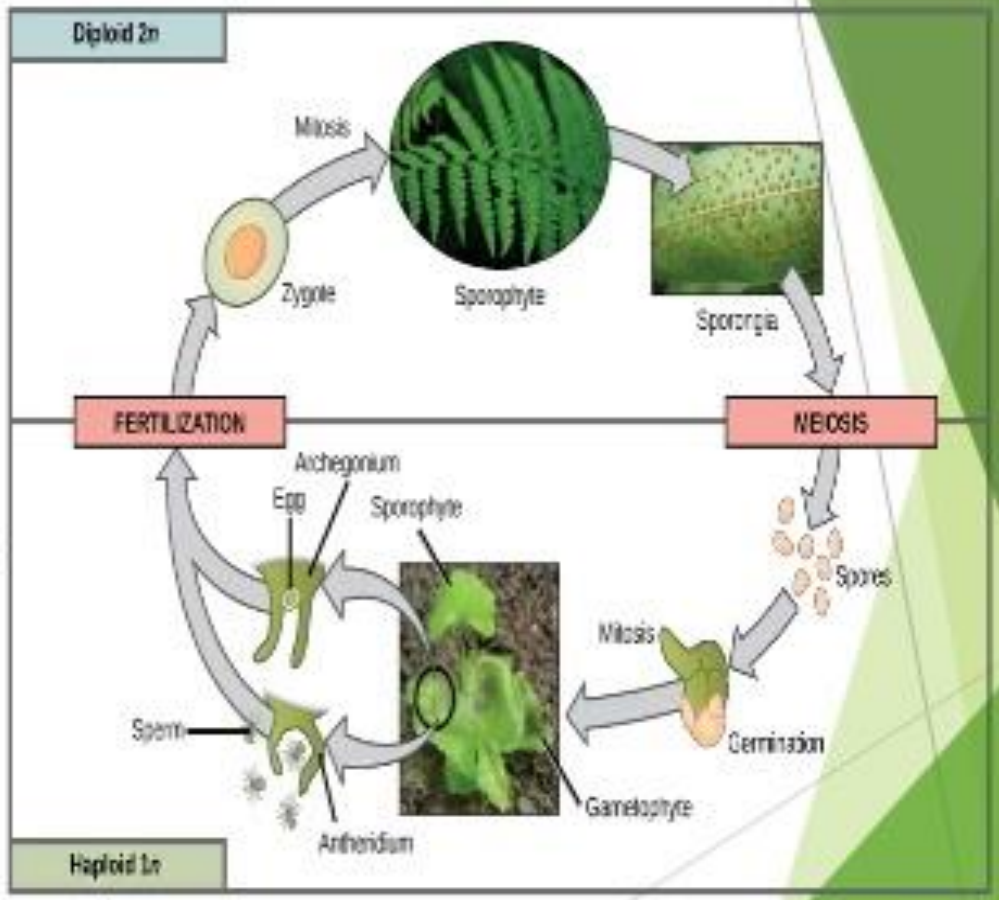
The sexual reproduction is oogamous type. The gametes are produced in multicellular sex organs. The male gametes are small and motile, while the female gametes are large and non motile.

The sex organs are antheridia and archegonia. These are multicellular and each sex organ is protected by an outer wall of sterile cells surrounding sex cells. Both kinds of sex organs may develop on the same plant (monoeious or homothallus) or on different plants (dioecious or heterothallic).

Each anthridium is usually club shaped. It contains androcytes or antherozoid mother cells surrounded by a single layer of sterile jacket cells. Each androcyte metamorphoses into a motile biflagellate antherozoid or male sperms. The archegonia are usually flask-shaped. Each archigonium consists of a basal swollen portion, the venter and an elongated part, the neck. An axial row of cells surrounded by jacket of sterile cells is present in the neck and venter. It consists of few neck canal cells, a ventral canal cell and an egg or oosphere.



