

CLASSIFICATION OF PLANTS

NON-VASCULAR PLANTS: thallophytes and bryophytes.

VASCULAR PLANTS (tracheophytes): ferns (pteridophytes), gymnosperm and angiosperm.

➤ **CRYPTOGAMS** (Seedless plants) –

- Thallophytes (algae and fungi)

- Bryophytes

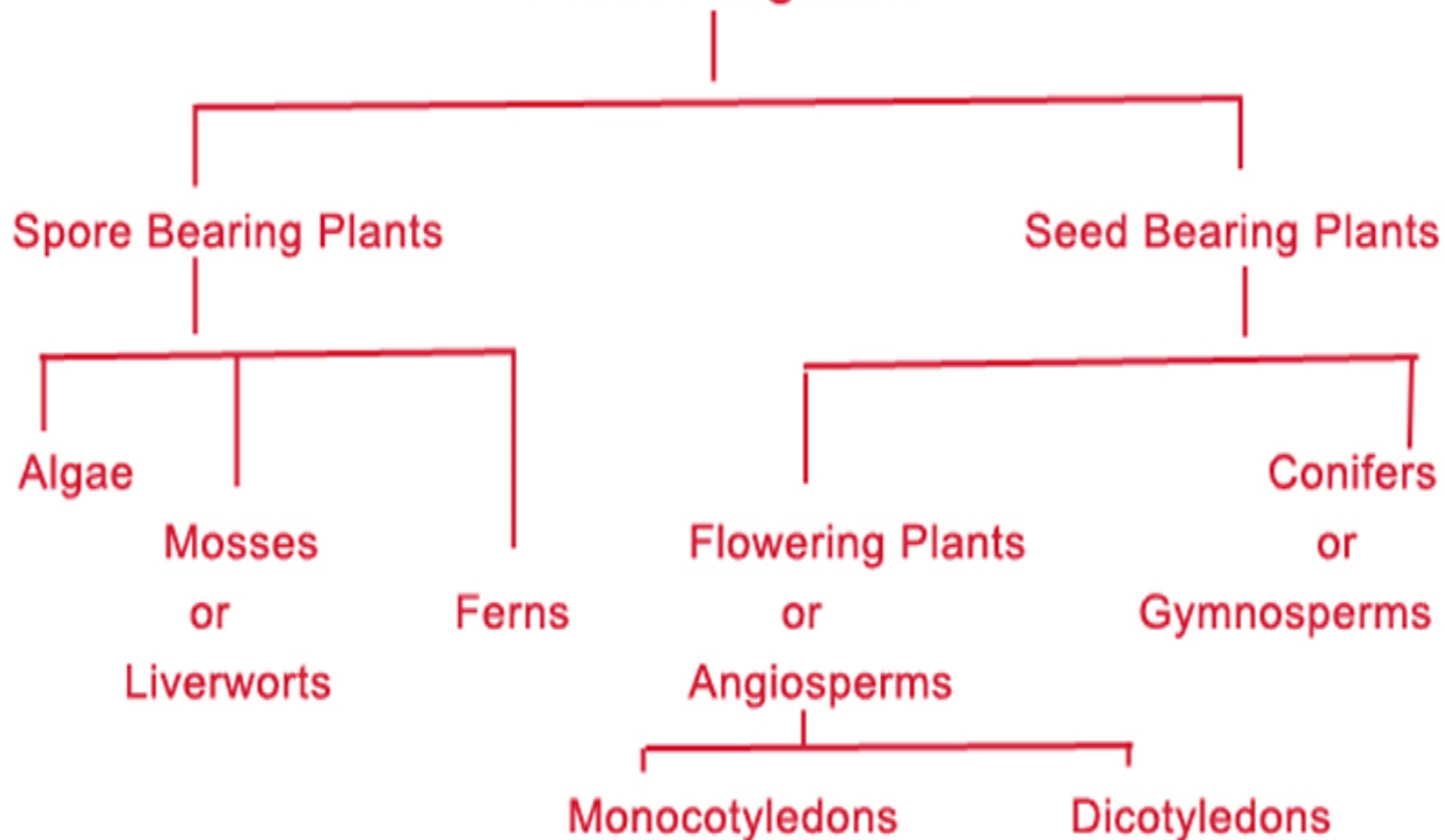
- Pteridophytes

➤ **PHANEROGAMS** (Seed plants) –

- Gymnosperm (naked seed)

- Angiosperm (enclosed seeds) - (monocot and dicot)

Plant Kingdom



ALGAE

CHARACTERISTICS OF ALGAE

- They are seedless plants i.e. cryptogams.
- They are non-vascular.
- They are chlorophyllous organisms (with chlorophylls a, b, c, d and e as well as other pigments.)
- Colours vary from green, red, brown to blue-green.
- Mostly found in moist or wet environments.

CHARACTERISTICS OF ALGAE contd.

- They are autotrophs, i.e. they are primary producers.
- They may be unicellular, multicellular, filamentous or colonial.
- They may be motile with the possession of flagella or cilia.
- They are eukaryotic organisms.
- They are important economically.
- Their cells contain some organelles.

Economic importance of algae

- Source of food.
- Important producers.
- Used for culturing in the laboratory.
- Deface the wall.
- Pollute water bodies.
- Production of toxins.

Morphological forms of algae

- **Unicellular forms:** single-celled and may be motile or non-motile. E.g. *Chlamydomonas*.
- **Colonial forms:** in groups or more than one cell but live together as a single entity. E.g *Gonium*, *Pandorina*, *Volvox*.
- **Filamentous forms:** made up of more than one cell formed as a result of cell division. E.g *Spirogyra*, *Oscillatoria*, *Anabaena*.

CLASSIFICATION OF ALGAE

Classification based on photosynthetic pigment:

- Cyanophyta (blue-green algae) – chl a, phycocyanin and phycoerythrin. (e.g. *Oscillatoria*)
- Phaeophyta (brown algae) – chls a and c, carotenoids. (e.g. *Laminaria*, *Fucus*)
- Rhodophyta (red algae) – chl a, phycocyanin and phycoerythrin. (e.g. *Carrageenin*)
- Euglenophyta – chls a and b. (e.g. *Euglena*)
- Chlorophyta – chls a and b. (e.g. *Chlamydomonas*, *Spirogyra*)

Classification based on stored food:

- Cyanophyta – glycogen.
- Phaeophyta – laminarin, mannitol or alcohol.
- Rhodophyta – floridean starch.
- Euglenophyta – pyramynoid granules.
- Chlolophyta – insoluble starch.

Life cycle of algae

They exhibit alternation of generation i.e. alternating haploid (n) and diploid ($2n$) stages.

- **Haploid stage** – multicellular with haploid parent but formed zygote is diploid.
- **Diploid stage** – multicellular with diploid parent but formed gamete is haploid.

