XI

BIOLOGY

NEET

CLASS ROOM STUDY PACKAGE

CHAPTER – 2

BIOLOGICAL CLASSIFICATION

TABLE OF CONTENT PAGE NO

1.	Introduction	2 – 4
2.	Concepts at a glance	5
3.	Ready reckoner for exam	6 - 65
4.	Basic Level Questions	66
5.	Intermediate Level Questions	67
6.	Expert Level Questions	68
7.	Comprehension Type Questions	69
8.	Questions from past papers	70 - 71

I. INTRODUCTION

Organisms have classified from different points of view at different times. The organisms were originally classified on the basis of their utility to man. They were grouped as the useful and harmful forms and as the edible and non- edible ones.

CLASSIFICATION OF ORGANISMS

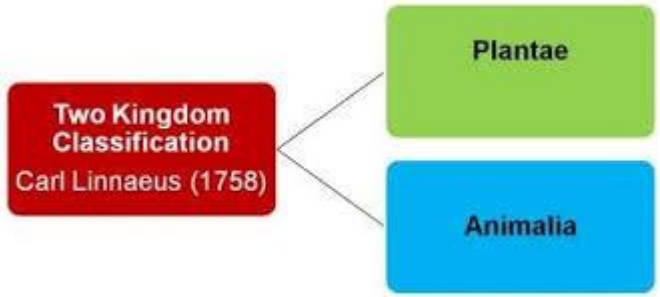
(A) TWO – KINGDOM CLASSIFICATION

- Aristotle divided the whole living world into two kingdom Plantae and Animalia.
- **Carolus Linnaeus** in 1758, first proposed two-kingdom system of classification which was the earliest scheme of natural classification. This system was used till very recently

(i) Kingdom Plantae:

- It included Bacteria, Lichens, Fungi, Algae, Bryophytes, Ferns, Gymnosperms and Angiosperms.

(ii) Kingdom Animalia: It included all animals, protozoans, sponges, worms, insects, fish, reptiles, birds and mammals.



DRAWBACKS:

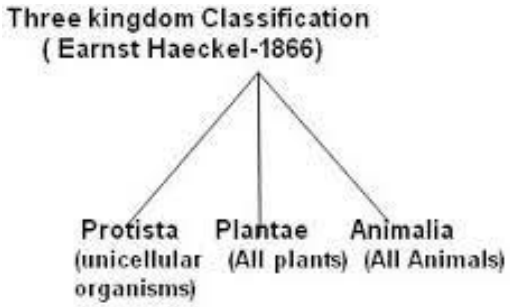
(i) Euglena possesses characteristics of both plants and animals.

(ii) Viruses share the characteristics of both living organisms & non- living things.

(iii) Bacteria and fungi are included in plants because they have cell wall. But their cell wall composition and is entirely different and the bacteria are prokaryotes while fungi is an eukaryote. So the two must be separated from one another.

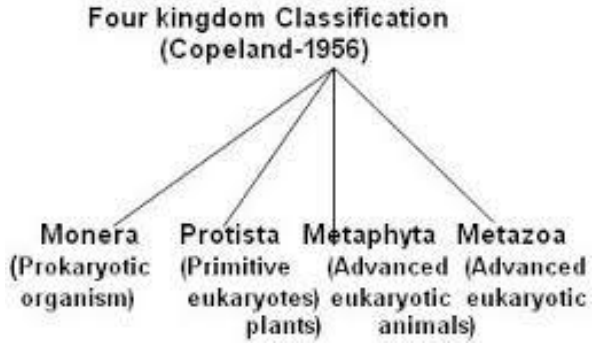
(B) THREE KINGDOM CLASSIFICATION

- Suggested by German Biologist, **E. Haeckel** in 1866.
- He divided unicellular organisms, algae and fungi from other organisms on the basis of lack of tissue differentiation.
- He named the group kingdom Protista.
- It includes single celled organisms that are intermediate in many respects between plants and animals.
- This system divides the living organism into three kingdoms namely Protista, Plantate and Animalia.



(C) FOUR KINGDOM CLASSIFICATION

- Proposed by Copeland, 1956.
- As prokaryotes (organisms without true nucleus) were different from eukaryotes (organisms with true nucleus) a new group was formed.
- Bacteria and Blue green algae comes under this kingdom.
- This system includes four kingdoms namely Monera, Protista, Plantae and Animalia.



(D) FIVE KINGDOM CLASSIFICATION

- Proposed by R.H. Whittaker (1969).
- This classification is based on cell structure, thallus organisation, mode of nutrition, reproduction and phylogenetic relationships.
- The five kingdoms of living organisms are

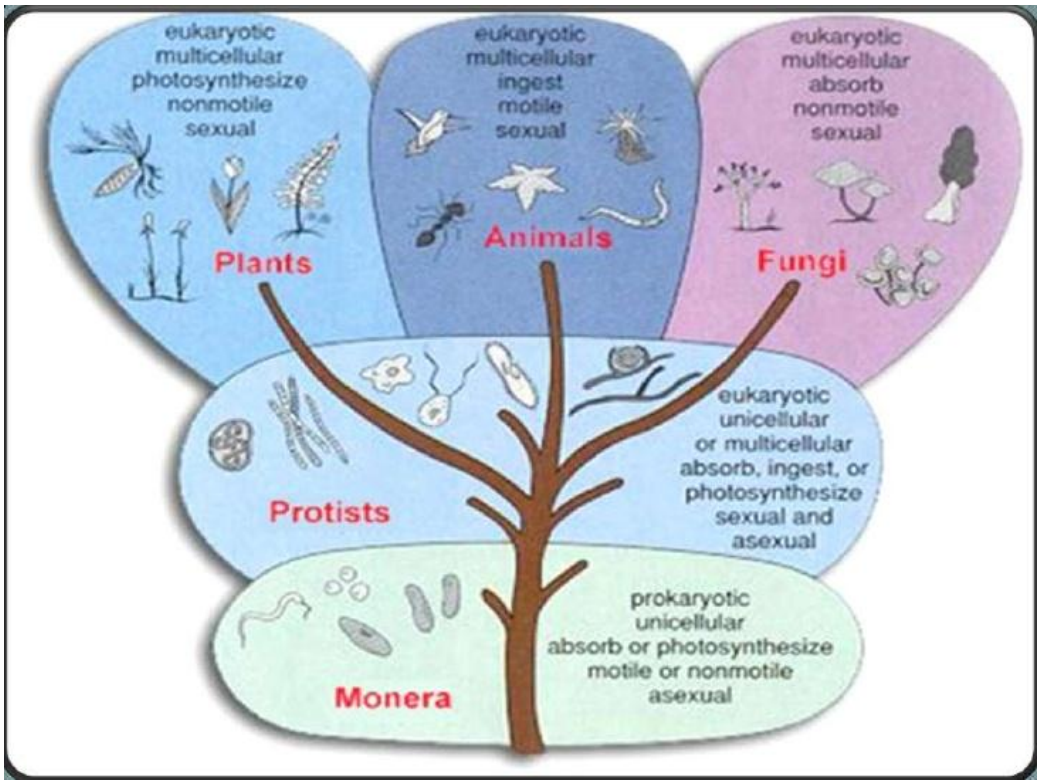
(1) Kingdom Monera (Prokaryotic Unicellular)

(2) Kingdom Protista (Eukaryotic Unicellular)

(3) Kingdom Fungi (Multi cellular Eukaryotic decomposers)

(4) Kingdom Plantae (Multicellular Eukaryotic Producers)

(5) Kingdom Animalia (Multicellular Eukaryotic consumers)



(E) THREE DOMAIN SYSTEM / SIX KINGDOM CLASSIFICATION

- Proposed by Carl woese in 1977
- Current system has following listed kingdoms in the three domains

1. Domain Archae
2. Domain Bacteria
3. Domain Eukarya

Include following kingdom

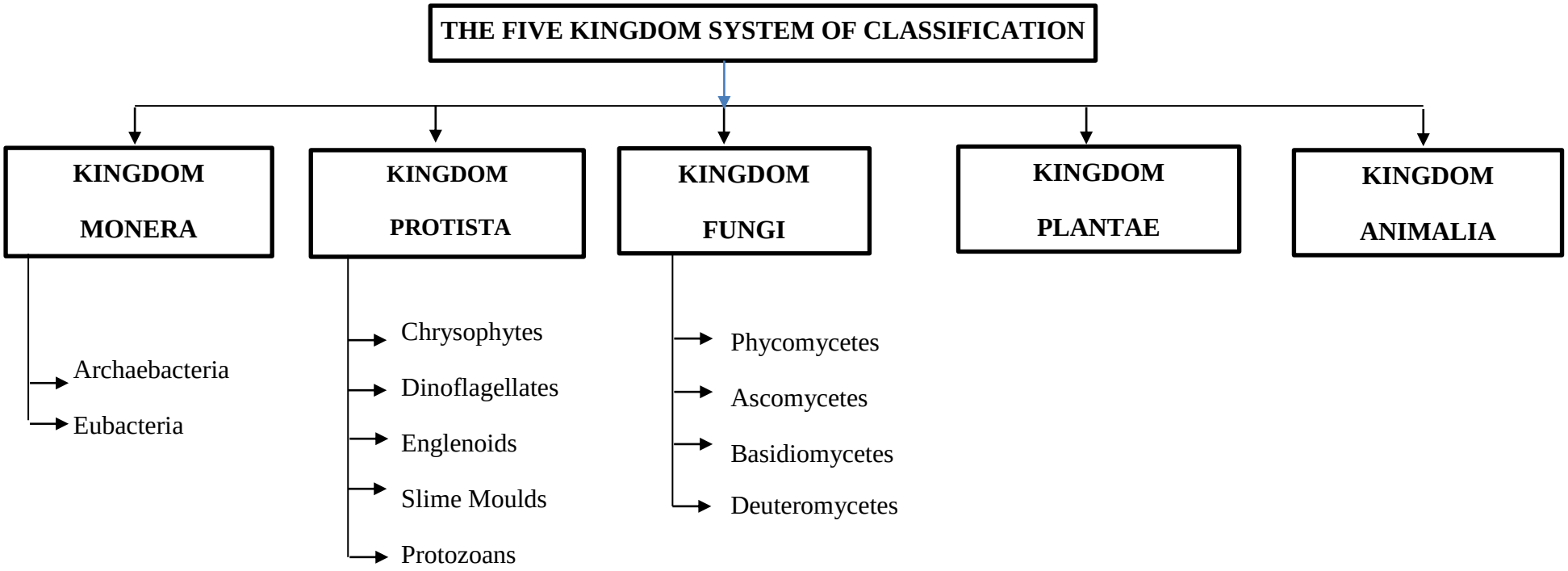
(i) Kingdom fungi

(ii) Kingdom Plantae

(iii) Kingdom Animalia

(iv) Kingdom chromalveolate

II. CONCEPT AT A GLANCE

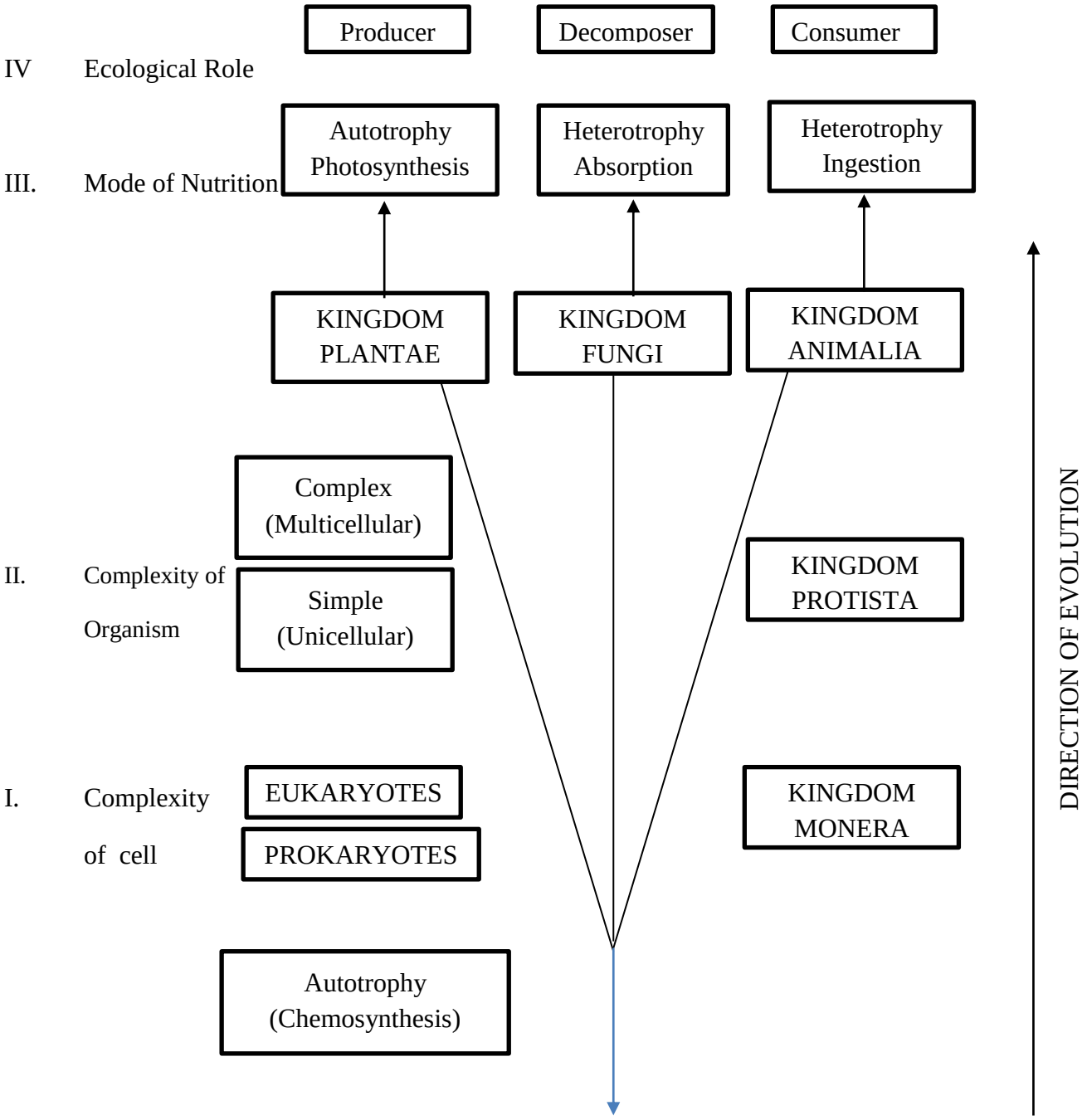


- Viruses, Viroids and Lichens

  In the five kingdom classification there is no mention of some acellular organisms like viruses,viroids and lichens.