Fertilization: Water is essential for fertilization. The jacket if mature antheridium ruptures liberating the sperms. The motile flagellated sperms swim in the film of water and reach the neck of an archi gonium. In the meantime axial row of the neck canal cells disorganize and the tip of the archigonium ruptures opens. The antherozoids enter the neck and swim down to the egg. One of these sperms fertilizes the egg to produce zygote



Alternation of generation In Bryophytes

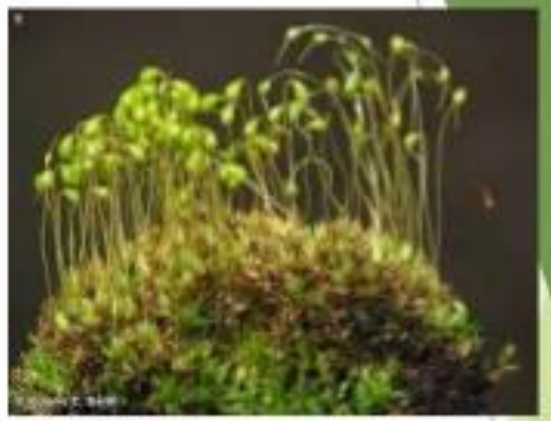
What is alternation of generations?

First time demonstrated by Hofmeister(1851)
Life cycle of a plant is called alternation of generations.
Haploid and diploid generation alternating during life cycle
-Sporophyte ie. Multicellular , spore forming diploid plant str.
-Gametophyte ie. Multicellular haploid plant structure, forms gametes.

Bryophytes(mosses and ferns)
- dominant generation-haploid phase
- main plant body is composed of **gametophyte**

Significance:

Better chance for survival
Better adapted to environment
Newer varieties develop
Variations are produced during meiosis



Alternation of generation in Bryophytes

Haploid phase (n) is gametophytic generation or sexual phase.

Bears reproductive organs

- produce antherozoids and eggs

Gametophytic stage - longer lived ,conspicuous as compared to sporophyte.

Gametophytic stage is dominant in life cycle.

Diploid phase (2n) or the sporophytic stage

- gametic union results into the formation of zygote which develops into sporophyte.

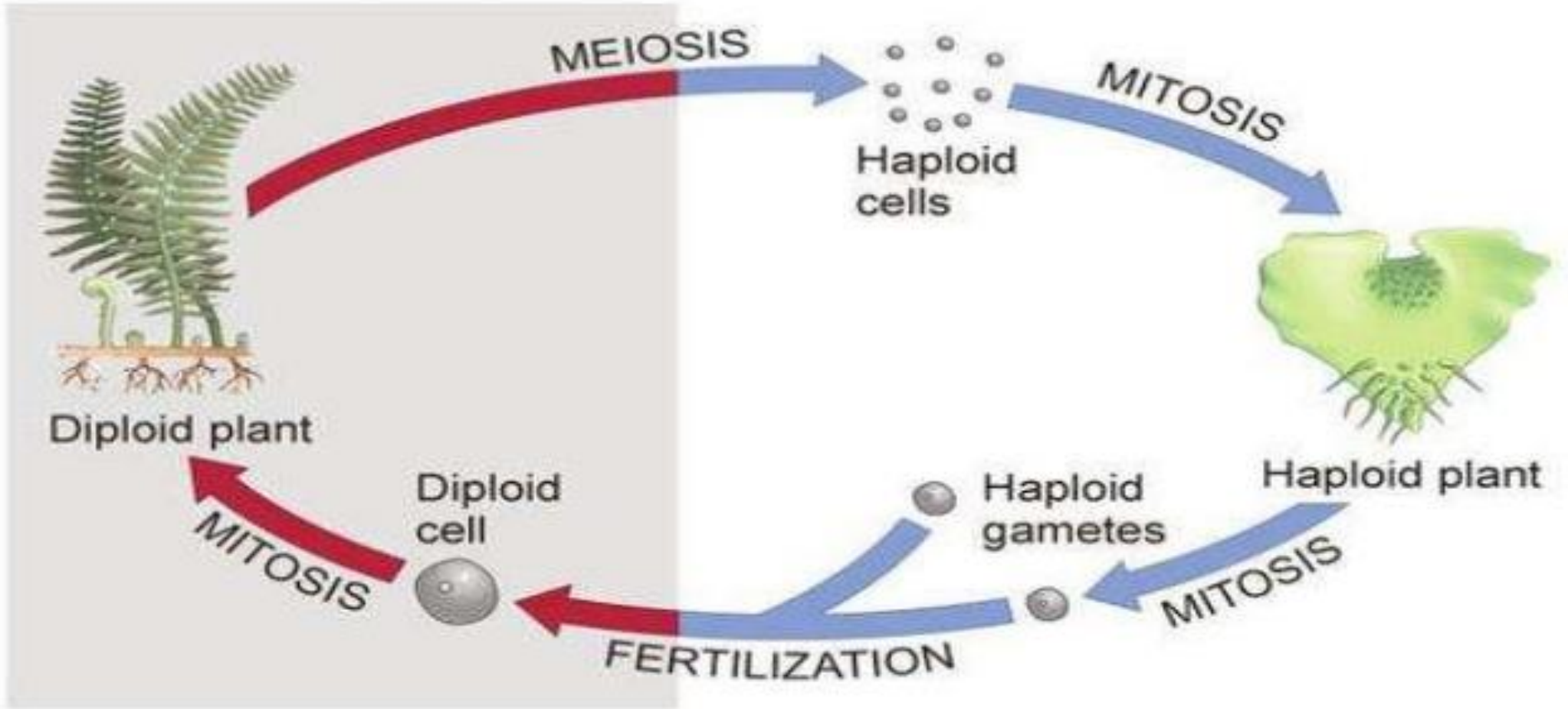
Meiosis in SMC (spore mother cell)