Reproduction in algae

They reproduce in three major ways:

➤ **Vegetatively:**

- Cell division: repeated rapid binary fission of cell.
- Fragmentation: fragments are able to develop into new individuals.

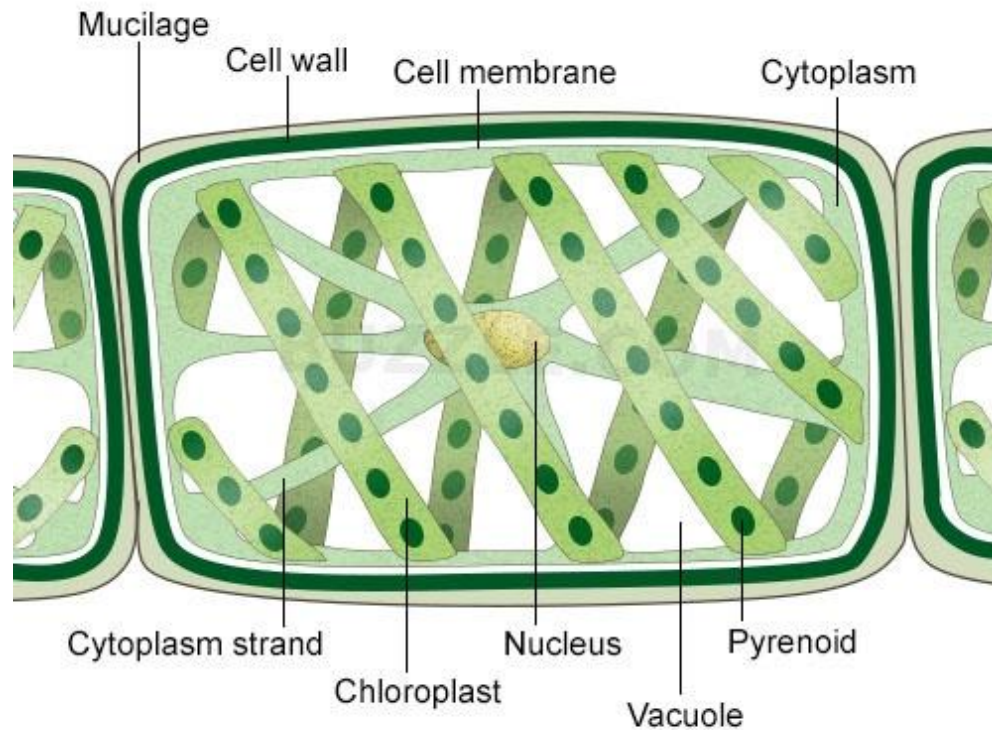
➤ **Asexually:** production of various types of spores.

➤ **Sexually:**

-**isogamy**: fusion of two morphologically identical gametes to produce zygote.

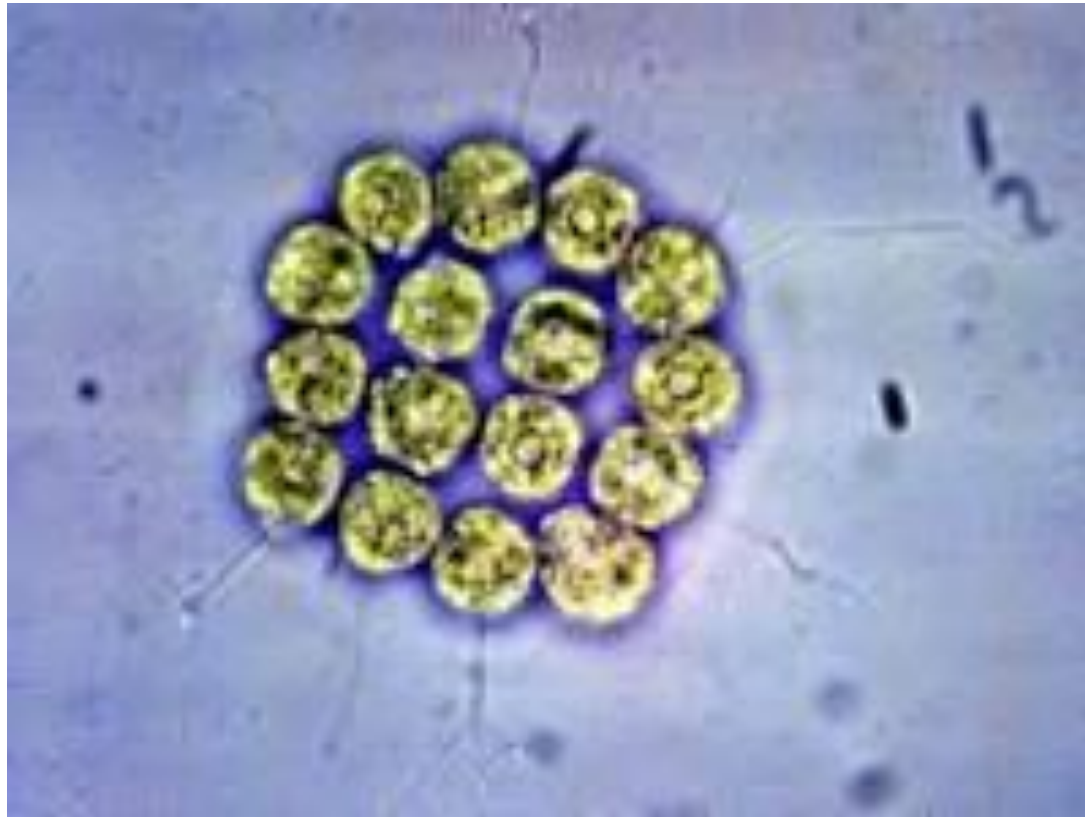
-**anisogamy**: small and big gametes.

-**oogamy**: motile male and non-motile female.



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Single *Spirogyra* cell (filamentous)



Gonium (16 cells) (colonial)

FUNGI

CHARACTERISTICS OF FUNGI

- They are heterotrophs: e.g. parasites, saprophytes.
- They have rigid cell walls with chitin (N-containing polysaccharide like cellulose).
- Body usually a mycelium (a network of fine tubular filaments called hyphae).
- They may be septate (have cross-walls) e.g. *Penicillium* or aseptate (no cross-wall) e.g. *Mucor*