III. READY RECKONER FOR EXAM

SYSTEMS OF CLASSIFICATION				
TWO KINGDOM	**THREE KINGDOM**	**FOUR KINGDOM**	**FIVE KINGDOM**	**SIX KINGDOM**
Proposed by **Carolus Linnaeus** (1758) ➢ Plant Kingdom ➢ Animal Kingdom (Not Approved fungi and organisms like Euglena, Chlamydomonas etc. were not justified in these two kingdoms)	Proposed by **Haeckel** (1866) ➢ Protista(for unicellular organisms) ➢ Plantae ➢ Animalia	Proposed by **Copeland** (1956) ➢ Monera ➢ Protista (for unicellular organisms) ➢ Plantae ➢ Animalia	Proposed by **R.H. Whittaker** (1969) ➢ Monera ➢ Protista ➢ Fungi ➢ Plantae ➢ Animalia	Proposed by **Carl Woese**(1990) ➢ Domain Archae ➢ Domain Bacteria ➢ Domain Eukarya (i) Kingdom Fungi (ii) Kingdom Plantae (iii)Kingdom Animalia (iv)Kingdom Chromalveolate

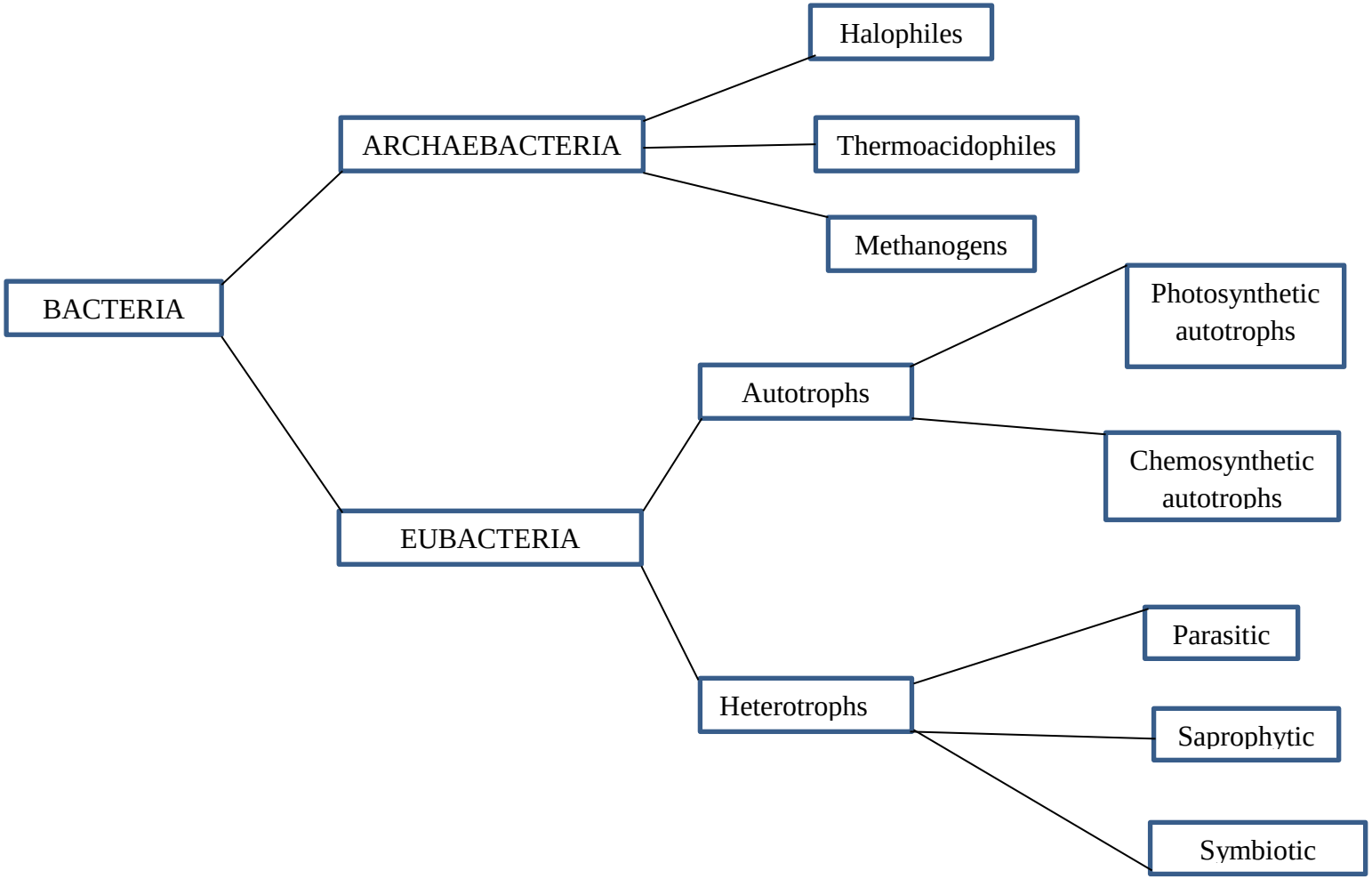


THE FIVE KINGDOMS OF LIFE

Diagrammatic representation of the propable phylogenetic relationships among them according to ROBERT. H. WHITTAKER(1969).

CHARACTERISTICS OF THE FIVE KINGDOM					
CHARACTERS	FIVE KINGDOMS				
	MONERA	**PROTISTA**	**FUNGI**	**PLANTAE**	**ANIMALIA**
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Noncellulosic (Polysacharide + amino acid)	Present some	Present (without cellulose)	Present (Cellulose)	Absent
Nuclear membrane	Absent	Present	Present	Present	Present
Body organisation	Cellular	Cellular	Multicellular loose tissue	Tissue/ organ	Tissue/Organ/organ system
Mode of nutrition	Autotrophic (chemosynthetic and Photosynthetic) and Heterotrophic (Saprophytic/parasitic)	Autotrophic (Photosynthetic) and Heterotrophic.	Heterotrophic (saprophytic/ parasitic)	Autotrophic (Photosynthetic)	Heterotrophic(Holozoic/ Saprophytic etc)

CLASSFICATION OF KINGDOM MONERA



KINGDOM MONERA

- Greek ; monos : Single
- The word ‘monera’ was coined by Stainer and Van Neil.
- Bacteria are the sole members.
- Bacteria (singular- bacterium) are the simplest, most abundant, chlorophyll bearing free prokaryotic, living organisms on this earth.
- Bacteria were first discovered by Anton von Leeuwenhoek in 1676 from scum of teeth, sewage water, saliva by observing under simple microscope.
- He called bacteria as ‘animalcules’.
- He is considered as the father of microbiology.
- The word ‘bacteria’ was coined by Ehrenberg.
- Kingdom monera first proposed by Ernst Haeckal (1866)
- Kingdom Monera includes the following

BACTERIA

- → EUBACTERIA (MODERN BACTERIA)
- → ARCHAEBACTERIA
- → ACTINOMYCETES
- → RICKETTSIA
- → MYCOPLASMA

CHARACTERISTIC FEATURES:

- Cell type - Prokaryotic
- Cell wall - Non cellulosic (poly saccharide + amino acid)
- Nuclear membrane - Absent
- Body organization - Cellular
- Mode of nutrition
  - Autotrophic
    - Photosynthesis
    - chemosynthetic
  - Heterotrophic
    - saprophytic
    - Parasitic
    - Symbiotic

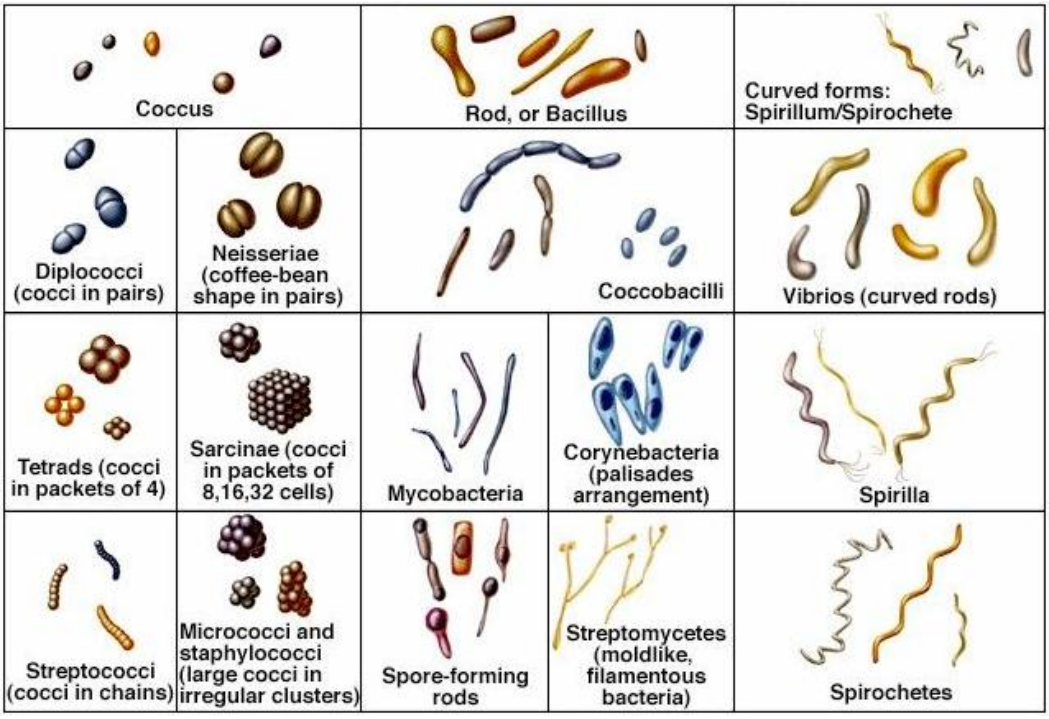
- Unicellular except cyanobacteria which are filamentous.
- The do not have a definite nucleus. The genetic material is circular, double – stranded and helical DNA (deoxyribonucleic acid) scattered in cytoplasm and not enclosed by a nuclear envelope (naked DNA)
- The cell wall of a bacterium is composed of mucopeptide called peptidoglycan.
- Cell wall is absent in certain monerans like Mycoplasma.
- Some circular bodies (mesosomes) are present on the plasma membrane of bacteria.
- Cell organells (membrane bound) like mitochondria, Golgi bodies, endoplasmic reticulum are absent. Ribosomes are present in the cytoplasm.
- Mode of nutition is either autotrophic or heterotrophic.
- Bacteria reproduce vegetatively (by fission) asexually (by endospores) and also sexually (by conjugation, transformation etc)
- Bacteria are present in soil, air, water, in animals and plants.
- Bacteria can withstand wide range of temperatures (in snow, upto - 170^0 C, in hot water springs upto 78^0C).
- Some of bacteria live as commensals (Eg: *Escherichia coli* in human intestine) or symbionts (Eg: *Rhizobium leguminosarum* in root modules of legumes)

EUBACTERIA

SIZE : Average size → 2mm

Smallest bacterium → *Dialister pneumosinetes* (0.15 -0.30 µm)

Largest bacteria (0.1 -0.3mm) [100-300 µm] → *Thiomargarita namibiensis*



SHAPE

Based on their shape bacteria are dividing into 5 categories. They are

(i) Coccus (Greek → kokkos = berry /particle)

→Spherical or ovoid in shape
→ usually devoid of flagella.
Micrococcus → occurs singly.
Diplococcus → in pairs
Tetracoccus → in tetrads.
Streptococcus → in chains
Staphylococcus → irregular grape like clusters
Sarcinae → Three dimensional, cubicals of 8, 64 or more.
Eg: *Staphylococcus aureus, Diplococcus pneumonia, Streptococcus* pyogenes etc

(ii) Bacillus

- Rod shaped
- *Bacillus* → Occur singly
- *Diplobacillus* → in pairs
- *Streptobacillus* → in the form of chain
- *Palisade bacillus* → in form of stacks
  Eg: *Bacillus anthracis, Salmonella* etc.

(iii) Spirillum

- Spiral shaped
- Spirally coiled like screw
- Does not occur in aggregation
  Examples: *Spirillum, Rhodospirillum*

(iv) Vibrio

- Comma or a small curbed rod shaped.
- Aggregation is not formed.

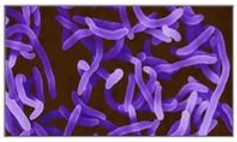
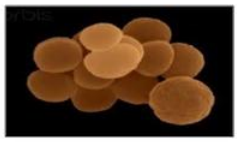
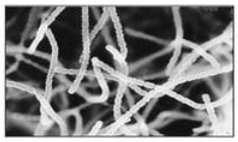
  Eg: *Vibrio cholerae*

(v) Filamentous or Mycelial

- Grow as filaments and are called *actinomycetes*.
  Eg:- *Actinomycetes, Streptomyces*

(vi) Pleiomorphic type

- Exist in different morphological forms at different times.
  Eg: *Azotobacter, Mycobacterium, Rhizobium, Corynebacterium.*

Circular (Coccus)	Rod-shaped (Bacillus)	Curved Forms	Other Shapes
 Diplo- (in pairs)	 Coccobacilli (oval)	 Vibrio (curved rod)	 Helicobacter (helical)
 Strepto- (in chains)	 Streptobacilli	 Spirilla (coil)	 Corynebacterium (club)
 Staphylo- (in clusters)	 Mycobacteria	 Spirochete (spiral)	 Streptomyces (filaments)

ULTRA STRUCTURE OF BACTERIAL CELLS

1.Capsule

2. Cell wall

3. Structures internal to cell wall

   (i) Plasma membrane

   (ii) Mesosomes

   (iii) Cytoplasmic area

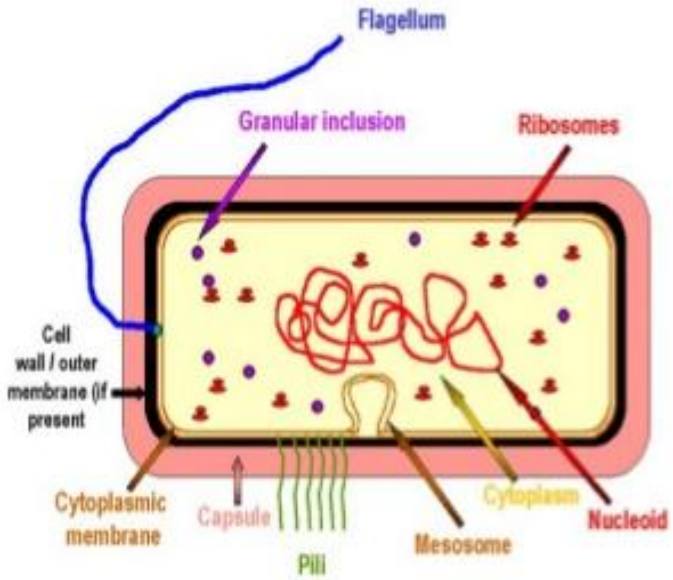
   (iv) Nuclear area

   (v) Extrachromosomal material

4. Flagella

5. Pili

6. Fimbriae



1) CAPSULE

- Thick, highly viscous covering over the cell wall
- 0.2 – 0.5 µm thick
- It is made up of polysaccharides.
- It could be smooth sheath called slime layer in some while in others it may be thick and tough called capsule.

FUNCTIONS

- Antigenic property and protective function.
- It is an osmotic barrier.
- Acts as a storage product during adverse condition.
- Helps in nitrogen fixation.