- spore formed
- germinate to form gametophyte again.
- cycle continues with alternation b/w gametophye and sporophyte.

Sporophyte dependent on gametophyte

Heteromorphic alternation of generation.

(c) Alternation of generations



Difference between moss and liverwort life cycle

GAMETOPHYTE

I. presence of protonema
II. Symmetry
III. Rhizoids

SPOROPHYTE

I. Development of embryo
II. Capsule organization.
III. Photosynthetic system in cell layers of capsule in mosses and absence in liver worts.
IV. Presence of air pores,columella

Affinities of Bryophytes with Algae

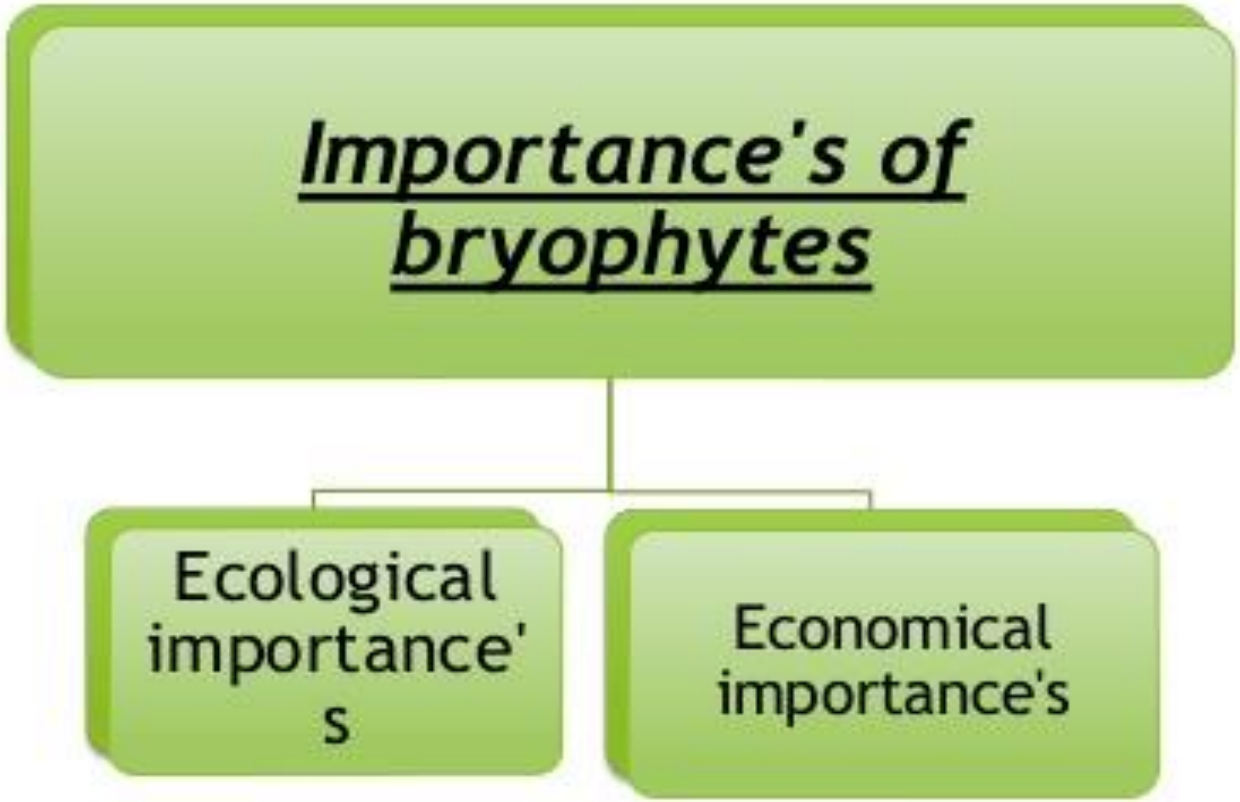
The origin of bryophytes from algae is supported from following facts:

1=There is a close resemblance between CHLOROPHYLLS and XANTHOPHYLLS of algae to that of bryophytes.