CHARACTERISTICS OF FUNGI contd

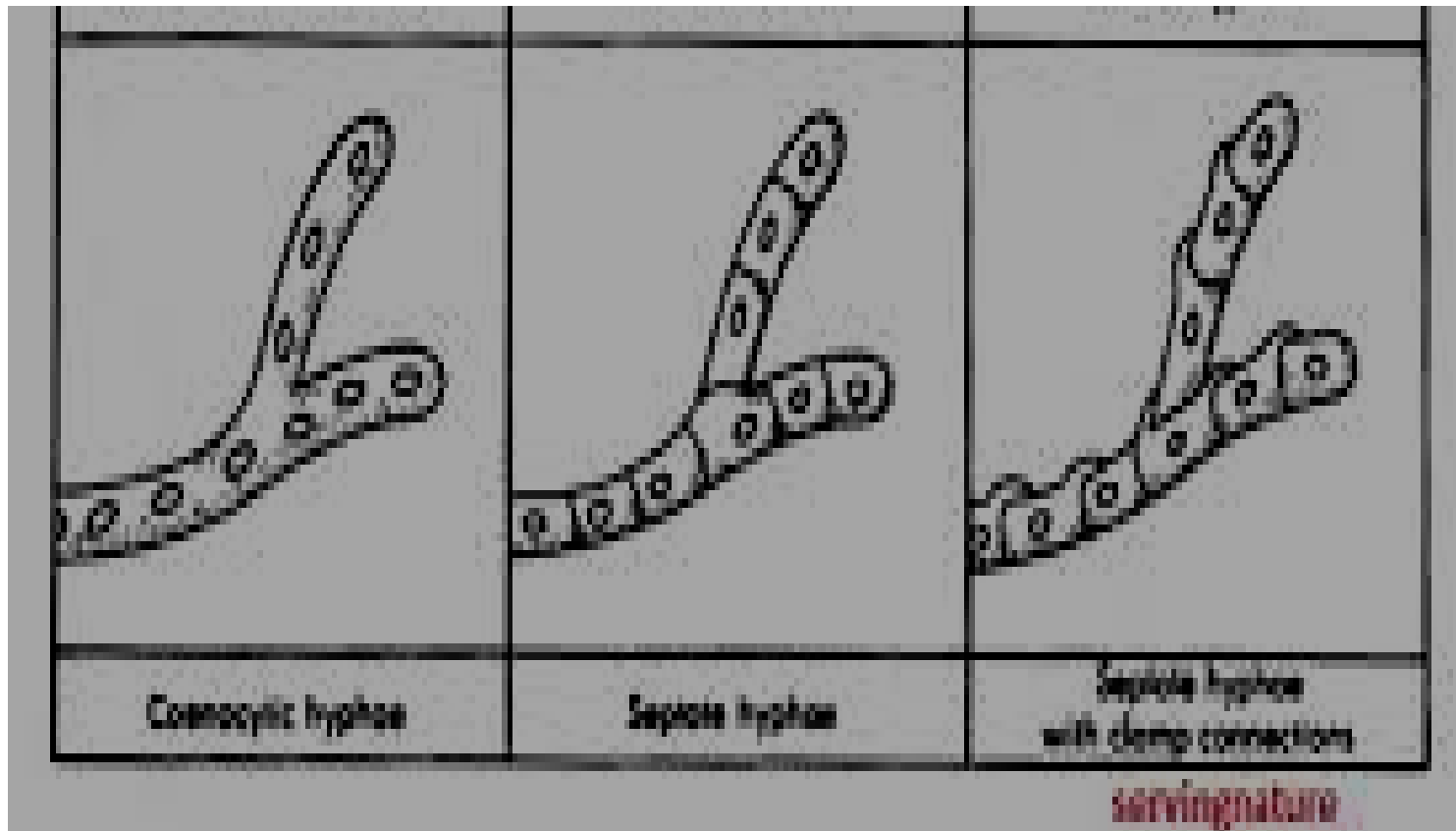
- They store their carbohydrate as glycogen.
- They reproduce by spores.
- They are non-motile.
- They are achlorophyllous.

ECONOMIC IMPORTANCE OF FUNGI

- Spoilage of food.
- Cause mycosis.
- Consumed as food.
- Involved in fermentation.
- For degrading polysaccharides.
- Important decomposers.
- Production of antibiotics.

MORPHOLOGY OF FUNGI

- The main vegetative feature is that they grow as a tubular, threadlike filament called **hypha**. (**hyphae-pl.**)
- These hyphae intertwine and fuse with other hyphae to form a mass known as **mycelium**
- **Yeast**- unicellular and grows at 37 degrees C.
- **Mould**- multicellular and grows at 25 degrees C.
- **Dimorphic**- grow in mould or yeast form.