2) BACTERIAL CELL WALL

- Rigid, thick, elastic and is composed of polysaccharides, proteins and lipids.
- Unique component is mucopetide called PEPTIDOGLYCAN or Murein, which is composed of N- aetyl glucosamine (NAG) and N- acetyl muramic acid (NAM) molecules linked alternately by short peptide chains of amino acids.
- The cell wall determines the shape of the cell and provides a structured support to prevent the bacteria from bursting or collapsing

Danish bacteriologist, Christian Gram for the first time classified bacteria on the basis of the cell wall into two groups: (i) Gram +ve (ii) Gram – ve

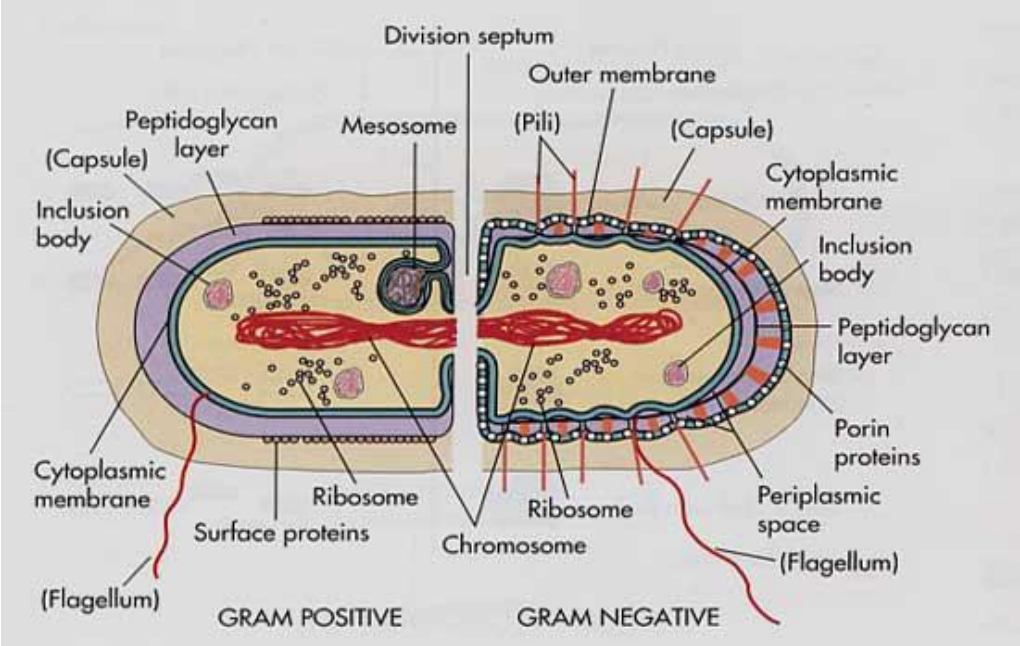
DIFFERENCES BETWEEN GRAM +ve AND GRAM –ve BACTERIA		
SL No	**GRAM +ve**	**GRAM -ve**
1.	Coloured blue or purple with Gram stain even after washing with alcohol or acetone	Do not retain Gram stain when washed with absolute alcohol.
2.	Stains with crystal violet	Stains with safranin
3.	Single layered wall which is 15-20nm in thickness	Double layered wall, 7.5 -12.0 nm in thickness
4.	Very low lipid content in their walls.	20-30% lipid content in their walls.
5.	Lipopolysaccharides layer absent	Present
6.	Walls contain 70-80% murein peptidoglycan	Walls contain 10-20% murein or peptidoglycan
7.	Cell wall contains teichoic acids	Teichoic acids are absent
8.	Mesosomes are more prominent.	Mesosomes are less prominent
9.	Only few pathogenic bacteria belong to Gram +ve group.	Most of the pathogenic bacteria are Gram –ve
10.	They are susceptibfle to antibiotics	They are resistant to antibiotics.
11.	Examples : *Bacillus, Closdtridium, Mycobacterium, Streptococcus, Staphylococcus, Diplococcus*	Exmples: *Salmonella, Pseudomonas, Vibrio, Helicobacter, Haemophilus, Escherichia*

Bacteria	Commonly found in
Staphylococci & streptococci	Skin and wound infections
Staph, Enterococci, corynebacteria	Line related infection
Clostridia	Gangrenous wound infections, **abdominal infections**

GRAM – POSITIVE

Bacteria	Commonly found in
The Coliform bacteria; *E. Coli, Klebsiella, enterobacter, salmonella*	The Gut! UTI, also can cause ventilator assisted pneumonia, wound infection, biliary tract infection, septicaemia
Pseudomonas	Moist environments – **chronic leg ulcers.** Catheters, pneumonia, septicaemia, CF/bronchiectasis
Bacteroids – anaerobic bacteria	Intra-abdominal infections, soft tissue infection below the waist

GRAM – NEGATIVE



3) STRUCTURES INTERNAL TO CELL WALL

(i) Plasma membrane

(ii) Mesosomes

(iii) Cytoplasmic area

(iii) Nuclear area

(iv) Extrachromosomal material → Plasmid

→ Episome

(i) PLASMA MEMBRANE

- Lipoproteinous
- Semipermeable
- Protein, PORIN serves as receptor for phages.

(ii) MESOSOMES:

In all gram +ve bacteria, the plasma membrane forms invaginations or intra cytoplasmic structures called as mesosomes or chondriods (bacterial or mitochondria). which can be lamellar or vesicular or tubular.

FUNCTIONS:

- Mesosomes contain oxidases, dehydrogenases (respiratory enzymes) and help in bacterial respiration.
- They are analogous to mitochondria of eukaryotes.
- DNA replicaion.
- Septum formation

(iii) CYTOPLASMIC AREA

- The cytoplasm is homogenous dense granular aqueous solution.
- It contains proteins, enzymes, RNA (mostly + RNA) and abundant ribosomes.
- Composed of 70S units.
- Reserve food matter in cytoplasm is of 3 types:

(a) Organic polymers (polysaccharides)

(b) Inorganic metaphosphate granules.

(c) Elemental sulphur

(iv) NUCLEAR AREA

NUCLEOID

- There is no nuclear membrane, but the genetic material is seen freely in the cytoplasm (but lack histone protein) hence it is called as nucleoid
- The nucleoid is composed of a double stranded circular supercoiled DNA (about 60%) with a small amount of RNA and protein.
- In E. coli DNA has about 10,000 genes

(v) EXTRA CHROMOSOME MATERIAL

Two types → Plasmid
Episome

(i) Plasmid

- Plasmid is also called as mini chromosome containing 3-4 genes except f - plasmid which has 9 genes.

- They are small extrachromosomal rings of DNA, present in monerans and some other organisms.
- Plasmids are discovered by Hayes and Lederberg (1952).
- The plasmids which carry useful genes are of three types: F - plasmid, R - plasmid, col – plasmid.

FUNCTION

- They can replicate independent of nucleoid. So they are used in the transfer of the genetic material between different bacteria.

(ii) Episome

- Episomes are extra- chromosomal genetic material that may replicate autonomously or become integrated into the chromosome.
- They get easily incorporated to the main chromosome of nucleoid region.

4) FLAGELLA

- Flagella are whip like organs of locomotion.
- Composed of an elastic fibrous protein FLAGELLIN.
- On the basis of flagellation, bacteria are classified as:

(A) ATRICHOUS → without flagella eg: Diphtheria

(B) TRICHOUS → They bear one or more flagella. They are further named as ;

(i)Monotrichous → Single flagellum is present at one end of the bacterial cell.

Eg:- *Thiobacillus*

(ii) Amphitrichous

- At each of the two ends of a bacterial cell, single or many flagella are present.

Eg:- *Nitrosomonas*.

(iii) Cephalotrichous

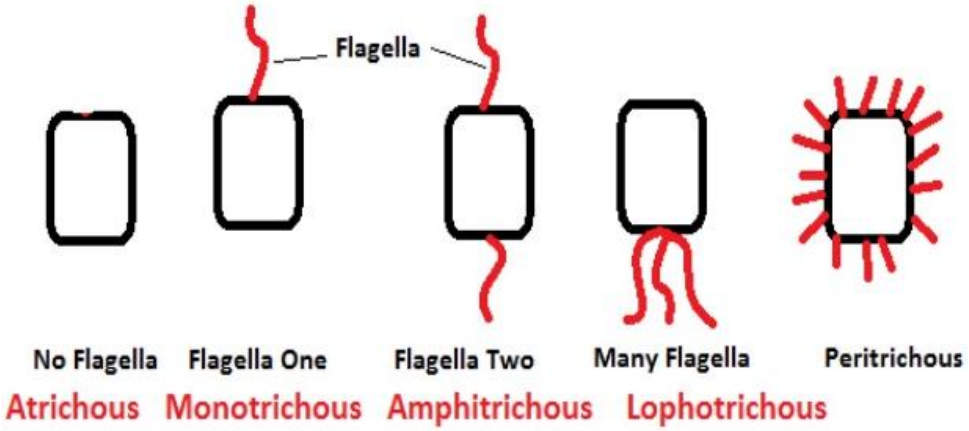
- A group of flagella at one end
  Eg:- *Pseudomonas fluorescence*

(iv) Lophotrichous

- A group of flagella at each of the two ends.
  Eg: *Vibrio*

(v) Peritrichous

- Many flagella are distributed all over the surface of a bacterial cell
  Eg:- *E. coli*



- Bdellovibrio is a highly motile small sized monotrichous bacteria that attack other bacteria, multiply inside their bodies and cause lysis of host cells.
- Bdellovibrio bacteriovorous is believed to help maintain purity of Ganga.

5) PILI

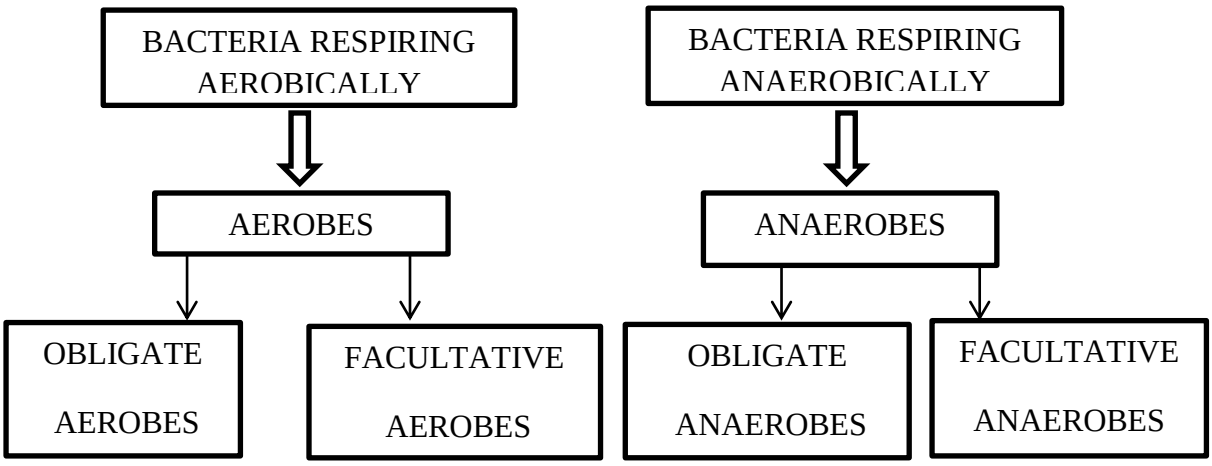
- Small in size (1µm).
- Hollow from inside
- Made up of protein, pilin and play no role in motility.
- Pili develop in response to fertility factor and take part in the formation of conjugation tube. So it is also referred to as sex pilus

6) FIMBRIAE

- Are small brustle like fibres sprouting out of the cell.
- They are known to help attach the bacteria to rocks in streams and also to the lost tissues.

RESPIRATION IN BACTERIA

- Process of respiration occurring in the presence of oxygen is called Aerobic Respiration.
- Respiration occurring in the absence of oxygen is called anaerobic
- According to the mode of respiration bacteria can be of two types- Aerobic and Anaerobic.



(i) Obligate Aerobic:

- They are bacteria which can respire only aerobically. They get killed under anaerobic conditions.

Eg:- *Bacillus subtilis*

(ii) Facultative Anaerobes:

- They are bacteria, which generally respire aerobically but switch over to anaerobic mode of respiration if oxygen becomes deficient

Eg:- *Clostridium tetani*.

(iii) Obligate Anaerobes:

- These bacteria, respire only anaerobically. They get killed under aerobic conditions

Eg:- *Clostridium botulinum*

(iv) Facultative Aerobes:

- These bacteria respire anaerobically under normal conditions but can respire aerobically, when oxygen is available.

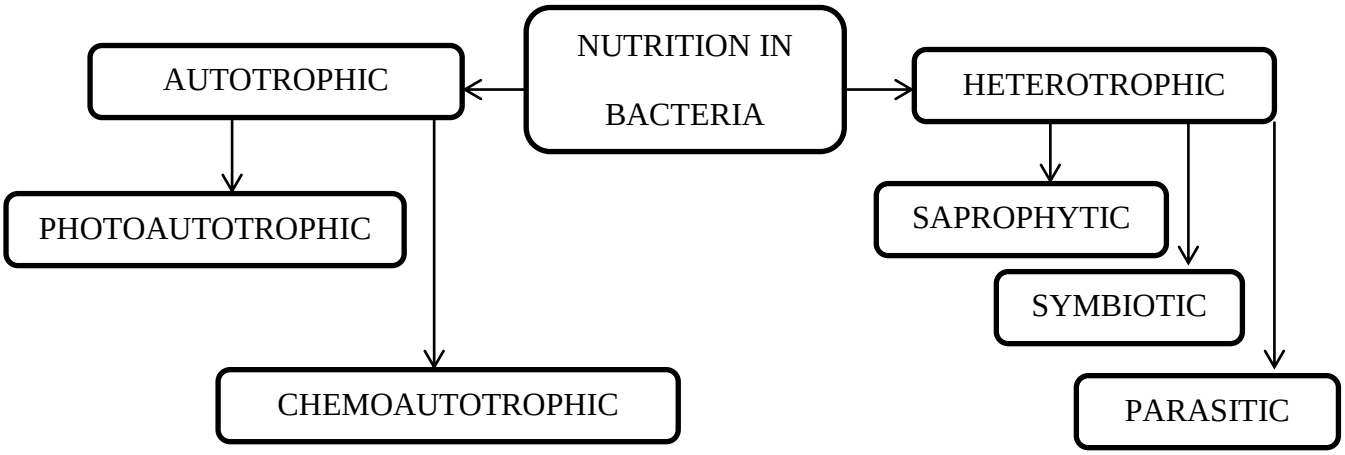
Eg:- Most of the photosynthetic bacteria.

NUTRITION IN BACTERIA

They are classified in to two categories

(1) AUTOTROPHIC BACTERIA

(2) HETEROTROPHIC BACTERIA



(1) AUTOTROPHIC BACTERIA

- Prepare their organic food from the inorganic materials obtained from the outside environment with the help of energy obtained from outside source.
- Autotrophic bacteria are of two types

  (i) Photoautotrophic bacteria

  (ii) Chemoautotrophic bacteria

(i) Photoautotrophic Bacteria

- Prepare their own food and the energy needed for the process is obtained from the sunlight.
- Bacteria possess photosynthetic pigments bacteriochlorophyll and Chlorobium chlorophyll to trap the solar energy.
- In some photoautotrophic bacteria pigments are located in spherical bodies called chromatophores.
- No oxygen is evolved in bacterial photosynthesis. Such type of photosynthesis is called anoxygenic.
- Photoautotrophic bacteria survive near bottom of lakes and ponds, where reduced sulphur and other compounds are freely available and oxygen content is very low.

Eg:- *Chlorobium, Chromatium, Rhodospirillum*

(ii) Chemoautotrophic Bacteria

- Bacteria prepare their organic food from inorganic raw materials with the help of energy derived from chemical reactions involving oxidation of an inorganic substance present in the external medium.
- The chemical energy obtained from oxidation reaction is trapped in ATP molecules.
- There are several types of chemoautotrophic bacteria

  (a) Nitrifying bacteria

  (b) Sulphur oxidising bacteria

  (c) Iron bacteria

  Eg:- *Nitrosomonas, Clostridium*

(2) HETEROTROPHIC BACTERIA

- Bacteria draw their organic food in ready made form from outside sources.
- They include → free living saprophytic

  →Symbiotic

  →Parasitic

(i) SAPROPHYTIC BACTERIA

- Free living bacteria
- They obtain their food from organic remains such as corpses, animal excreta, fallen leaves, vegetables, fruits, meat, jams, jellies and several other products of plants and animal origin.

  Eg:- *Pseudomonas*

BENEFICIAL ACTIVITIES

- Decomposition of dead bodies and organic wastes.
- Mineralisation of soil
- Sewage disposal
- Curing of tea, tobacco and coffee
- Rotting of fibres.
- Cleaning of hides
- Preparation of curd and butter.
- Industrial synthesis of alcohol, organic acids, vitamins, enzymes, antibiotics etc.

HARMFUL ACTIVITIES

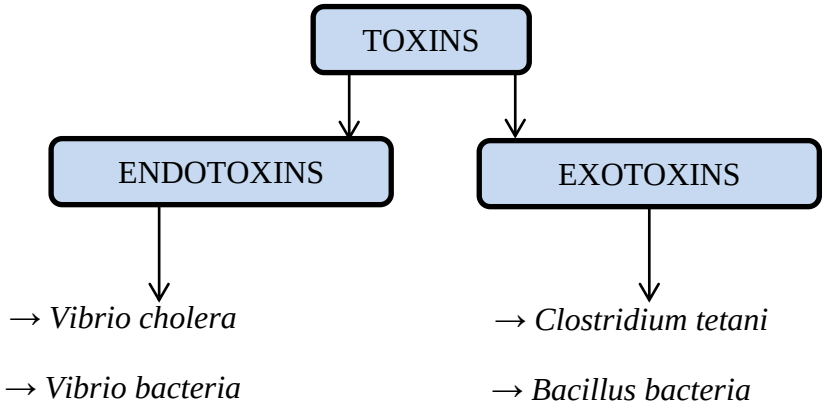
- Spoilage of food stuffs
- Food poisoning
- Deterioration of house hold articles.
- Denitrification
- Desulphurification of soils

(ii) SYMBIOTIC BACTERIA

- Bacteria which form mutually beneficial association with other organisms.
  Eg:- *Rhizobium, Escherichia coli*

(iii) PARASITIC BACTERIA

- Bacteria draw their nourishment from other living organisms.
- Parasitic bacteria may or may not cause disease.
- Disease causing forms are called pathogenic bacteria
- The diseases is produced either due to breakdown of the host cells or due to liberation of toxins.