2=The presence of motile sperms in bryophytes supports algal ancestry.

3=The development of green, filamentous, alga-like PROTONEMA in the life cycle of some bryophytes.

Importance of Bryophytes


Importance's of bryophytes
Ecological importance's
Economical importance's

Economical Importance's of bryophytes

Source of fuel	***Horticulture,***	Preservative agent
Household Uses	House Construction	***pharmaceutical industry***
	Moss industry	

Bryophytes as Fuel

- Liverworts and mosses have long been tried and used as a fuel in developed countries like Finland, Sweden, Ireland, West Ger-many, Poland and Soviet Union.
- Peat a brown, soil-like material characteristic of boggy, acid ground, consisting of partly decomposed vegetable matter.
- Peat is suitable for production of low and intermediate BTU gas as well as hydrogen, ethylene, natural gas, methanol and Fisher Tropsch gasoline.
- Peat mosses are best suited for the production of methane, and peat is likely to become an important source of fuel for production of heat,methane, or electricity in the future.

Horticultural Uses

- There is a long tradition of use of bryophytes in horticulture as soil additives, because of their high water holding capacity and to air. Peat is an important soil conditioner and is commonly used for agricultural and horticultural purposes around the world.

Bryophytes as ornamental plant

- Bryophytes have also been used for green house crops, potted ornamental plants and seedlings, and in garden soil.

As preservative agent

Bryophytes have excellent power to absorb moisture and can act as a good preservative agent . They not only help to prevent food but also help to preserve death bodies.

House Construction

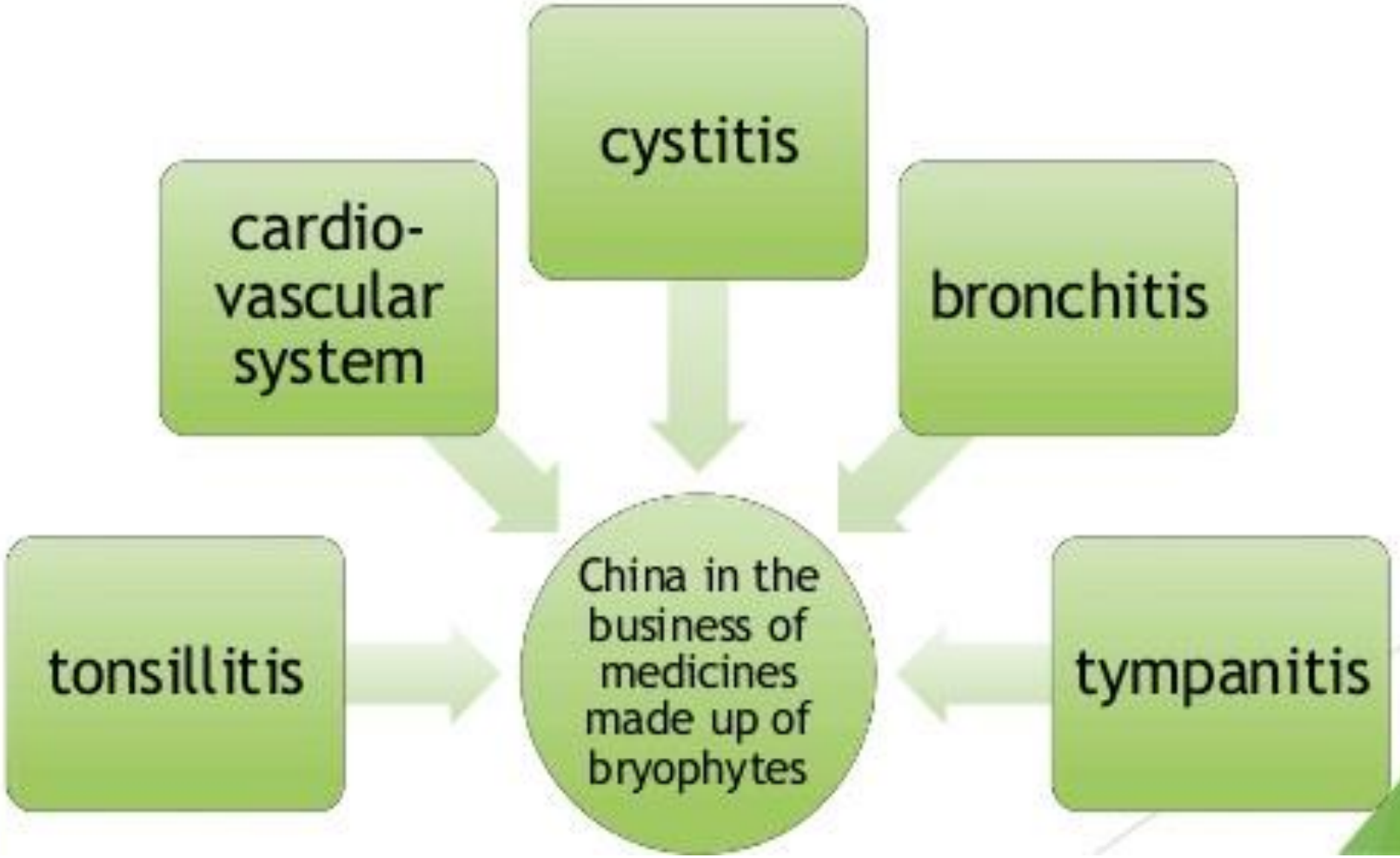
- **These tiny plants are used in the construction of houses and their furnishings.**
- At Kapkot in the Himalayas, villagers use moss mats with shrubs, grasses, and bamboo to make a pharki, a kind of door placed at the openings of their temporary huts. Sphagnumpeat, peatcrete and peatwood are the new material use for making houses ,they are low cost and easy to transport.