Aseptate and septate hyphae

Reproduction in fungi

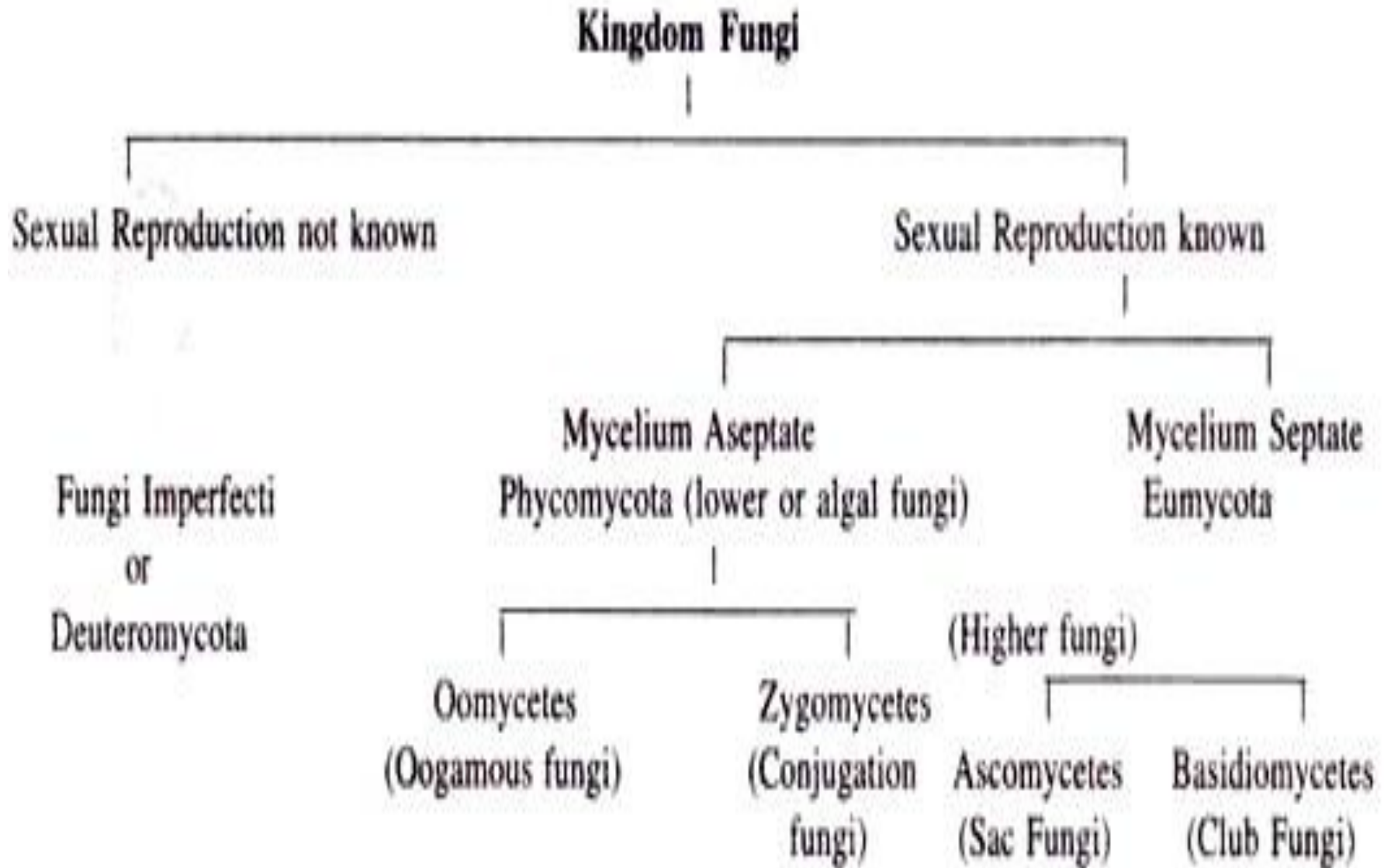
Asexual or vegetative reproduction

- **Fragmentation:** part of hypha broken and cultured can grow into a complete organism.
- **Fission:** splitting of a single individual into two organisms.
- **Budding:** development of a new individual from an old one.
- **Spore formation:** varying spores (wall thickness, colour and shape) are formed by different classes of fungi.

Sexual reproduction in fungi

- **Plasmogamy:** fusion of cytoplasm of two compatible gametes but the nuclei do not fuse.
- **Karyogamy:** fusion of nuclei and formation of diploid cell.
- **Formation of specialized spores** after meiosis and named according to fungal classes.

Classification of fungi



BACTERIA

The study of bacteria – bacteriology.

Characteristics of bacteria

- They are mainly unicellular.
- Cell division is by binary fission.
- DNA lies freely in the cytoplasm (single circular molecule).
- They have few organelles.
- Cell wall is rigid and strong.

Characteristics of bacteria

- Many are motile with one or more flagella.
- Flagellum is simple and hollow.

e.g. *Rhizobium* (1), *Azobacter* (many)

- They are prokaryotic organisms.
- They exhibit different shapes and sizes.

A typical bacterial cell

- Bacterial cell is 90% water and contains:
- Vacuole, 70s ribosomes, granules of stored food, nuclear apparatus, mesosomes, cytoplasm.

Morphology of bacteria

- Bacillus: straight rod-like/kidney-like form.
- Coccus: spherical/rounded form.
- Other forms are spiral, oval and comma.
- Motile with flagella.
- Some are covered with short hair-like protein rod called pili (fimbriae).
- Different bacteria have different cell wall structures which give them diff. staining characteristics.

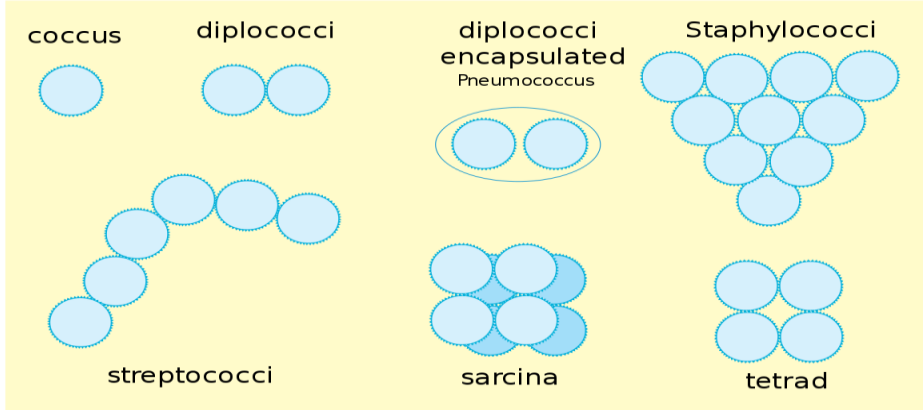
- Gram positive bacteria: have large amount of peptidoglycan (a special polymer of protein) in their cell wall (purple). E.g. *Staphylococcus*, *Bacillus*, *Lactobacillus*.
- Gram negative bacteria: one or two layers of peptidoglycan (pink). E.g. *Salmonella*, *E. coli*, *Azobacter*.

Classification of bacteria

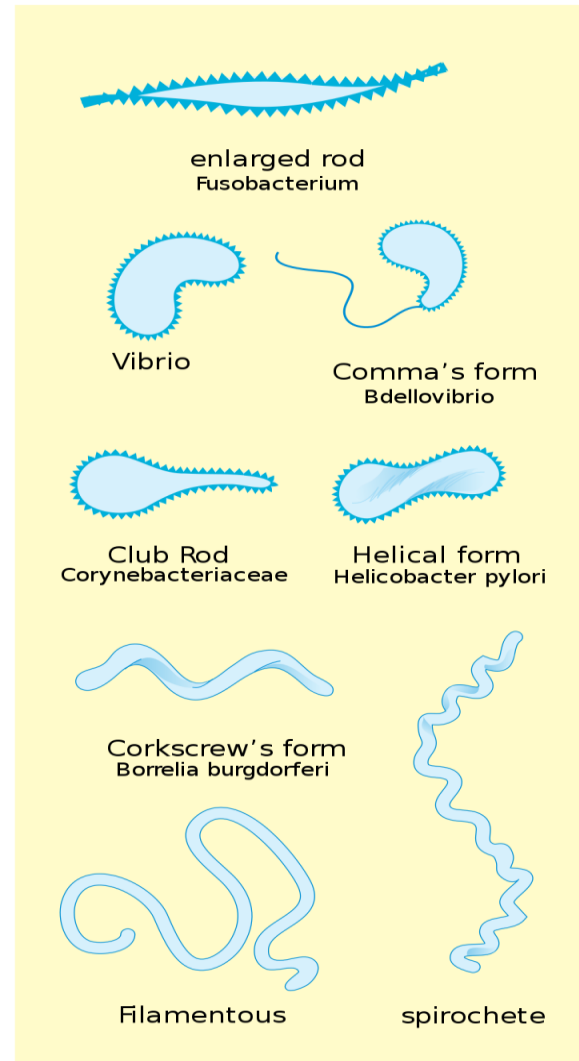
Classification based on shape

- Cocci: round or oval. When in pair (diplococci), in chain (streptococci), irregular (staphylococci).
- Bacilli: rod-like with rounded and tapered head. May be in chains or branching. E.g. *Clostridium tetani*.
- Vibrios: small slightly curved like comma. E.g. *Vibrio cholerae*.
- Spirilla: small regularly curved and rigid. E.g. *Spirochete*