BACTERIAL DISEASES IN HUMAN BEINGS		
	DISEASE	**CAUSATIVE AGENT**
1.	Pneumonia	*Diplococcus pneumoniae*
2.	Cholera	*Vibrio cholera*
3.	Tuberculosis	*Mycobacterium tuberculosis*
4.	Leprosy	*Mycobacterium leprae*
5.	Syphilis	*Treponema pallidum*
6.	Tetanus	*Clostridium tetani*
7.	Typhoid	*Salmonella typhi*

REPRODUCTION IN BACTERIA

I. VEGETATIVE REPRODUCTION

(a) Binary fission

- Bacterial cell divides into two independent daughter cells. The cell division is of amitosis

II. ASEXUAL REPRODUCTION

(a) Endospore formation

(b) Conidia formation

(c) Cyst formation

(a) Endosperm formation

- During unfavourable environmental condition, bacteria produce thick- walled, highly resistant spores which are known as Endospore. (Endo = inside).
- In each bacterial cell, single endospore is formed.

(b) Conidia formation

- Formation of conidia (spore like structures are formed in chains) may occur in some filamentous bacteria, Eg:- *Streptomyces.*
- New bacteria are developed from conidia.

(c) Cyst formation

- The cyst is the transformation of entire cell.
- They are modified vegetative cell.
  Eg:- *Azotobacter*

III. SEXUAL REPRODUCTION

- In bacteria, typical sexual reproduction is absent; gene recombinations occur in them. There are three different methods of genetic recombination.

(a) Conjugation

(b) Transformation

(c) Transduction

(a) Conjugation

- The method of conjugation was first reported by Lederberg and Tatum (1946) in Escherichia coli.
- Bacteria which exhibit conjugation are dimorphic ie, 2 two types of cells
- Male (F^+) or donor & Female (F^-) or recipient.
- The male or donor cell possess sex pili and F^+ or fertility factor on its plasmid.
- The female or recipient cells lack both the structures.
- The donor cells gets attached to the recipient cell with the help of pili. In region of contact, a pilus grow in size and forms conjugation tube. The plasmid of donor cell undergoes replication and a copy is transferred to recipient through conjugation tube. This is called sexduction.

(b) Transformation

- Transformation was discovered by F. Griffith (1928) in Streptococcus pneumoniae while proving that DNA is the genetic material.
- It is known as "Grifth effect". He found that bacteria of non-virulent strain developed characteristics of the virulent strain, when injected in mice along with killed bacteria of virulent strain.
- Griffith's experiment was proved by Avery, Macleod and Mc Carty (1944) who received Nobel Prize. They proved that DNA is the transforming principle during transformation.

(c) Transduction

- This phenomenon was first studied in Salmonella typhimurium by Zinder and Lederberg in 1952.
- It is the process of transfer of genetic material from one bacterial strain to another by bacteriophages.

ECONOMIC IMPORTANCE OF BACTERIA

HARMFUL ACTIVITIES

1. Spoilage of food.
2. Food poisoning
3. Deterioration of Domestic Articles
4. Denitrification of soils
5. Diseases in human and animals and about 40% of plant diseases.

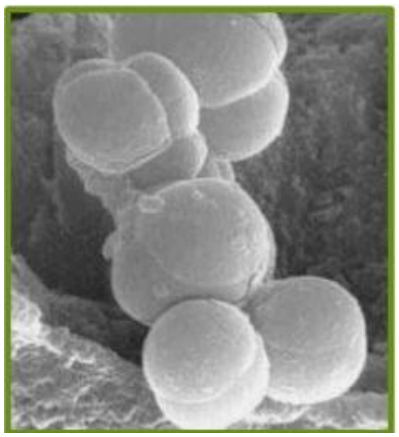
USEFUL ACTIVITIES

1. Decomposition of Plant and Animal bodies.
2. Sewage Disposal
3. Ammonification eg: Bacillus vulgaris
4. Nitrification eg:- Nitrosomonas, Nitrobacter
5. Nitrogen fixation eg:- Rhizobium,Clostridium, Azotobacter
6. Manure & Gobar Gas
7. Diary Industry
8. Vinegar making
9. Preparation of Alcohol and Acetone.
10. Curing of Tea, Tobacco and Coffee.
11. Retting of fibres.
12. Cleaning of Hides.
13. Vitamin production in human intestine.
14. Production of Antibiotics.
15. Production of Biodegradable Plastic
16. Bioleaching.
17. Genetic Engineering

SL NO:	FUNCTIONS OF BACTERIA	EXAMPLES
1.	Ammonification	*Bacillus ramosus, B. Vulgaris*
2.	Nitrification	*Nitrosomonas, Nitrobacter*
3.	Nitrogen fixation	*Rhizobium, Clostridium, Azotobacter*
4.	Food poisoning • Botulism • Salmonellosis	*Staphylococcus aureus, Clostridium botulinum* *Salmonella enteridis* *Salmonella typhimurium*
5.	Deterioration of Domestic Articles	*Spirochaete, cytophaga*
6.	Dentrification of soils	*Thiobacillus denitrificans* *Micrococcus denitrificans*
7.	Antibiotics production	*Bacillus subtilis*
8.	Synthesis of Riboflavin (Vitamin B12)	*Clostridium*
9.	Production of acetone, methanol and butanol	*Clostridium acetobutylicum*
10.	Acetic acid from alcohol	*Acetobacter aceii.*
11.	Sugar solution to acetic acid	*Mycoderma aceii.*
12.	Lactose to Lactic acid	*Lactobacillus, Streptococcus*
13.	Curd to lactic acid	*Streptococcus lactis*
14.	Extraction of fibres from jute, hemp and coir (Retting of fibres)	*Bacillus subtilis, B. polymyxa, Clostridium tertium, C. felsimium*
15.	Curing of tea, tobacco	*Mycococcus candisans(tea)* *Bacillus megatherium (tobacco)*
16	Bacteria, which are found in human intestine and synthesize vitamin K & B that help in food fermentation	*E.coli, Lacto bacillus, Streptococcus, Staphylococcus*
17.	Genetic engineering ; Trangenic bacteria used to make third generation vaccinations, drugs as insulin, somatostatin and interferons.	*Escherichia coli*

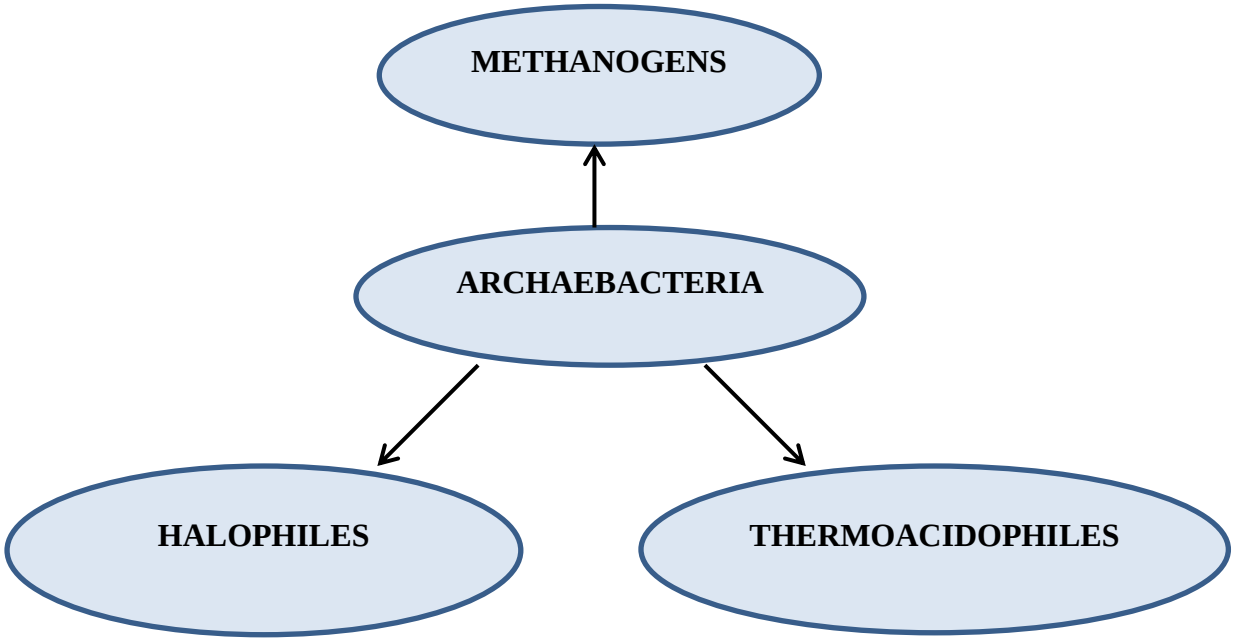
Sl NO:	DISEASES CAUSED BY BACTERIA	CAUSATIVE AGENTS
1.	**In Animals**	
	Chicken Cholera	*Salmonella sp*
	Sheep anthrax	*Bacillus anthracis*
	Eye diseases	*Chlamydia trachomatis*
	Pneumonia	*Mycoplasma pneumoniae*
2.	**Plant Diseases**	
	Fire blight of pear	*Xanthomonas*
	Angular leaf spots of cotton	*Xanthomonas malvacearum*
	Soft rot of potato, tomato, cabbage and turnip	*Erwinia aroideae*
	Black rot of potato	*Erwinia atroseptica*
	Wildfire disease of tobacco	*Pseudomonas tabaci*
	Plant tumours or crown galls.	*Agrobacterium tumefaciens*
3.	**Human Diseases**	
	Plague	*Pasterella pestis*
	Urinogenital infection	*Klebsiella sp*
	Abscesses	*Staphylococcus*
	Anthrax	*Bacillus anthracis*
	Cholera	*Vibrio cholerae*

- **ARCHAEBACTERIA**
- They have pseudomurein (protein) in their cell wall but lack peptidoglycan compounds.
- The cell membranes of archaebacteria contain branched lipids which make them adapt to adverse habitats.

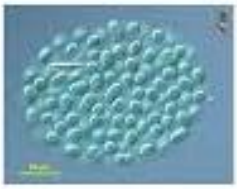


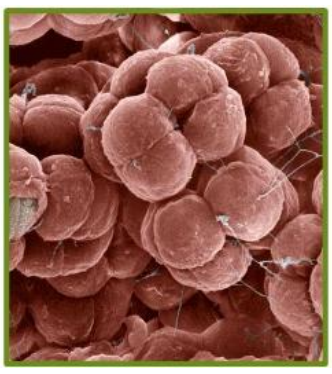
Methanogens

Methanogens can be found in environments that are anaerobic (no oxygen). Types of environments methanogens are found in are swamps and marshes, or intestinal tracts of animals and some humans. As their name suggests, methanogens produce methane gas. According to a study published in the October 2000 issue of The American Journal of Gastroenterology, their trait of producing methane makes them easily detected within the intestinal tract.



Halophiles: "salt-loving" archae that live in environments that have very high salt concentration such as the Dead sea.



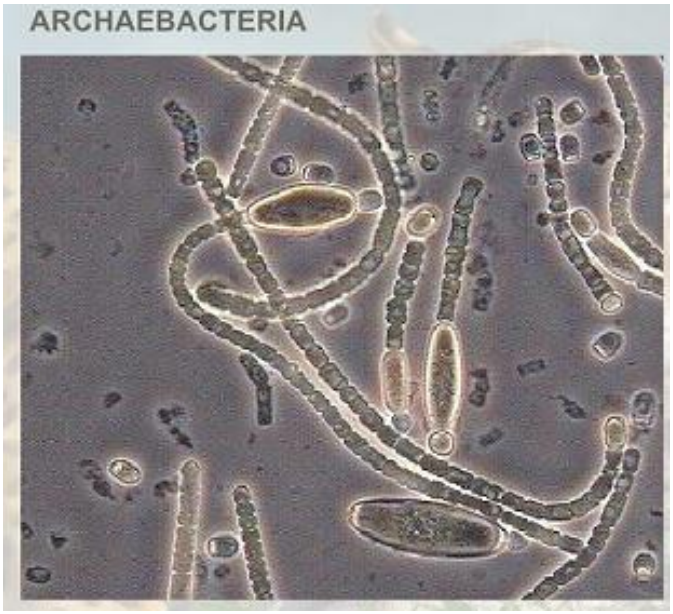


Thermoacidophiles

Thermoacidophiles, or thermophiles, inhabit hot environments. A report on bacteria from the University of Miami Department of Biology states that thermoacidophiles thrive in extremely acidic, hot and moist regions, such as those in and near sulfur hot springs. If they are in temperatures below 131 degrees F (55 degrees C), they die.

Characteristics Chart

Kingdom	Archaebacteria
Cell Type	Prokaryotes
Cell Structures	Have cell walls that lack peptidoglycan
Body Form	Unicellular
Nutrition	Autotrophic or heterotrophic
Examples	Methanogens, halophiles, sulfolobus



METHANOBACTERIA	HALOPHILES	THERMOACIDOPHILES
• Most primitive • Produce energy buy converting H_2 & CO_2 into methane (CH_4) gas. • Killed by O_2 • Live in the digestive tract of grazing animals and helps in digestion of cellulose in gut of these animals and rotten sewage. Eg:- *Methanococcus,* *Methanosarcina*	• Chemo – organotrophic • Use salt to generate ATP • Require 17- 23% of Nacl. • Gram –ve • Occur in salt lakes and are aerobic in nature "Salt loving bacteria" Eg : - *Halococcus,* *Halobacterium*	• Grow in high temperature and high acidic conditions (P^H 1 to 4) • Oldest of "living fossils" • Gram –ve • Found in hot sulphur springs and coal mines Eg : - *Thermoplasma,* *Sulpholobus*

RICKETTSIA

- Discovered by H.T. Ricketts (1909).
- He discovered 'rocky mountain spotted fever' which is caused by Rickettsia.
- This group of bacteria is the connecting link between virus and bacteria.
- They are non motile coccoid / rod shaped and reproduce by binary fission
- Human diseases caused by them include the following;
  - Rocky mountain spotted fever
  - Srub typhus
  - Trench fever
  - Query fever

Rickettsial species and its disease

Species	Disease	Reservoir
R. prowazekii	Epidemic typhus, Brill-Zinsser disease	Human body louse
R. typhi	Endemic typhus	Rat flea
R. rickettsii	Rocky-Mountain spotted fever	Ticks
R. conori	Boutonneuse fever	Ticks
R. australis	Australian tick typhus	Ticks
R. siberica	Siberian tick typhus	Ticks
R. akari	Rickettsial pox	Mites

ACTINOMYCETES

- Harz (1878) coined the term '*actinomycetes'*.
- They are commonly called as 'mycelial eubacteria' or *'streptomycetes'*.
- They grow in the form of radiating colonies in culture, therefore commonly called 'Ray fungi'
- Gram +ve
- Occur in soil, fresh water manure, food products and other substrate rich in dead organic matter.
- Reproduce asexually by conidia.

DISEASES	EXAMPLES OF ACTINOMYCETES
• *Streptomyces somaliensis* • *Actinomyces bovis* • *Streptomyces scabies*	• Actinomycetoma disease of man • Lumpy Jaw disease of cattle • Scab disease of potato and sugarbeet.