Fibre industries

- Mosses are mixed with wool to make cheap clothes.
- They are used in decoration of net bags and other objects.
- Women also wear their steam like structure in their hair and as decorations in bracelets .
- Used in hiking boats to absorb odour and moisture.
- Used in lining of diapers to improve absorbing power.

Medicinal Uses

Medicines


cystitis
cardio-vascular system
bronchitis
tonsillitis
China in the business of medicines made up of bryophytes
tympanitis

Ecological Importance of Bryophytes

Role of Bryophytes in Different Ways

- PEAT FORMATION
- SEED BEDS
- FOOD AND SHELTER
- POLLUTION
- SOIL CONSERVATION
- INDICATOR OF soil PH
- INDICATOR OF ACID RAIN

PEAT FORMATION

- Peat is a brown dark colour spongy matter produce due to compression and carbonization by deposits and water.
- Sphagnum and other mosses form peat.
- used in horticulture, making ethyl alcohol and illuminating gas.

Food AND SHELTER

- Many animals make use of bryophytes. Numerous invertebrates eat bryophytes, lay their eggs on them or shelter in them. They form a vital part of the construction material of the nest of some birds

  - In Vertebrates the range of associations is much less.
- Northern Corroboree Frog are found near *Sphagnum* bogs . These endangered frogs breed in *Sphagnum* bogs in the alpine and sub-alpine areas but move away from boggy areas outside of season.

POLLUTION

- Pollutants come in many forms from both urban and rural areas. Sulfur dioxide has been a significant industrial pollutant for many years, being a by-product of the use of high sulfur fuels.
- Sulfur dioxide is very damaging but some bryophytes are highly tolerant of sulfur dioxide pollution and examples of these are the mosses *Funaria hygrometrica* and *Bryum argenteum*

SOIL CONSERVATION

- Bryophytes form a mat and prevent soil erosion.
- The intertwined moss stems and rhizoids bind soil particles firmly.
- Hold large amount of water and reduce run off.

Indicator of soil pH

- Liverworts and mosses are good indicators of soil ph.
- Some bryophytes can grow in narrow and specific range of pH so therefore their presence can be used as an indicator of soil ph.
- For example Campylopus paradxus indicates acidic soil.

Indicator of acid rain

- Mosses are good indicators of acid rain because they lack a protective epidermis and cuticle hence are most susceptible than vascular plants.
- For example Neck era indicates high pH as like of acid rain.