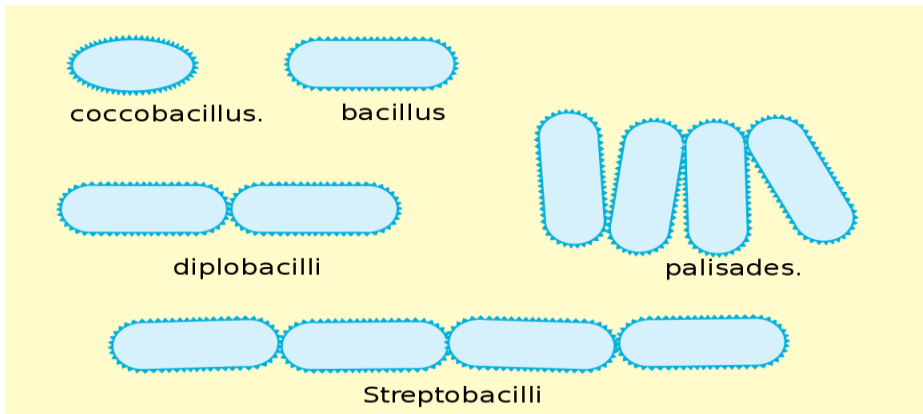
Cocci



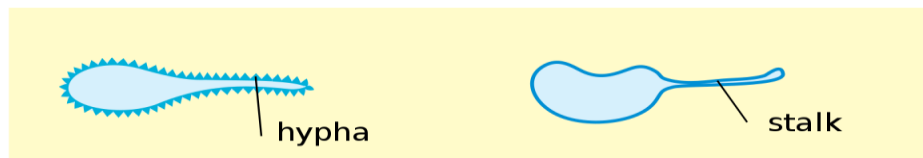
Others



Bacilli



Budding and appendaged bacteria



Bacterial morphology

Classification based on Oxygen requirement

- Obligate (strict) aerobes: can only survive in the presence of oxygen.
- Facultative aerobes: grow best in the presence of oxygen but can still survive in its absence.
- Obligate (strict) anaerobes: can only survive in the absence of oxygen.
- Facultative anaerobes: can live with or without oxygen.

Classification based on temperature requirement

- Psychrophiles: low temperature.
- Thermophiles: very high temperature.
- Mesophiles: moderate temperature.

Mode of nutrition

- **Heterotrophs**
- Parasitic bacteria: derive nutrition from other organisms on which they grow. Their effects on the host are usually observable as disease symptoms. (aerobes or anaerobes)
- Saprophytic bacteria: grow on dead and decaying organisms, dung, rotten wood, etc.
- Symbiotic bacteria: mutually benefit from association formed with other organisms.

Mode of nutrition

- **Autotrophs**
- Chemosynthetic bacteria: oxidizes inorganic substances and utilizes the obtained energy. They convert carbon of the carbondioxide into organic material.
- Photosynthetic bacteria: few of them have red pigment which helps them synthesize carbohydrates in the presence of sunlight.

Growth and reproduction in bacteria

Asexual reproduction

- Binary fission: Their growth is defined as increase in the number of cells, and it is by binary fission.
- Endospore formation: these spores are usually formed during unfavorable conditions.

Sexual reproduction

- The fusion of two different cells and transfer of hereditary materials.

Economic importance of bacteria

- Human diseases.
- Breakdown organic matter.
- Spoil food, food poisoning.
- Production of antibiotics.
- Alcoholic beverages.
- Nitrogen fixation.
- Loss of soil fertility.
- Used in butter and cheese making industries.

VIRUS

Characteristics

- Smallest living organism.
- Do not respond to stimuli.
- No cellular structure.
- Only reproduce by invading living cells.
- Simple structure with either DNA/RNA surrounded by protein/lipoprotein coat.
- Vary in appearance and size.
- Some produce symptoms after infecting an organism while others do not.

Characteristics

- Cannot grow in artificial media.
- Host-specific.

AIDS/HIV – human; TMV – plants, polio virus – spiral nerve cells, etc.

- Resistant to high temp, acid, alkali and salt.
- Retain potency after a long period of time.
- Transferable from plant to plant via mechanical means.
- Transferred by vectors.

Morphology of virus

- A typical virus comprises at least two parts viz:
 - Outer capsid (protein subunits).
 - Inner core (DNA/RNA or both).
- Helical virus: rod-like or thread-like.
- Isometric virus: roughly spherical shape.

Mode of transmission in plants

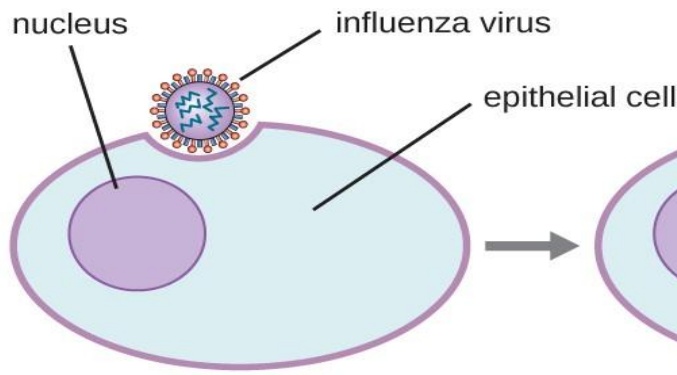
- By seeds: e.g. tubers, rhizomes, bulbs, corms, etc.
- Air and water.
- Soil e.g. TMV.
- Tools and equipment.
- Smokers and unburnt pieces of cigarettes.
- Insects.

Symptoms of viral infection in plants

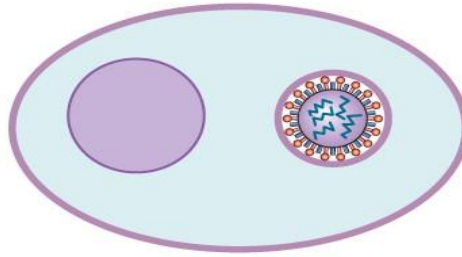
- Chlorosis: disappearance of chlorophyll from some green organs and leaves yellow spots.
- Vein clearing/vein banding: disappearance of chlorophyll along the vein is vein clearing and around the vein is vein banding.
- Necrosis: results in brownish spots due to the death and drying of tissue.
- Rolling and curling up of leaves.
- Ring spots: necrotic ring spot alternating with green areas.
- Stunting and dwarfing of plants.

Control

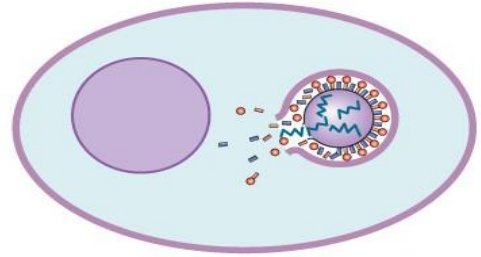
- Destruction of infected plants.
- Elimination of insect vectors.
- Tuber indexing or selection at the time of harvesting (e.g. potato).
- Planting of resistant variety.