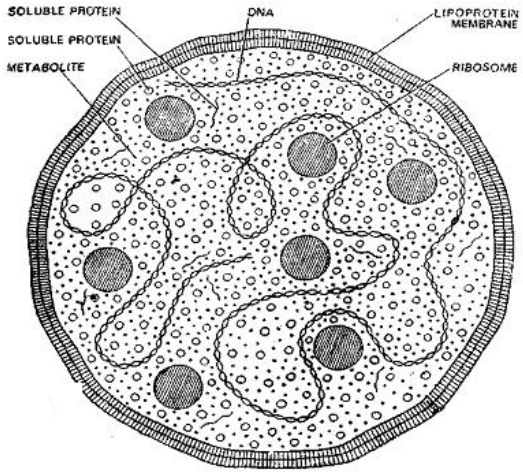
EXAMPLES OF ACTINOMYCETES YIELDING ANTIBIOTICS & VITAMINS

ANTIBIOTICS/VITAMIS	SYNTHESIZED BY
Cyanobalamin (Vitamin B12)	*Streptomyces olivaceus*
Erythromycin	*Streptomyces griseus*
Chloramphenicol	*Streptomyces venezulae*
Neomycin	*Streptomyces fradie*
Terramycin	*Streptomyces ramosus*

MYCOPLASMA

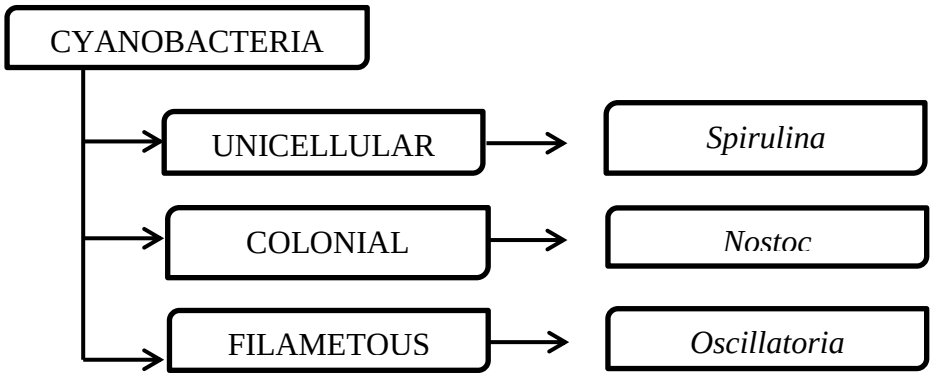
- Prokaryotic, smallest self replicating and pleiomorphic organism.
- Simplest unicellular and smallest known prokaryotes.
- Discovered by E. Nocard and E.R. Roux (1898) from pleural fluids of cattle suffering from bovine pleurppneumonia.
- They can survive without oxygen
- Mycoplasmas are often called PPLO (pleuropneumonia like organisms)
- Size ranges from 0.1 – 0.15µm
- Due to absence of cell wall their body can change shape easily.
- Gram negative, non motile
- Reproduction by budding or binary fission.

- They are parasites in animals and plants.
- They cause several plant diseases like aster yellow, citrus greening, sandal spike, grassy shoot of sugarcane, potato witches broom, dwarf disease of mulberry and little leaf of brinjal.
- They can cause cardiovascular disorders and abortions in human.

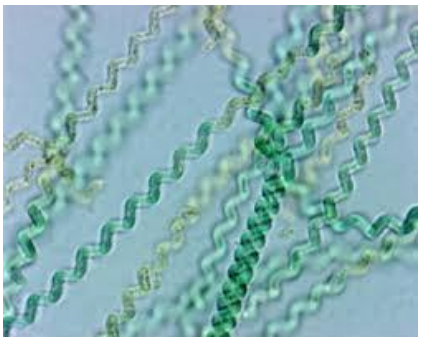


CYANOBACTERIA

- Blue- green algae or Cyanophyceae or Myxophyceae.
- Gram –ve photosynthetic prokaryotes.
- First organisms to make atmosphere aerobic.
- They are the only organisms which are capable of performing 'oxygenic photosynthesis' and fix nitrogen also.



SPIRULINA



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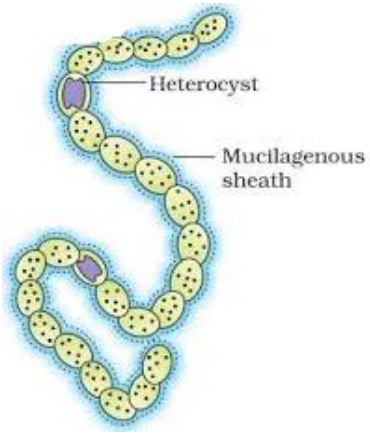
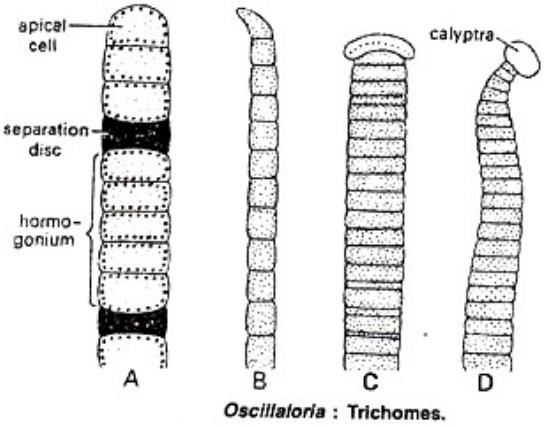




Oscillatoria : Trichomes.

- In certain cyanobacteria, one or more cells may be modified into barrel shaped, thick walled specialised cells for nitrogen fixation, called heterocytes. These heterocytes fix atmospheric nitrogen into nitrogenous compounds to the presence of nitrogenase enzyme.

  Eg:- *Nostoc, Anabaena* etc.

- They occur in saline lakes, moist rocks, tree trunks, moist soils,hot springs and below the ice bergs.
- Filaments contain sheath of mucilage and one or more cellular strands called 'trichomes'

TRICHOMES

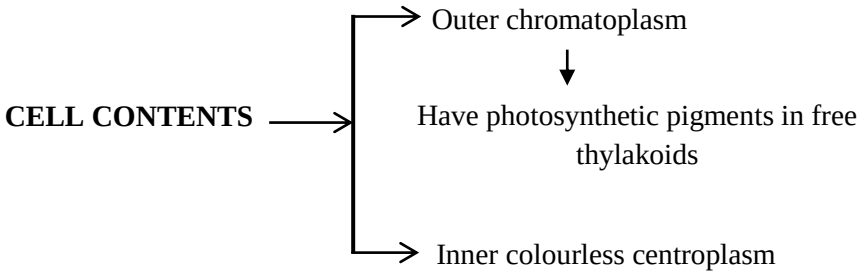
→ Homocystous ⟶ Without heterocysts

Eg:- *Oscillatoria*

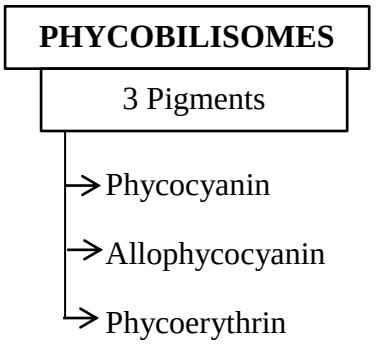
→ Heterocystous ⟶ With heterocysts

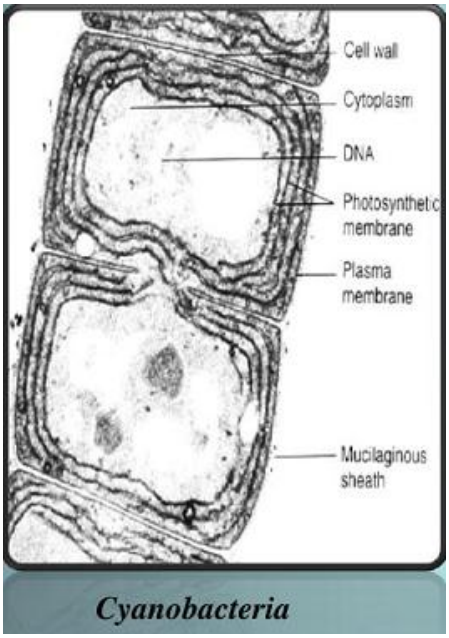
Eg:- *Nostoc, Anabaena*

- Cell wall possess an outer sheath which is jelly like slimy and mucilaginous.



- The cell wall is 2 layered; inner wall is made up of peptidoglycan or mucopeptides.
- They lack mitochondria, true vacuoles, endoplasmic reticulum, sterols and true nucleus.
- Thylakoid membrane contain chlorophyll α, carotenes and xanthophylls.
- Attached to the thylakoid are minute structure called phycobilisomes.





REPRODUCTION IN CYANOBACTERIA

ASEXUAL METHODS

1. Binary fission

- Unicellular forms multiply by binary fission.

2. Hormogonia

- Filamentous forms reproduce by fragmentation in which filaments breaks up into small segments called Hormogonia. which grow to form new filaments.

3. Akinetes

- These are enlarged thick walled cells produced under unfavourable environmental conditions. When favourable condition return, they generate and produce new filaments

4. Spores

- Most common form of asexual reproduction.
- Non filamentous cyanobacteria generally produce spores. Such as endospores, exospores etc.
- Sexual reproduction is absent but gene recombination occur in some forms through conjugation, transformation and translation.

DIFFERENCE BETWEEN		
SL. NO:	**CYANOBACTERIA**	**BACTERIA**
1.	Larger cells	Smaller cells
2.	Higher structural elaboration	Lesser structural elaboration
3.	Lack flagella	Possess flagella.
4.	Autotrophic	Both autotrophic heterotrophic
5.	Photosynthetic pigments: chlorophyll α, phycocyanin and phycoerythrin	Photosynthetic pigments- bacterio-chlorophyll and chlorobium chlorophyll
	Oxygenic photosynthesis	Anoxygenic photosynthesis.
7.	Always aerobic	Aerobic / Anaerobic
8.	Reserve food: Cyanophycean starch	Reserve food:Glycogen

ECONOMIC IMPORTANCE OF BLUE GREEN ALGAE

- The mucilage present in the algal thallus binds the soil particles and prevents soil erosion.
- They reduce high alkalinity making the soil fit to cultivate higher plants.
- Nitrogen fixation and makes the soil fertile.

WATER BLOOMS: (ALGAL BLOOM)

- In ponds and lakes, they grow rapidly to produce water blooms. Blue green algae like microcystis, imparts an unpleasant odour making the water unsuitable for human consumption.

- The algal bloom consumes oxygen for respiration and at night the water is depleted of oxygen. This kills valuable aquatic organisms like fishes which decompose and pollutes the water.

KINGDOM PROTISTA

- It includes eukaryotic unicellular organisms and their immediate multicellular descendants.

CHARACTERISTIC FEATURES

Cell type : Eukaryotic → Unicellular / Multicellular

Cell wall : Present in some

Nuclear membrane : Present

Body organization : Cellular

Mode of nutrition : Autotrophic and Heterotrophic

- Solitary unicellular or colonial unicellular organisms.
- Aquatic organisms.
- Membrane bound organelles are present inside the cytoplasm.
- Cell wall, if present, contains cellulose.
- Cytoplasm is always in motion. The phenomenon is called cytoplasmic streaming or cyclosis.
- Locomotion can occur through flagella, cilia, pseudopodia, wriggling (wave like contraction and expansion), Mucilage propulsion.
- Photosynthetic protists are found in fresh water and oceans, where they occur as phytoplankton and function as chief producers in aquatic food chains.
- Food reserve is starch, glycogen, paramylon, chrysolaminarin and fat.

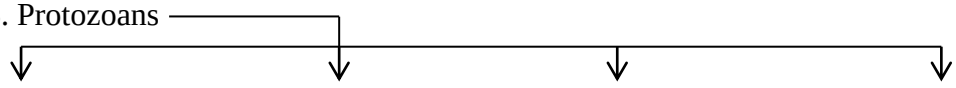
NUTRITION IN PROTISTS			
Sl. NO:	**MODES OF NUTRITION**	**EXPLANATION**	**EXAMPLES**
1	Photosynthetic (Holophytic)	Organisms prepare their food from CO_2 and H_2O by utilising sunlight with the help of chlorophyll.	Dinoflagellates Diatoms Euglenoids
2	Holozoic or Zootrophic	Protistants captures and ingests the food like animals.	Protozoans like *Amoeba, Paramecium*
3	Saprobic or Saprophytic	Organisms releases enzymes into the surroundings where the enzymes convert organic matter into simple products. These products are then absorbed through body surface of organism.	Slime moulds
4	Parasitic	Some protists get their food from the body of other organisms. The individual which obtain its food parasite and the organism which gets food is host .	*Trypanosoma, Giardia, Entamoeba, Plasmodium*
5	Myxotrophic	Organisms have two types of nutrition- autotrophic and heterotrophic	*Euglena*

REPRODUCTION IN PROTISTS

	TYPE OF REPRODUCTION	
SL. NO:	**ASEXUAL REPRODUCTION**	**EXPLANATION**
1.	(i) Binary fission	It is the division of the parent cell into two daughter cells by mitosis. Each daughter cell grows to repeat the process.
	(ii) Multiple fission	It is the division of the parent organism into several daughter cells. Each daughter cell grows into a new individual.
2.	Spore formation	On germination, each spore give rise to a new individual.
3.	Budding	In budding, a small out growths develops from the parent body which separates and develops into a new individual.
4.	Cyst formation	Under unfavourable conditions, some protists secrete a thick resistant covering to form a structure called cyst. At favourable condition, cyst absorbs water & active organism emerges out.
5.	Plasmotomy	It is the division of the multinucleate protist into two or more multinucleate offspring by the division of cytoplasm E.g*: Opalina*
	SEXUAL REPRODUCTION	
1.	Meiosis	Reduces the chromosome no, from diploid (2N) to haploid (IN)
2.	Syngamy/ fertilization	Fusion of 2 haploid (IN) gametes to form a diploid (2N) Zygote.
3.	Conjugation	Fusion of nuclei takes place to form zygote nucleus . Eg:- *Paramecium*

The Kingdom Protista is classified into 5 major groups

1. Chrysophytes — Diatoms, Desmids
2. Dinoflagellates
3. Euglenoids
4. Slime moulds
5. Protozoans



Amoeboid Flagellated Ciliated Sporozoans

I. Chrysophytes: Diatoms/ Golden brown Yellow Green Algae.

- Chrysophyta includes diatoms and desmids (Golden algae)

A. DIATOMS

IMPORTANT FEATURES

- They constuitue an important phytoplamkton component of marine and fresh waters.
- It is an important food source for aquatic animals.
- Microscopic, unicellular, photosynthetic organisms.
- They have cell wall of cellulose
- They do not have flagella but float to light storage lipids.
- The body is covered by a transparent siliceous shell (Silica deposited in cell wall) known as frustule.
- Frustule is made of two halves; Epitheca and hypotheca.
- Epitheca and hypotheca both fit together like two parts of a soap box (pennate types) or pair of petri dishes(centric types). The frustule possesses very fine markings, pits, pores and ridges.
- The two segments are held together firmly by the cingulum or connecting band.
- The silicified in destrictible cell wall of diatoms accumulate at the bottom of sea and form rock like deposits (gritty soil) over billions of years. This is called 'diatomaceous earth'.
- Uses of Diatomaceous earth :

  1. It is used in polishing and filtration of oils and syrups.

  2. It is used in making tooth pastes and face powder.

- In cytoplasm, there are golden brown coloured chromatophores.
- Chromatophores have photosynthetic pigments → Chlorophyll a, Chlorophyll c, Xanthophyll, fucoxanthium and diatoxanthium
- Reserve food material: Leucosin (Chyrsolaminarin), oil drops, volutin globules (proteinaceous substance)

DIATOMS

REPRODUCTION

- ❖ Asexual Reproduction
- ❖ Sexual reproduction

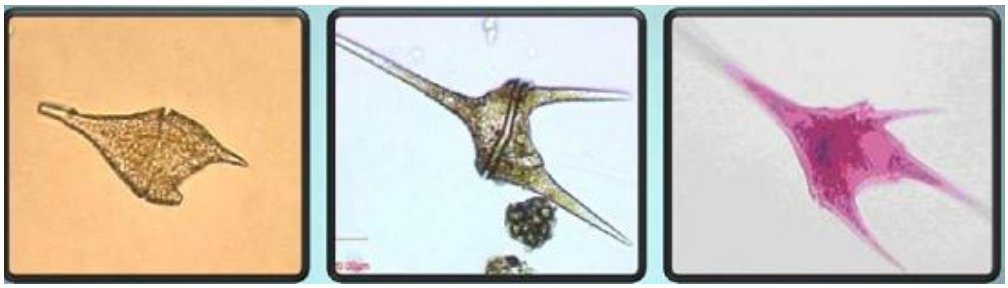
ASEXUAL: By cell division

- Size of the cell increases slightly
- Separation of epitheca and hypotheca.
- The nucleus divides mitotically with the completion of nuclear division.
- The cytoplasm divide in a plane parallel to the length of the cell.
- The two parental valves separate and a pair of new walls are synthesised

SEXUAL : By meiosis

- Dialoms are diploid (2n)
- Reproduce by producing haploid(n) gamete by meiosis
- In marine forms, some individual produce numerous small motile male gametes and others produce single large non- motile female gametes or eggs.
- Male and female gametes fuse to form diploid zygote which germinate into a new individual by forming rejuvenascent cell or auxospore.
- Diatoms are sensitive to certain pollutants in water and used as pollution indicators.

2. DINOFLAGELLATES



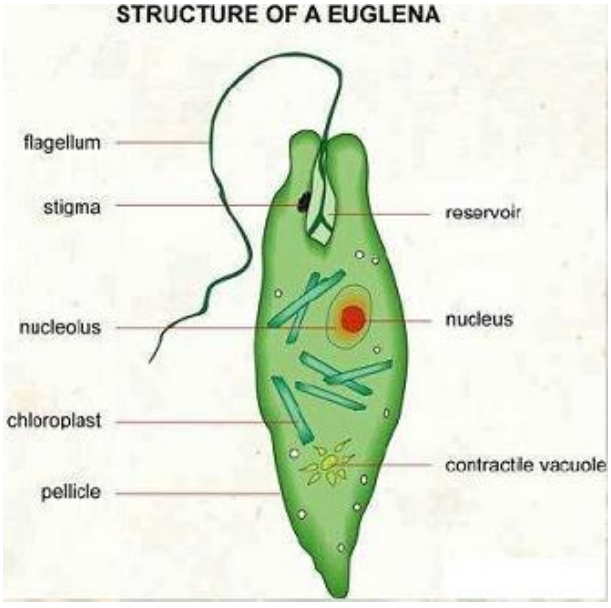
IMPORTANT FEATURES

- Marine unicellular motile, photosynthetic organisms.
- Nutrition: Holozoic or photosynthetic
- Body is enclosed in a cellulose cell wall divided into plates which give an armoured appearance.
- Have two unequal flagella; Due to presence of two flagella at right angle to each other in a furrow between the cell plates the dinoflagellates show peculiar spinning movement. Hence, they are called "whirling whips"
- Photosynthetic pigments – Chlorophyll-a, Chlorophyll-c, α-carotene and Xanthophylls.
- Food reserve is stored in the form of starch like carbohydrates and oils.

- They reproduce asexually only
- The blooms of *Gonyaulax* and *Gymnodinium* causes RED TIDES since the cells are present in such a large quantity that they colour the water . Toxins released by such large numbers may even kill other marine animals such as fishes.
- Some dinoflagellates are bioluminescent, they emit light.
- Their phosphorescence causes sea surface glow in the dark.
- Eg:- *Noctilua*, *Gonyaulax*, *Pyrocystis*, *Pyrodinium*.

3. EUGLENOIDS

- Cell wall without cellulose but possess a proteinous flexible or elastic pellicle.
- It lies within the cell membrane and contains spirally arranged rigid stripes of protein called myonemes.
- Changes its shape, because of the flexibility of pellicle.
- Two flagella – One long
  -One short
- Flagella are inserted in a flask shaped depression called cytopharynx or gullet at the front end.
- An eye spot or stigma containing red pigment astaxanthin lies near the base of flagella.
- It senses the direction and intensity of light and thus helps in regulating the movement towards the optimum light.
- PIGMENTS: Chlorophyll – a, chlorophyll- b, carotene, xanthophyll.
- Near base of the gullet is situated contractile vacuole to maintain water balance (osmoregulation)



- Store found in the form of carbohydrate- Paramylum.
- Example: *Euglena*

NUTRITION → MYXOTROPHIC

↓

Different modes of nutrition

↓

Autotrophic, Saprozoic, holozoic

4. SLIMEMOULDS

IMPORTANT FEATURES

- Saprophytic protists
- The body moves along decaying twigs and leaves engulfing organic material.
- Cell wall is absent

Slime moulds are of 2 types

1. Acellular Slime Moulds (Myxomycetes)

- These have a walless mass of multinucleate protoplasm called plasmodium
- Eg:- Physaram, Stemonits, Didynium etc.
- Plasmodium and its fruitification is coloured
- Phagotrophic / Holozoic mode of nutrition
- Plasmodium produce spores (under unfavourable condition)
- Spore produce either amoeboid cells called Myxamoebae or flagellated cells called swan cells. Ultimately swan cells are also transformed into myxamoeba.
- Underfavourable condition, nyxamoeba multiply and form helped cells which fuses and form zygote(diploid). Zygote develops into plasmodium after enlargement and repeated nucleus division.

2. Cellular slime Moulds (Acresinomycetes)

- Uninucleate, haploid amoeboid like cells, which aggregate into a composite structure called pseudoplasmodium
  Eg:- Dictyostelium
- Fusion of individual protoplasm is absent. Because of this reason, cellular slime moulds are called communal slime mould.
- The spore produced in sporangium germinates and give rise to myxamoeba. If condition is unfavourable myxamoeba becomes encysted to form microcysts. On return of favourable condition microcyst germinate to produce myxamoeba.
- Under suitable conditions, they form an aggregation called plasmodium which may grow and spread over several feet.
- During unfavourable conditions, the plasmodium differentiates and forms fruiting bodies bearing spores at their tips.

- Spores possess true walls.
- They are extremely resistant and survive for many years, even under adverse conditions.
- Spores are dispersed by air currents

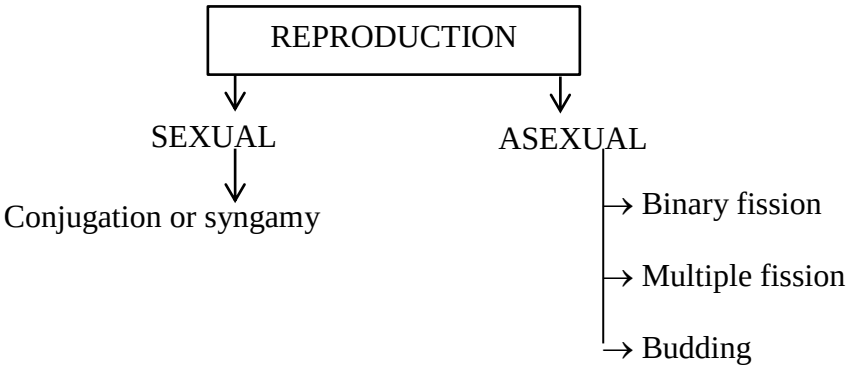
ECONOMIC IMPORTANCE OF SLIME MOULDS

- *Plasmodiophora brassiae* attacks the root of cabbage
- *Spongospora subterranea* causes powdery scab disease of potato tubers.

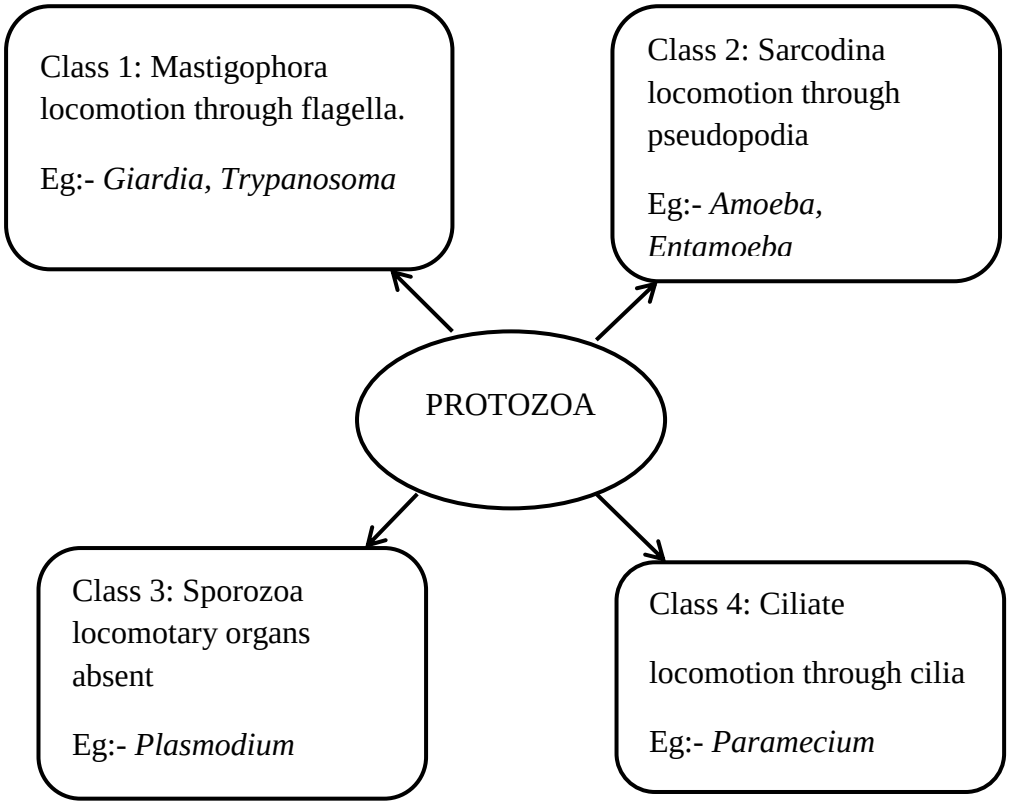
5. PROTOZOAN PROTISTS

IMPORTANT FEATURES

- Unicellular organisms with varied form, shape and symmetry.
- Free- lving, commensal or parasitic causing serious diseases in humans and animals.
- NUTRITION: Heterotrophic mode of nutrition and live as predators or parasites.
- LOCOMOTION:by pseudopodia, flagella or cilia
- Uninucleate, binucleate or multinucleate
- Cell wall is absent. Body covered by pellicle /calcareous/silicaceous shells.
- Some fresh water forms possess contractile vacuoles for osmoregulation.
- Cytoplasm is differentiated into outer ectoplasm and inner endoplasm.

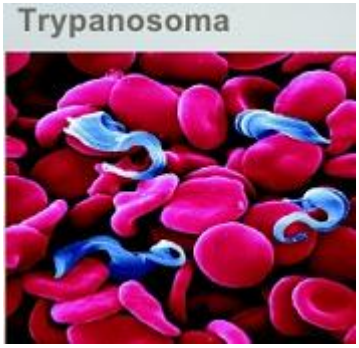


- Some protozoan protists form cysts during unfavourable periods for perennation



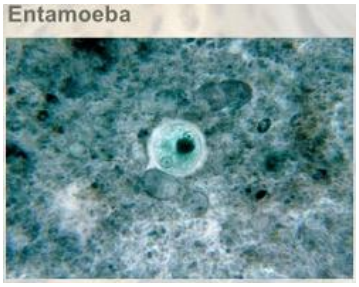
CLASSIFICATION OF PROTOZOANS

CLASS 1 : MASTIGOPHORA



- Either free- living or parasitic
- Flagellated protozoans
- Parasitic forms cause diseases such as sleeping sickness
- Eg:- *Trypanosoma, Giardia*

ClASS 2: SARCODINA



- Organisms live in fresh water, sea water or moist soil
- They move and capture their prey by putting out pseudopodia (false feet).
- Marine forms have silica shells on their surface.
- Eg:- *Amoeba, Entamoeba* (Parasite)
- Amoeboid protozoans

CLASS 3: Sporozoa

- Diverse organisms that have an infections spore-like stage in their life cycle
- Locomotary organs are absent.
  Example: *Plasmodium vivax* (material parasite) which causes malaria.

CLASS 4 : Ciliate

- Ciliated protozoans
- Aquatic , actively moving organisms because of the presence of thousands of cilia.
- Locomotion through cilia.
- They have a cavity (gullet) that opens to the outside of the cell surface.
- The co-ordinated movement of rows of cilia causes the water laden with food to be steered into the gullet
  Eg: *Paramoecium*
- Contractile vacuole is present to maintain water balance.

KINGDOM FUNGI

IMPORTANT CHARACTERISTICS

Cell type - Eukaryotic

Cell wall - Present (without cellulose)

Nuclear membrane - Present

Body organization - Multicellular

Mode of nutrition - Heterotrophic → Saprophytic
Heterotrophic → Parasitic
Heterotrophic → Symbiotic → Lichens – Algae + fungi
Symbiotic → Mycorrhiza – Fungi +root of higher plants

- Fungi are alchlorophyllous, spore bearing, non- vascular organisms or plants, which reproduce both asexually and sexually
- Study of fungi is known as mycology.

HABITAT

- Ubiquitous - diverse habitat.
- Terrestrial, few are aquatic (monoblepharis saprolegnia)
- Many grow on humans soils as saprophytes Eg : mushrooms.
- Fungi grow well at 20-30^{0}C and at acidic p^H(6.0)
- A few fungi are epiphytic .
  Eg- *Armillaria* on apple tree, causes red rot of apple.
- Fungi live in symbiotic association with alage and form lichen.

- Mycorrhiza (Myks - fungus + rhiza - roots) ia an association of fungi with roots of higher plants.
- Ectotrophic - Eg: Pinnus or endotrophic Eg:- Orchids.
- Some soil fungi which live upon annelids, nematodes and rotifers etc.found in soil, they are known as Predacious fungi.
- Examples: *Dactyllela, Dactylaria, Arthrobotrys, Zoophagus* etc.
- Parasitic fungi, obtain their food from living hosts.

Parasitic fungi

- Ectophytic → these are outside
  Eg:- Erysiphe (powdery mildew)
- Endophytic → inside the tissue of plants.
  Eg*:- Albugo, Phytophthora, Alternaria*.

BODY ORGANISATION

- Eukaryotic, cell wall has cellulose or chitin (fungal cellulose) or both, except yeasts (unicellular) they are filamentous.
- Body of the fungus consists of microscopic threads or filaments called hyphae which form a web called mycelium.
- Fungal hyphae are associated to form perennating structure of two types, rhizomorphs and sclerotia.
- Hyphae may be septate or Aseptate.
- A hypha may have cross walls/ Septae dividing it into a number of cells, such a hypha is said to be a septate one.
- In an aseptate hyphae cross walls /septae are not formed. They has a large number of vacuoles and minute nuclei within it, such a multi nucleate, tubular, aseptate hypha is called a coenocyte.
- In most of advanced fungi, the hyphae get organised into a loosely or compactly woven tissue like structure called plectenchyma.

NUTRTION

- Heterotrophic mode of nutrition.
- Parasitic, saprophytic and symbiotic.
- Reserve food is glycogen and oil globules.

REPRODUCTION

FUNGI
- Eucarpic (only a part forms reproductive body)
- Holocarpic (whole forms reproductive body)

Three methods:-

(i) Vegetative

(ii) Asexual

(iii) Sexual

(i) VEGETATIVE REPRODUCTION

- Fragmentation – eg:- *Rhizopus, Mucor, Aspergillus, Alternaria* etc.
- Fission – Eg :- *Yeast*
- Budding – eg:- *Yeast* and *Ustilago*
- Oidium formation – Eg:- *Collybia, Coprinus, Rhizopus*.
- Sclerotia- they serve as organs of perennation and formed singly in Ergot (Claviceps) or produced in large number from one mycelium in Botrytis.

ASEXUAL REPRODUCTION

Zoospore formation

- Uniflagellate Eg:- *Synchytrium*
- Biflagellate Eg: - *Saprolegnia, Pythium*

Aplanospores

- –Eg: *Rhizopus, Mucor*

Conidia or Sporangiospores

- Arranged in chains Eg:- *Aspergillus, Penicillium*
- Singly Eg:- *Pythium, Phytophthora*

Pycniospores Eg:- *Puccinia*

SEXUAL REPRODUCTION

- Sexual reproduction is by oospores, ascospores and basidiospores.
- The various spores are produced in distinct structures called fruiting bodies.
- The sexual cycle involves the following three steps:

(i) PLASMOGAMY

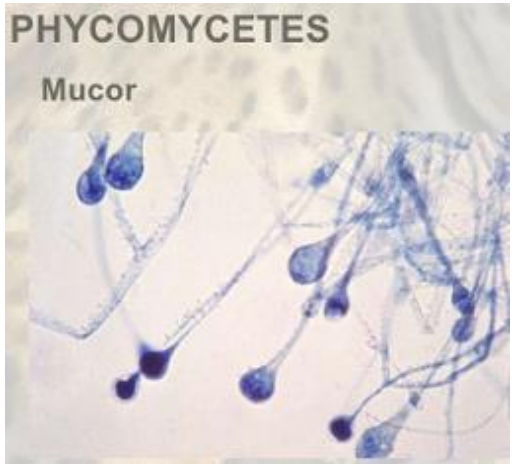
- Fusion of protoplasms between two motile or non-motile gametes called plasmogamy.