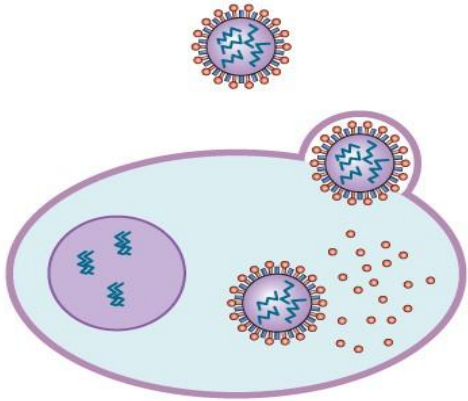
1 Attachment
Influenza virus becomes attached to a target epithelial cell.



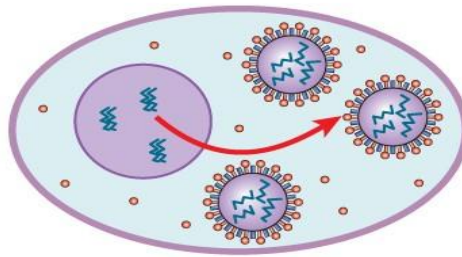
2 Penetration
The cell engulfs the virus by endocytosis.



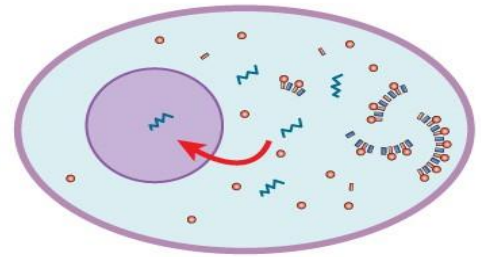
3 Uncoating
Viral contents are released.



6 Release
New viral particles are made and released into the extracellular fluid. The cell, which is not killed in the process, continues to make new virus.