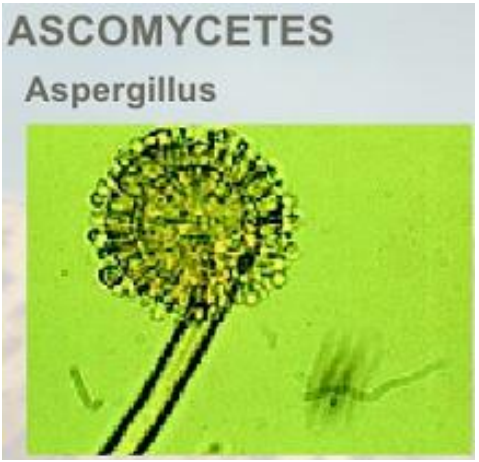
(ii) KARYOGAMY

- By fusion of two haploid nuclei, a diploid zygote is produced called karyon.

(iii) MEIOSIS

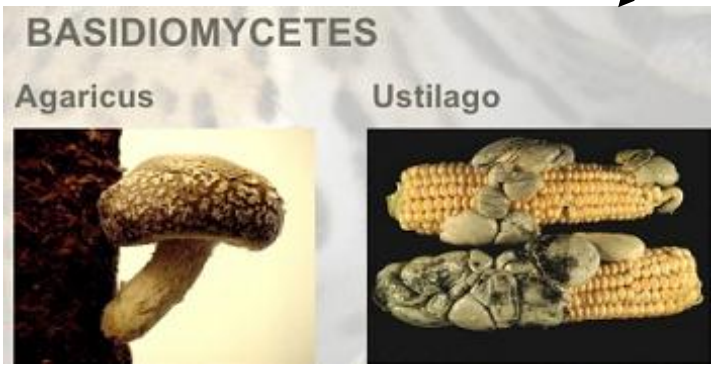
- Reduction division takes place in zygote, reducing the number of chromosomes to half.
- When a fungus reproduces sexually, two haploid hyphae of compatible mating types come together and fuse.
- In some fungi, the fusion of two haploid cells results in diploid cells (2n).
- In ascomycetes and basidomycetes, an intervening dikaryotic stage (n + n, ie, two nuclei per cell) occurs, such a condition is called dikaryon and the phase is called dikaryophase of fungus.

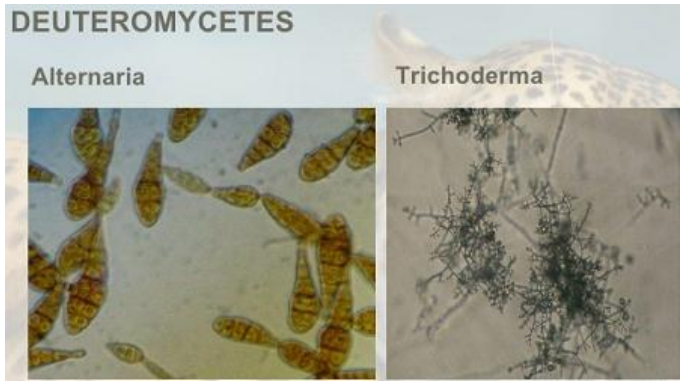




CLASSIFICATION OF FUNGI

Fungi are divided into 4 classes according to the septation of mycelium and on the basis of characteristic features of reproduction





CLASSIFICATION OF FUNGI	HABITAT	BODY ORGANISATION	NUTRITION	REPRODUCTION	DISTINCT FEATURES
PHYCOMYCETES Eg:- *(Mucor, Rhizopus, Albugo)*	In water or in damp places known as water moulds	Eukaryotic cell wall is present coenocytic hyphae found	Vegetative thallus Non - motile	Asexual (zoospores,aplanospores,chamydospores, sporangiospores)Sexual (isogamy, anisogamy & oogamy)	They are called algae like fungi thus named so(phycos algae) They are most primitive true fungi.
Ascomycetes (*Penicillium, Claviceps*)	Terrestrial but many live in water	Eukaryotic, cell wall present mostly multicellular mycelial except a few (Eg:- yeast), septate branched mycelium	Saprophytic decomposer parasitic or coprophytic (on dung)	Asexual spores are conidia, sexual spores ascopores produced in ascus, fruiting body ascocarp which may be cleistothecium, apothecium or perithecium specialised sex organs present which gradually decline in advanced form.	Neurospora used in biochemical and genetic work, morels and buffels are edible.Yeast is used in bakery and fermentation products. They are called sac fungi due to the presence of sac like asci.
Basidiomycetes *(Ustilago, Puccinia, Agaricus*)	In soil on logs, tree stumps or in other organisms body, terrestrial	Mycelial, mycelium is branched and septate. Primary mycelium produces dikaryotic secondary mycelium by somatogamy (fusion of two somatic hyphae causing dikaryotisation)	Saprophytic Parasitic	Asexual spores absent, vegetative reproduction by fragmentation is common. Sexual reproduction by basidiospores borne in fruiting body basidiocarp.	Commonly called club fungi. Rust and smut causing fungi are included in basidiomycetes. They peculiarly show clamp connection during reproduction.
Deuteromycetes Eg*:- Alternaria Colleotrichum, Trichoderma*	Terrestrial	Eukaryotic mycelial, branched septate mycelium, hyphal cells usually multinucleate	Saprophytic parasites or decomposers	Only known method by conidia, sexual reproduction absent.	Known as fungi imperfecti as their perfect (sexual) stages are either absent or not known.

SOME DISEASES CAUSED BY FUNGI		
SL. NO:	**NAME OF THE FUNGUS**	**DISEASE CAUSED**
	A. Oomycota (Lower fungi)	
	I. Phycomycetes	
1.	*Plasmodiophora brassicae*	Club root of crucifers
2.	*Synchytrium endobioticum*	Wart disease of Potato
3.	*Pythium debaryanum*	Damping of seedlings of vegetable and ornamental plants.
4.	*P. myriotylum*	Rhizome rot of ginger
5.	*Phytophthora infestans*	Late blight of potato and tomato.
6.	*P. Colocasie*	Blight of colacasia
7.	*Albugo candida*	White rust of crucifers
8.	*Sclerospora graminicola*	Downy mildew of cereals and green ear disease of Bajra
9.	*Plasmopora viticola*	Downy mildew of grapes
10.	*Peromospora parasitica*	Downy mildew of pea, mustard spinash, onion etc.
	II. Zygomycetes	
1.	*Rhzopus stolonifer*	Soft rot or leek disease of strawberry, apple, jack fruit, sweet potato etc.
	B. Eumycota	
	I. Ascomycetes	
1.	*Protomyces macrosporus*	Stem galls of coriander
2.	*Taphrina deformans*	Leaf curl of peach
3	*Unicinula necator*	Powdery mildew of grapes
4.	*Trysipe graminis*	Powdery mildew of cereals.
5.	*E. Polygoni*	Powdery mildew of peas
6.	*Claviceps purpurea*	Ergot of rye and grasses.
7.	*Sclerotinia fruticola*	Brown rot of pear, plum, peach etc.

8.	*Giberella fujikori*	Bakane disease of rice
	II. Basidiomycetes	
1.	*Ustilago tritici*	Loose smut of wheat
2.	*U. hordei*	Covered smut of barley
3.	*U. maydis*	Smut of corn
4.	*U. avenae*	Loose smut of oat
5.	*U.scitaminae*	Whip smut of sugarcane.
6.	*Tilletia tritici*	Blunt or stinking smut of wheat
7.	*Puccinia*	Black rust of wheat
8.	*P. flumarum*	Yellow or stripe rust of wheat.
9.	*P. triticina*	Leaf or orange rust of wheat.
10.	*Uromyces fabae*	Rust of peas and lentil.
11.	*Hemileia vastatrix*	Leaf rust of coffee.
	C. Deutero mycetes (Fungi Imperfecti)	
1.	*Alternaria solani*	Early blight of potato and tomato
2.	*Collectotrichum falcatum*	Red rot of sugar cane.
3.	*C. Capsici.*	Die back of chillies.
4.	*Piricularia oryzae*	Blast of rice.
5.	*Fusarium oxysporum*	Wilt of potato, tomato, cotton, pigeon, banana, flex etc.
6.	*Cercospora personata*	Tikka disease of groundnut.

HUMAN PATHOGENIC FUNGI		
SL. NO:	**DISEASE**	**ORGANISM**
1.	Ring worm	*Microsporum audouini*
2.	Athletes foot	*Epidermophyton fuccosum*
3.	Barber's itch	*Trichophyton sp*
4.	Omychomycoses	*Microsporum sp, Trichophyton rubrum*
5.	Aspergillosis	*Aspergillus fumigatus*
6.	Candidiasis	*Candida albicans*

LICHENS

General characteristics

- The team 'lichen' was coined by Theophrastus from a Greek word meaning superficial growth.
- It is a close association of a fungus (mycobiont) and an alga (Phycobiont).
- Mycobiont is a member of ascomycetes, sometimes of basidiomycetes and rarely a deuteromycetes.
- They are even found in artic tundra where no other plant can grow.
- Lichen prefers to grow in pollution free environment, so they are used as pollution- indicators.

STRUCTURE

- Upper cortex is made of interwoven hyphae to form plectenchyma.
- Below this layer is the algal zone.
- The medulla consist of loosely placed hyphae that run in all directions.
- The cortex is also made of fungal hyphae which run to lower surface.
- Anchoring organs called rhizines develop from the lower surface.

ACCORDING TO THEIR HABITAT, LICHENS ARE CLASSIFIED INTO THE FOLLOWING TYPES:

SL NO:	TYPE	HABITAT	EXAMPLES
1.	Saxicolous	Rocks	Dermatocarpon
2.	Corticolous	Bark of trees	Usnea
3.	Terricolous	Soil	Lecidea cladonia
4.	Marine		Caloplaca malina
5.	Fresh water Aquatic		Hymenelia cacustris
6.	Lignocolous	wood	Cyphelium

KINDS OF LICHEN

- On the basis of habitat and growth.
- Fructicose → bush like; attached at base Eg: Cladonia, Usnea, Evernia
- Foliose → Leaf like, attached to base by rhizine, creeps horizontally Eg:- Parmelia, Gyrophora, Peltidea and Peltigera.
- Crustose → Thallus is in form of crust and areolate (with air spaces) Eg:- Graphis. Lecanora and Rhizocarpon.

REPRODUCTION

- The algal and fungal partners reproduce independent of each other and in their typical manner.
- The most common method of reproduction is fragmentation and rejuvenation of thalli.
- They develop detachable outgrowths, on the upper surface. These outgrowths are called soredia.
- Some undetachable outgrowth called isidia also develop on the upper surface.
- When the thallus become dry they break off and develop into new thallus.
- Sexual reproduction is not common. when present, fertilization between spermogonia and ascogonia takes place.

ECOLOGICAL SIGNIFICANCE

- Pioneer plants on barren rocks and hard rocky soil.
- By secreting some organic acids they can disintegrate rocks.
- The disintegrated rock particle and the decaying of lichen form a fertile layer of soil where other plants particularly mosses can colonise.
- In this way lichen pave the way of succession of a climax vegetation on a barren land.

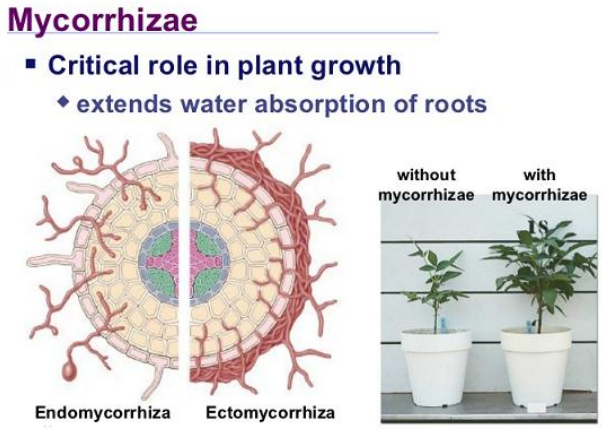
ECONOMIC IMPORTANCE OF LICHEN

- Ice land mosses are used in preparation of food articles.
- 'Stone mushroom' is used in Japan as food.
- Important dyes are prepared from lichens for use in woollen and silken clothes.
- Orchil is an important dye obtained from Lecanora.
- Litmus is obtained from Roccella.
- Used for tanning of leather.
- Used as medicine for lung cure, heating of wound, jaundice, fever, skin diseases.
- Usnic acid obtain from Usnea is broad spectrum antibiotics.
- Lichens like Evernia and Ramalina are used in cosmetics and perfumes.
- Liches can used as an indicator of air pollution

MYCORRHIZA

GENERAL CHARACTERISTICS

- It is a mutually beneficial or symbiotic association of fungi with roots of higher plants.
- There are some plants (eg:- orchids, ericaceous plants) which always associate with mycorrhizal fungi and without them they cannot grow.
- The higher plants provide the fungi with carbohydrates and in return the fungi provide the plants with minerals which the plants cannot absorb from soil.



TYPES OF MYCORRHIZA

- Ectomycorrhizas
- Endomycorrizas (arbuscular mycorrhizas)
- The two groups are differentiated by the fact that the hyphae of ectomycorrhizal fungi do not penetrate the cell wall of the plant's root cells, while the hyphae of arbuscular mycorrhizal fungi penetrate the cell wall.

IMPORTANCE OF MYCORRHIZA

- Arbuscular mycorrhizas or VAM (Vesicular – Arbuscular Mycorrhizas) the hyphae develop an arbuscule (penetrate) within the cortex of root.
- It helps mainly in phosphate absorption from the soil.
- It enables the plant to get an increased supply of water and essential minerals from the soil.
- The fungus also produce various growth promoting substances and antimicrobial substances that protect the young roots from the attack of pathogens.
- In the presence of mycorrhizal associations, forest trees such as pines and birches absorb more nitrogen, potassium and phosphorus.
- Orchids never germinate and grow without the presence of members of basidiomycetes mushrooms.

KINGDOM PLANTAE

GENERAL CHARACTERISTICS

Cell type - Eukaryotic
Cell wall - Present
Nuclear membrane - Present
Body organization - Tissue/ organ
Mode of nutrition - Autotrophic

- Commonly include plants
- Few members are → Partially heterotrophic insectivorous plants
  → Parasites
- Eukaryotic chlorophyll containing organisms.
- Prominent chloroplast in plant cells.
- Cells are made up of cellulose.
- Examples of insectivorous plants → Bladderwort, Venus fly trap.
- Example of parasite → Cuscuta
- Distinct alternation of generation.
- It includes algae, bryophytes, pteridophytes, gymnosperms and angiosperms.

ALTERNATION OF GENERATION

- Life cycle of plants has distinct phases the diploid sporophytic and the haploid gametophytic- that alternate with each other.

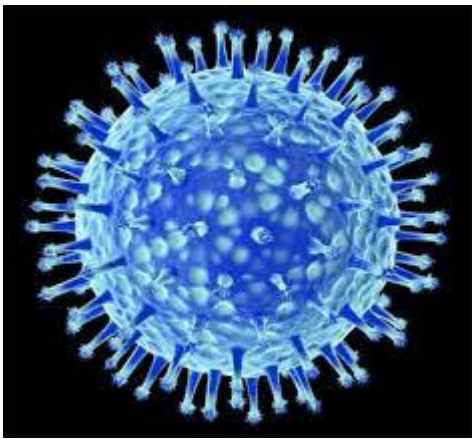
KINGDOM ANIMALIA

GENERAL CHARACTERISTICS

Cell Type : Eukaryotic
Cell Wall : Absent
Nuclear membrane : Present
Body organisation : Multicellular
Mode of Nutrition : Heterotrophic , Holozoic → by ingestion of food.

- Cells lack cell walls.
- Directly or indirectly depend on plants for food.
- Reserve food in the form of glycogen or fat.
- Nutrition:
- Sexual reproduction is by copulation between male and female followed by embryological development.
- Capable of locomotion.
- Higher forms shows elaborate sensory and neuromotor mechanism.

VIRUS



HISTORY OF VIRUS		
YEAR	**NAME OF SCIENTIST**	**CONTRIBUTIONS**
1576	Carolus Clusius	Viruses were first described from plants while studying variation in tulip flowers.
1796	Edward Jenner	Vaccination was introduced against small pox.
1880	Adolf Mayer	Tobacco mosaic disease was first reported.
1884	Louis Pasteur	Coined the word'Virus' (Latin = poison)
1892	Dimi trii Ivanowski	Existence of viruses was scientifically proved.
1898	M.W. Beijerinek	Extract of infected plants of tobacco cause infection in healthy plants called the fluid (contagium vivum fluidum
1899	Beijerinek, Loefler, Frosch	Ivanowski's observations were confirmed after discovery of foot and mouth disease
1917	d' Herelle	Bacteriophages were discovered
1933	Schelsinger	First to determine the chemical composition of virus.
1935	W.M. Stanley	Showed viruses could be crystallised and crystals consist largely of proteins.
1971	T.O. Diener	Discovered a new infections agent that was smaller than viruses and caused potato spindle tuber disease.

CHARACTERISTIC FEATURES

- Acelular, non- cytoplasmic infections particles, obligate parasites.
- Most viruses are composed of a nucleic acid core and protein covering termed capsid.
- Ultramicrospic and smaller than bacteria.
- Nucleoproteins, they have a single nucleic acid.
- All viruses are obligate parasites and can multiply only within the specific living host cells.
- Easily transmitted.
- Highly resistant to germicides and extremes of physical conditions.
- Not affected by antibiotics.
- They can be crystallised in the form of crystals.
- They do not have capacity to grow and divide independently.
- Reproduce from genetic material only.
- Absence of enzymes for energy metabolism, ie, they have no metabolic activity of their own.
- Absence of ribosomes.
- Absence of information for the synthesis of ribosomal proteins.
- Absence of information for the synthesis of ribosomal RNA and soluble transfer RNA.

Living characters of viruses

- They can reproduce using the metabolic machinery of the host cell.
- They are sensitive to various environmental conditions.
- Viruses show replication and mutation.
- They get destroyed by UV rays, X – rays

Non- living characters of viruses

- They lack cellular structure, protoplasm and enzyme system.
- They do not respire.
- They can be crystallized like non- livings.
- Outside the living cell they exist as inactive particles.
- The inert extracellular form is known as virion.
- They do not synthesize proteins.
- So they are metabolitically inactive outside the host cells.

MORPHOLOGY

SIZE

- It is less than 200 mm.
- Smallest virus- foot and mouth disease virus (10 mm)
- Largest virus- small smallpox virus or Variola (250 mm)

SHAPE

- Brick shaped – smallpox virus
- Spherical- Influenza virus
- Rod shaped – TMV
- Tadpole like- Bacteriophages

SYMMETRY

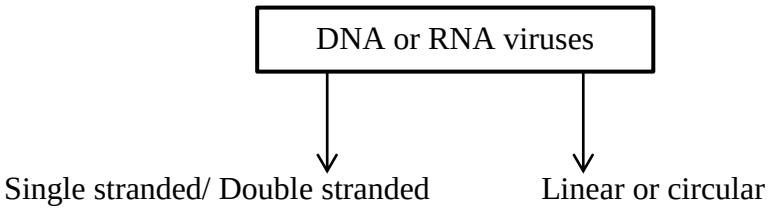
- Helical, cubical and biosymmetrical

STRUCTURE

- Nucleic acid (DNA or RNA)
- Envelop
- Capsid
- Enzymes

NUCLEIOD

- It represents genetic material which is either DNA (deoxyviruses or deoxyvira) or RNA (riboviruses or ribovira) but never both.
- Nucleoid is infective part.
- It is surrounded by a protein called the capsid.



ANIMAL VIRUSES

- Double stranded DNA
- Rarely single or double stranded RNA

PLANT VIRUSES

- Single stranded RNA
- Bacteriophages → Double stranded DNA.

ENVELOPE

- Outer loose covering present. (Eg:- HIV or Human Immuno deficiency Virus)
- Made of protein of viral origin, lipid and carbohydrate of host.
- Outgrowths called spikes may or may not be present.
- Envelop proteins has subunits called peplomers.
- A virus without envelop is naked virus.

CAPSID

- It is protein covering around the genetic material.
- Capsid is made up of subunits called capsomeres.
- They are arranged helically or in geometric forms.
- It has antigenic properties.

ENZYMES

- Rarely lysozymes found in bacteriophages.
- Reverse transcriptase enzyme (Catalyses RNA → DNA synthesis) is found in some RNA viruses like HIV.

TYPES OF VIRUSES

- Based on the type of host, viruses are of different types:-

Plant viruses (Phytophages)

- Viruses that attack plants.
- Possess single stranded RNA.
- Cauliflower mosaic virus contains DNA.

Animal viruses (Zoophages)

- Viruses that attack animals.
- Possess double stranded DNA
- Polio virus and Influenza virus contain RNA.

Bacteriophages

- Viruses infect bacteria
- Contain DNA as genetic material

Gymnophages

- Viruses infect blue- green algae.
- Contain DNA.

Zymophages

- Viruses infect yeast.
- Contain DNA

Mycophages

- Fungal viruses

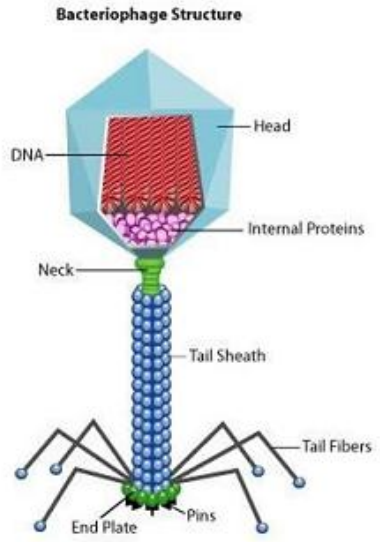
GENETIC MATERIAL OF CERTAIN VIRUSES			
SL. NO:	**GROUPS**	**EXAMPLES**	**GENETIC MATERIAL**
1.	Animal viruses	Herpes virus, Pox virus, Human adenovirus	ds DNA
		Parvo virus	ss DNA
		Rous sacroma virus	ds RNA
		Polio virus, Influenza virus, Mumps virus, Rabies virus, AIDS virus, SARS virus	ss RNA
2.	Plant viruses	TMV (Tobacco mosaic virus), TNV(Tobacco necrosis virus)	ss RNA
		Wound tumour virus, Rice dwarf virus	ds RNA
		Cauliflower mosaic virus	ds DNA
3.	Bacteriophages	$\phi \times 174$	ss DNA
		T_1, T_2, T_3 phages	ds DNA
		ϕ_2 phage	ss RNA
		ϕ_6 phage	ss RNA

TOBACCO MOSAIC VIRUS (TMV)

- Rod shaped virus
- Each virus particle is about 300 nm long and 18 nm in diameter.
- Rod has a core of about 4nm which contains helically coiled single stranded RNA.
- It is infective genetic part.
- Protective covering of protein called capsid is present around the infective part.
- Capsid consists of 2130 subunits called capsomeres.
- Each capsomere has 158 amino acids.
- TMV causes mosaic disease of tobacco leaves and some related plants.

BACTERIOPHAGE

- Discovered by Twort and d' Herelle.
- Tadpole- shaped virus.
- Bacteriophages which infect E.coli are known as Coliphages.



TYPES

- ❖ Prophages/non- virulent phages / non-infective phages.
- ❖ Virulent phages / infective phages.

- Bacteriophage is having tadpole like structure ie, with head and tail and inside the head, ucleic acid present is DNA.

APPLICATIONS OF BACTERIOPHAGES

- Used in studying viral infection mechanism.
- Used in control of certain bacterial diseases.
- Purity of Holy Ganges is due to the presence of bacteriophages.

VIROIDS

- Discovered by T.O. Diener & Raymer in 1967.
- They are simple infections agent consist of ss- RNA (without protein coat).
- Smallest infections agents of plant disease.
- They have naked RNA molecule.
- It can multiply in plant cells.
- It consists of only nucleotides.
- It can dispense into the environment and produce diseases.
- ss RNA molecules are capable of replication.

IV. BASIC LEVEL QUESTIONS

1. Imperfect fungi are called imperfect because:
   (a) They have no zygospore
   (b) They cause disease
   (c) They form conidiospores
   (d) Sexual reproduction has not been observed.

2. In bacteria:
   (a) DNA is double- stranded and ringed
   (b) DNA is scattered
   (c) DNA is enclosed in nucleus.
   (d) DNA is 4 in number in nucleus.

3. Folds of plasma membrane in bacterial cells are known as:
   (a) Episomes (b) Mesosomes
   (c) Sphaerosomes (d) Acrosomes

4. Neurospora is also called
   (a) Black mould (b) Bakery mould
   (c) Red Bread mould (d) Green mould

5. Griffith performed experiments on bacteria
   (a) Bacillus pneumonia
   (b) Streptococcus pneumonia
   (c) Salmonella pneumonia
   (d) Xanthomonas pneumonia

6. Bacteria having a tuff of flagella at one and are called:
   (a) Peritrichous (b) Monotrichous
   (c) Cephalotrichous (d) Amphitrichous

7. Bacteria whose cells have only a single curve are known as:
   (a) Vibrio (b) Cocci
   (c) Spirilla (d) Bacillia

8. The fixation of free nitrogen from the air in the nodules of roots of leguminous plants is done by symbiotic bacteria?
   (a) Azotobacter (b) Rhizobium
   (c) Bacillus subtilis (d) Micrococcus

V. INTERMEDIATE LEVEL QUESTIONS

1. Which of the following cause black rust of wheat?
   (a) Rhizopus (b) Mucor
   (c)\ Puccinia (d) Aspergillus

2. Which of the following structure helps in the respiration of lichen?
   (a) Soredia (b) Cyphella
   (c) Isidia (d) Cephalodia

3. Gills are present in
   (a) Agaricus (b) Spirogyra
   (c) Cycas (d) Ulothrix

4. Which of the following classes of fungi do not develop fruit bodies?
   (a) Ascomycetes (b) Basidiomycetes
   (c) Phycomycetes (d) All of these

5. Copulating branches of Rhizopus are called
   (a) Gametangia (b) Pregametangia
   (c) Coenogametangia (d) Progametangia

6. In Rhizopus, the fusion of two different thalli which form zygospore is called.
   (a) Spermaciation
   (b) Gametangial contact
   (c) Gametangial copulation
   (d) Both 1 and 2

7. Aspergillus niger produces:
   (a) Citric acid (b) Oxalic acid
   (c) Glucomic acid (d) All of these

8. Blue green algae cultivated in water tanks as protein rich animals food are:
   (a) Spirillum (b) Spirulina
   (c) Oscillatoria (d) Nostoc

VI. EXPERT LEVEL QUESTIONS

1. The part of biological chromosome that is homologous to a genome fragment transferred from the donor to the recipient cell in the formation of a merozygote is
   (a) Endogenote (b) Dysgenic
   (c) Exogenote (d) None of these

2. Extra nuclear DNA in E. coli is termed as:
   (a) F∗ factor (b) Sex factor
   (c) Episome (d) All of these

3. Which one belongs to monera?
   (a) Amoeba (b) Gelidium
   (c) Spirogyra (d) Escherichia

4. Which type of DNA is found in bacteria?
   (a) Circular free DNA (b) Straight DNA
   (c) Helical DNA (d) Membrane bound DNA

5. What is true for Cyanobacteria?
   (a) Oxygenic with nitrogenase
   (b) Oxygenic without nitrogenase
   (c) Non oxygenic with nitrogenase
   (d) Non oxygenic without nitrogenase.

6. The group comprising the smallest cellular organisms which represent the oldest kingdom of evolution is
   (a) Monera (b) Protista
   (c) Fungi (d) Plantae

7. The feature that is not suitable to Euglena is that
   (a) The presence of chlorophyll a and b.
   (b) It stores carbohydrate as paramylum.
   (c) It is unicellular and motile in nature.
   (d) It cell wall is made up of cellulose.

8. Which of the following is not a character of Protista?
   (a) Organism with a true nucleus.
   (b) Organism with membrane bound organelles.
   (c) They can carry out nitrogen fixation.
   (d) A few possess pseudopodia for locomotion.

VII. COMPREHENSION TYPE QUESTIONS

1. Chains of bacterial ribosomes are called:
   (a) Polyribosomes (b) Autosomes
   (c) Mitochondria (d) Ribosomes

2. Some bacteria have a capsule outside cell wall. If is made of:
   (a) Protein (b) Cellulose
   (c) Fat (d) Mucopolysaccharide

3. Sea weeds are a source of:
   (a) Chlorine (b) Fluorine (c) Bromine (d) Iodine

4. Regeneration in which animal was discovered for the first time?
   (a) Sycon (b) Hydra (c) Planaria (d) Pheretima

5. Which one of the following pairs is wrongly matched?
   (a) Yeast - Ethanol
   (b) Streptomycetes - Antibiotic
   (c) Coliforms - Vinegar
   (d) Methanogens - Gobar gas

6. Which one of the following statements about mycoplasma is wrong?
   (a) They are also called PPLO
   (b) They are pleomorphic
   (c) They are sensitive to penicillin.
   (d) They cause disease in plants.

7. Eukaryote developed around
   (a) 1.6 billion years ago
   (b) 2.0 billion years ago
   (c) 2.5 billion years ago
   (d) 2.8 billion years ago

8. Single - celled eukaryotes are included in
   (a) Monera (b) Protista
   (c) Fungi (d) Archaea

VIII. QUESTIONS FROM PAST PAPERS

1. Which one of the following matches is correct?

a	Agaricus	Parasitic fungus	Basidiomycetes
b	Phytophthora	Aseptate mycelium	Basidiomycetes
c	Alternaria	Sexual reproduction absent	Deuteromycetes
d	Mucor	Reproduction by conjugation	Ascomycetes

(AIPMT – 2015)

2. The guts of cow and buffalo possess
   (a) Cyanobacteria (b) Fucus spp.
   (c) Chlorella spp (d) Methanogens

AIPMT- 2015

3. Which one of the following statements is wrong?
   (a) Mannitol is stored food in Rhodophyceae.
   (b) Algin and carragen are products of algae.
   (c) Agar- agar is obtained from Gelidium and Gracilaria
   (d) Chlorella and Spirulina are used as space food.

(AIPMT – 2015)

4. Tue nucleus is absent in:
   (a) Mucor (b) Vaucheria
   (c) Volvox (d) Anabaena

(AIPMT- 2015)

5. Which one is a wrong statement?
   (a) Brown algae have chlorophyll a and c and fucoxanthin
   (b) Archegonia are found in Bryophytes, pteridophyta and gymnosperms.
   (c) Mucor has biflagellate zoospores
   (d) Haploid endosperm is typical feature of gymnosperms.

(AIPMT- 2015)

6. Which of the following structures is not found in prokaryotic cells?
   (a) Plasma membrane (b) Nuclear envelope
   (c) Ribosome (d) Mesosome

(AIPMT – 2015)

7. Choose the wrong statement.
   (a) Yeast is unicellular and useful in fermentation.
   (b) Penicillium is multicellular and produces antibiotics.
   (c) Neurospora is used in the study of biochemical genetics.
   (d) Morels and truffles are poisonous mushrooms.

(AIPMT- 2015)

8. Thermococcus, Methanococcus and Methanobacterium exemplify

(a) Bacteria that contain a cytoskeleton and ribosomes

(b) Archaebacteria that contain protein homologous to eukaryotic core histones.

(c) Archaebacteria that lack any histons resembling those found in eukaryotes but whose DNA is negatively super coiled.

(d) Bacteria whose DNA is relaxed or positively supercoiled but which have a cytoskeleton as well as mitochondria

(AIPMT – 2008)