5 Assembly
New phage particles are assembled.

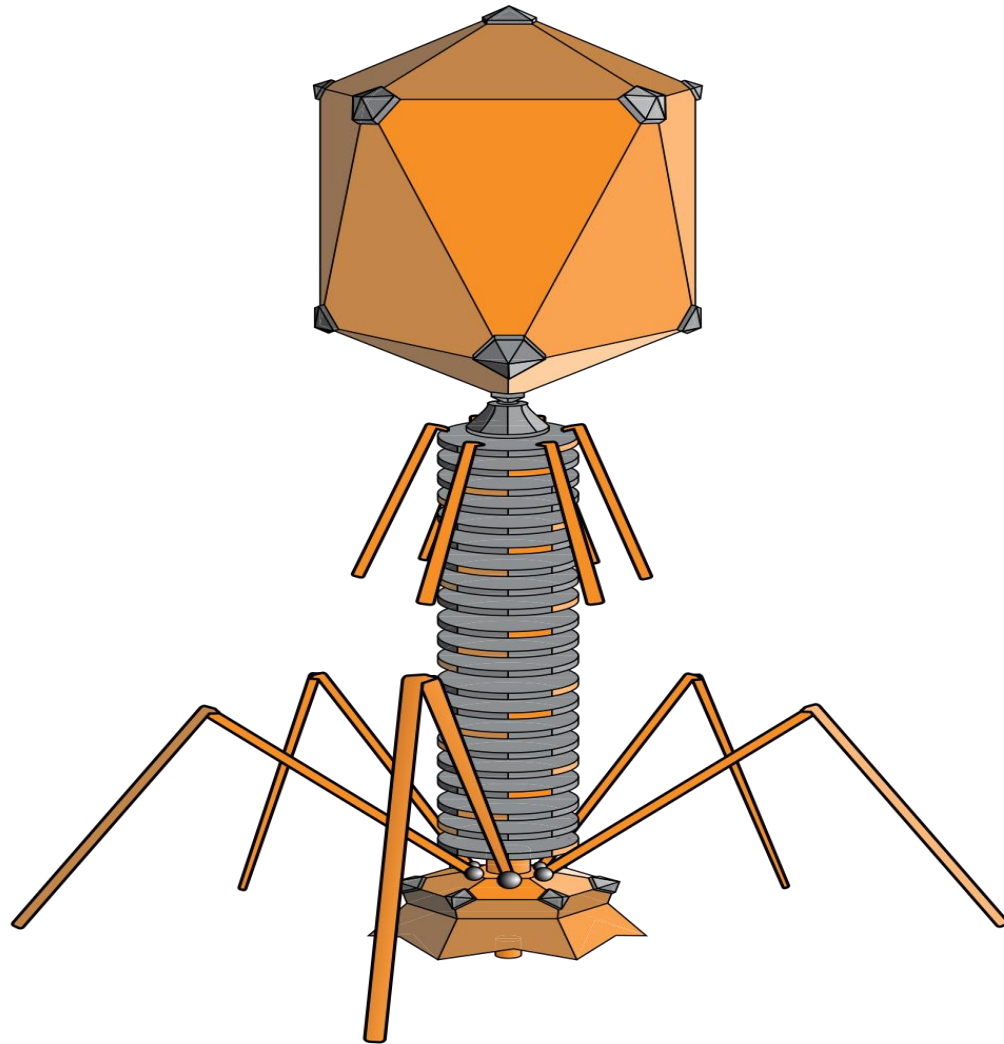


4 Biosynthesis
Viral RNA enters the nucleus, where it is replicated by the viral RNA polymerase.

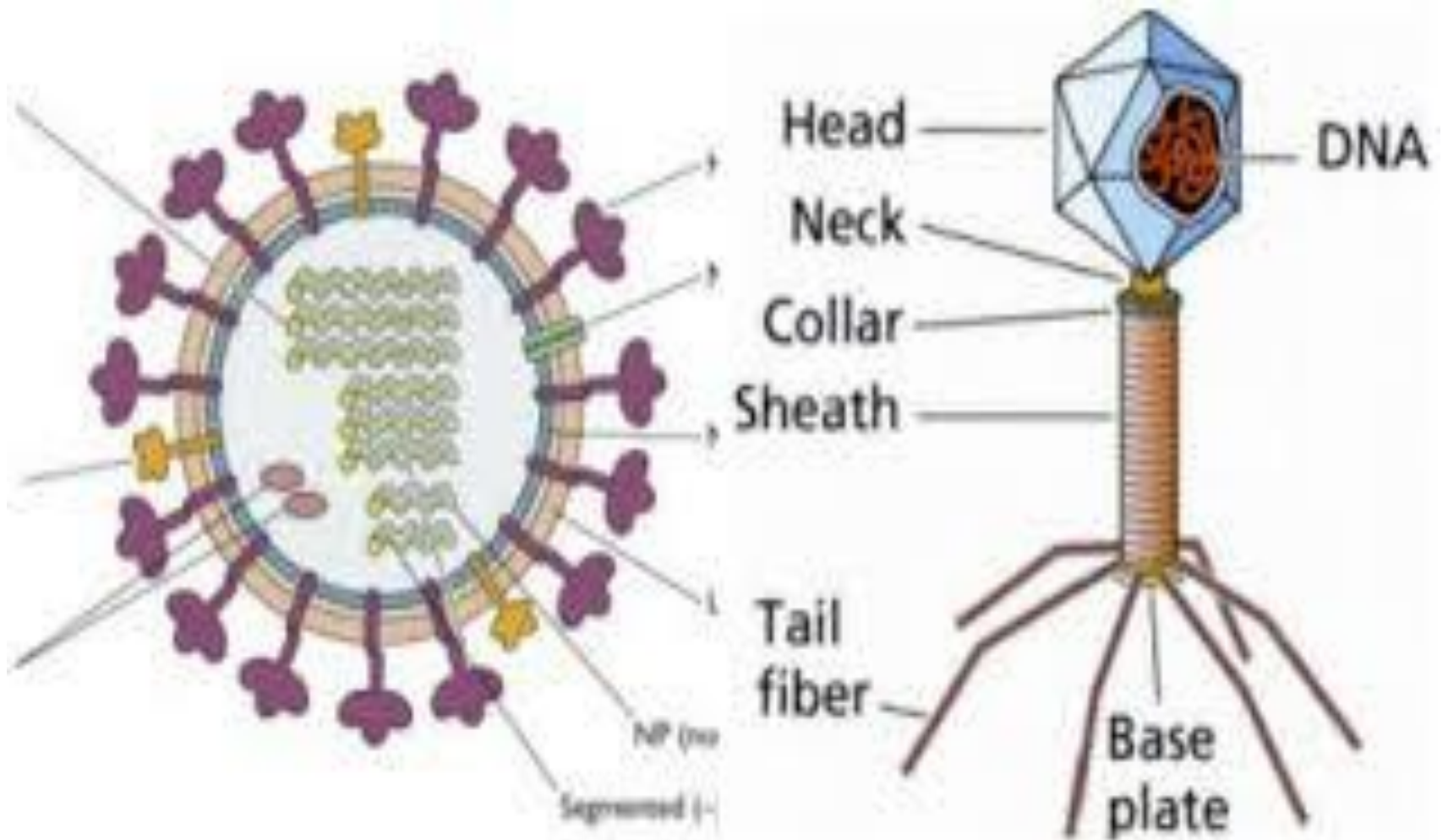
Life cycle of virus

Bacteriophages

- They are viruses which attack bacteria.
- Tail and head surrounded by protein sheath.
- DNA located within the head.



Bacteriophage



Bacteriophage

BRYOPHYTES

Regarded as “amphibians” of plant world.

Characteristics of bryophytes

- Show alternation of generations - the haploid gametophyte (producing gametes for sexual reproduction) alternates with diploid sporophyte (producing spores for asexual reproduction).
- Gametophyte dominant.
- Lack specialized cells for the transport of materials (vascular tissue). Absence of vascular tissue limits bryophytes to moist habitats and small size.
- No true roots, stems and leaves.
- Sporophyte attached and dependent on gametophyte.

Characteristics of bryophytes

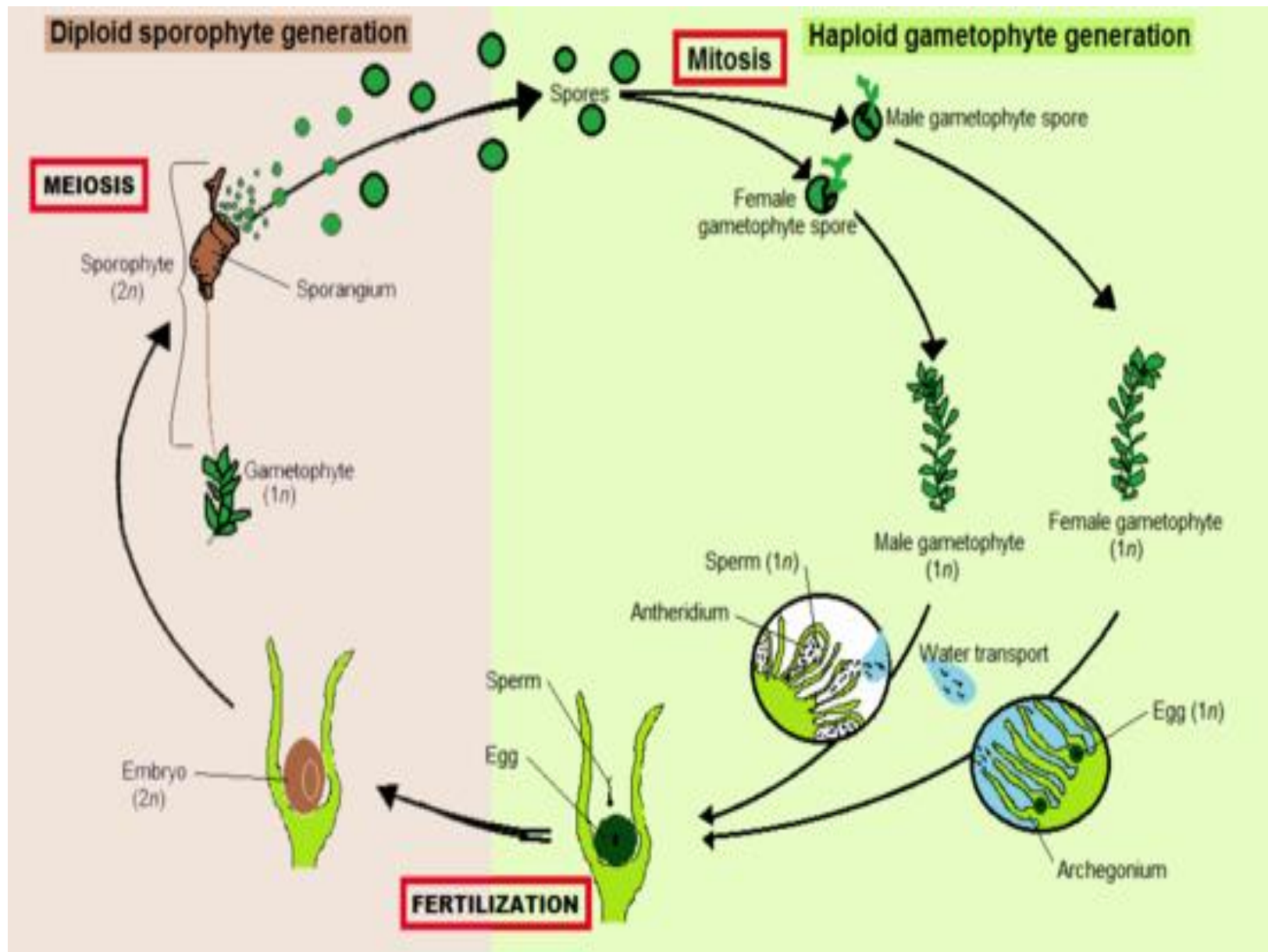
- Cuticle and stomata are absent.
- The female sex organ is the archegonium.
- The male sex organs are antheridia.
- Live mainly in damp, shady places.
- Chlorophyllous (A & B), carotene and xanthophylls.
- Excess food as starch and oil.

Economic importance of bryophytes

- Animal food.
- Prevent soil from erosion.
- Monitor atmospheric pollution.
- Important producers.

Reproduction in bryophytes

- Asexual **reproduction** occurs when a sporophyte releases spores, and sexual **reproduction** happens when gametes fuse and form a zygote. When a **bryophyte** spore settles somewhere, it grows into a gametophyte. Gametophytes are green and leafy, but small.



Life cycle of bryophytes

Classification of bryophytes

Liverworts (Hepaticae)

- “Leaves” in 3 ranks along the stem.
- Rhizoids unicellular.
- Gametophyte flattened.
- Capsule of sporophyte splits into 4 for spore dispersal.

e.g. *Pellia*, *Marchantia*, *Lophocolea*.

Mosses (Musci)

- “Leaves” spirally arranged.
- Rhizoids multicellular.
- Capsule of sporophyte has elaborate mechanism for spore dispersal.
- E.g. *Mnium*, *Sphagnum*.

Hornwort (Anthocerotae)

Sporophyte linear with foot and capsule.

PTERIDOPHYTES

Commonly referred to as ferns.

Characterisitics

- Mostly terrestrial, some in moist/shady places, aquatic, epiphytes, etc.
- Alternation of generation with sporophyte dominant.
- Sporophyte is conspicuous and gametophyte is reduced.
- Vascular tissue in sporophyte.
- True leaf, stem and root.
- Leaves relatively large and called fronds.
- Leaves with waterproof cuticle.

Characteristics contd

- Spores reduced in sporangia in cluster called sori
- Chlorophyllous (a & b), carotene and xanthophyll.
- Excess food as starch.
- Widely distributed but mostly found in moist places.
- Homosporous (same size and structure) *Lycopodium* or heterosporous (megaspore and microspore) *Selaginella*
- E.g. *Dryopteris filix-mas*, *Pteridium*, *Azolla*.

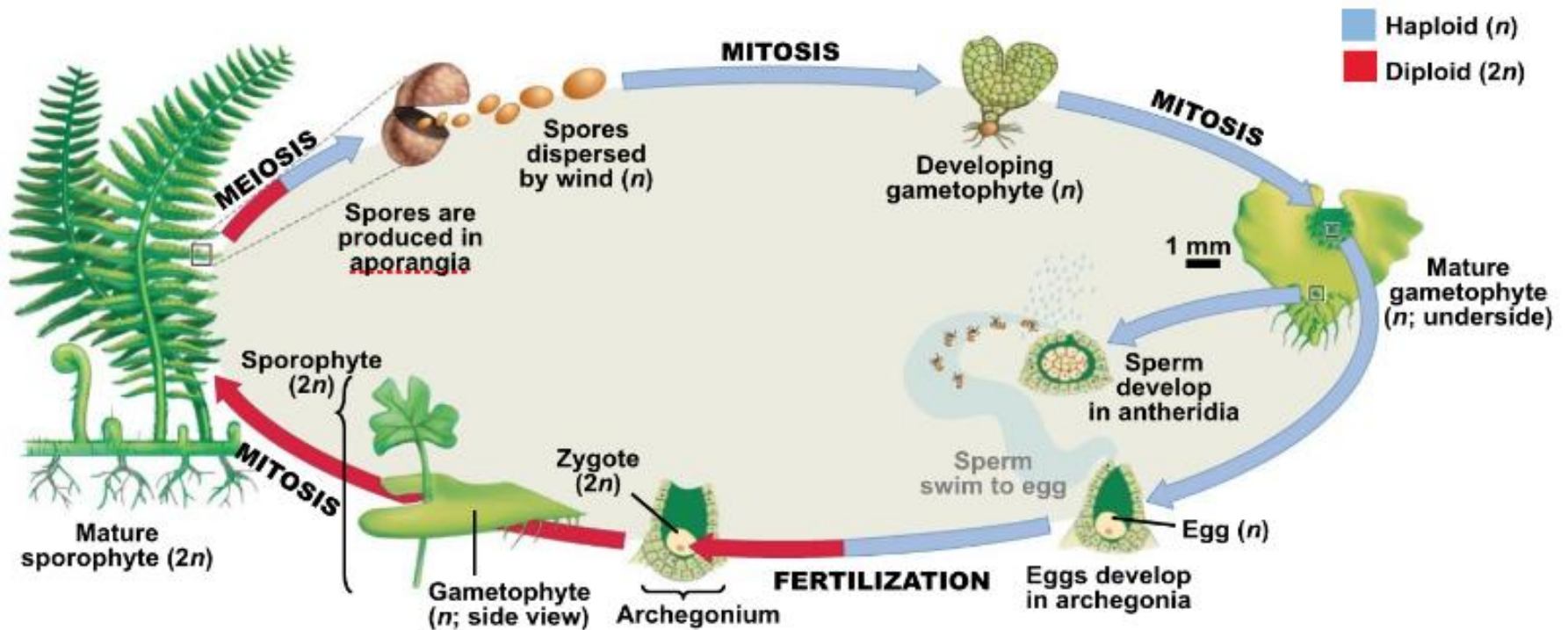
Characteristics contd

- Gametophyte bears sex organs (antheridia and archegonia).
- Sporophyte is dependent on gametophyte only during its early stage till it develops its roots, stems and leaves.

Economic importance of pteridophytes

- Biofertilizers.
- As ornamental plants.
- Treatment of ailments.
- Important producers.

Life Cycle of Pteridophyta



SEED-BEARING PLANTS

Characteristics

- Dominant sporophyte.
- Heterosporous: microspore (pollen grain) and megaspore (embryo sac).
- Water needed for fertilization.
- Complex vascular tissues.

Gymnosperm

Angiosperm

Seeds not enclosed.

Seeds enclosed in ovary.

Produces cones.

Produces fruits.

Non-flowering.

Flowering.
E.g. monocot and dicot

Biological life cycle

- Series of changes in form that organisms undergo.
- A life cycle describes the series of stages that an individual organism passes through between the time it is conceived until the time it produces offspring of its own.
- Organisms are said to have iteroparous life cycles if they have repeated birth. Examples include man, cattle. In contrast, salmon and annual plants are examples of species with semelparous (single-birth) life cycles.

Plants' life cycle

- **Annuals:** plants that complete their life cycle in a growing season, e.g. herbs, some grasses.
- **Biennials:** plants that require two growth seasons to complete a life cycle.
- **Perennials:** plants that require more two growth seasons to complete a life cycle, e.g. trees.