Chapter 6

KINGDOM PROKARYOTAE (MONERA)

Q.1 (a) Define: Kingdom prokaryotae, Eubacteria & archaeobacteria.

(b) Write a note on the discovery of bacteria.

Ans. (a) PROKARYOATE

PRO means before, ***KARYON*** means nucleus.

A group of organisms which have prokaryotic cell (non nucleated cells). E.g. Bacteria and Blue green algae.

(1) Eubacteria (Eu means true):

The bacteria with typical cell wall (i.e., murein) are called eubacteria.

(2) Archaeo bacteria (Archaeo means ancient):

The bacteria without murein cell wall are known as archaeo bacteria.

(b) DISCOVERY OF BACTERIA

(1) Animalcules and Leeuwenhoek:

Firstly, bacteria were discovered by ***Leeuwenhoek*** in 1673. He observed bacteria, protozoans and red blood cells (RBCs). Bacteria were microorganism, thus, they named as *animalcules*. First time these tiny creatures were discovered from rain water, after it, bacteria were confirmed in saliva, vinegar, infusions and other substances.

(2) Louis Pasteur's Contributions:

The progress in the field of bacteria was very slow. After two centuries, the work of Leeuwenhoek was recognized in field of biology and medicine.

(a) Fermentation:

In 1867, ***Louis Pasteur*** demonstrated the role of bacteria in fermentation and decay. Pasteur evolved many basic techniques of bacteriology. He described that bacteria cause diseases.

(b) Vaccine Formation:

It is a great contribution of Pasteur. He developed vaccine against the disease like Anthrax, Fowl Cholera and Rabies.

(c) Pasteurization:

It is also a great development of Pasteur. ***Pasteurization is a process in which milk or other liquids are heated at certain temperature (60°C) in particular time (30 minutes) to kill the bacteria***.

(3) Robert Koch and Germ Theory:

In 1876, almost at the same period of Pasteur, Robert KOCH (German) made valuable contribution in bacteriological techniques. He proved that bacteria can cause diseases such as anthrax; tuberculosis and cholera. He isolated rod shaped bacteria i.e. Bacilli from the blood of anthrax infected sheep.

Koch formulated very **important postulates** to understand the disease and disease causing agents:

(i) A specific pathogen or organism can always be found in ***association with*** **a** ***disease***.

(ii) The organism can be isolated and ***grown in pure culture*** in laboratory.

(iii) The pure culture can produce the disease when inoculated into animal (or susceptible animal).

(iv) ***Recovery is possible*** of that organism which is infected in pure culture as experimental basis.

Koch and his co-workers formed many methods of isolation, inoculation, media preparations, specimen preparation, culturing and microscopic examinations.

Q.2 What do you know about occurrence of bacteria?

Ans. **OCCURRENCE AND DISTRIBUTION**

Bacteria found ***everywhere***. So the occurrence of bacteria is very wide.

They are in air, land, water, oil deposits, food and organic matter, on milk, on meat and eggs, pathogenic to man and plants.

They are also found in acidic soil, alkaline soil, saline soil, and in hot springs.

Q.3 Describe name of some common bacteria with reference to their environments (distribution).

HELP LINE

Ans. DISTRIBUTION OF BACTERIA:

In Soil: *Nitrosomans, Nitrobacters, Rhizobium, Azobacter*

In H_2O: *Salmonella typhosa, Vibrio comma.*

In AIR: *Sarcina sp. Clostridium.*

On Meat & Egg: *Escharichia proteus*

In Milk: *Streptococcus, Lactobacillus, E.coli.*

On Man: *Salmonella, Diplococcus pneumoniae, E.coli, Mycobacterium tuberculosis, Clostridium tetani, etc.*

On Plants: *Xanthomonas, Rhizobium, Erwinia, etc.*

Q.4 Briefly discuss the size of bacteria.

Ans. SIZE OF BACTERIA:

There is a variety of size and shape in bacteria. The range is from 0.1 to 600 um over a single dimension. ***Mycoplasma is considered as smallest bacterium***. Mycoplasma are 100 to 200 nm in diameter.

Some Spirochetes may reach up to 500 micron in length. In case of diameter, Staphylococci and Streptococci have 0.75 to 1.25 u diameter.

Q.5 Discuss the shape of bacteria.

Ans. SHAPE OF BACTERIA

Generally, the bacteria are divided into three types on the basis of shape:

(i) Cocci = ***OVAL*** shaped bacteria.

(ii) Bacilli = ***ROD*** shaped bacteria.

(iii) Spiral = ***CURVED*** shaped bacteria.

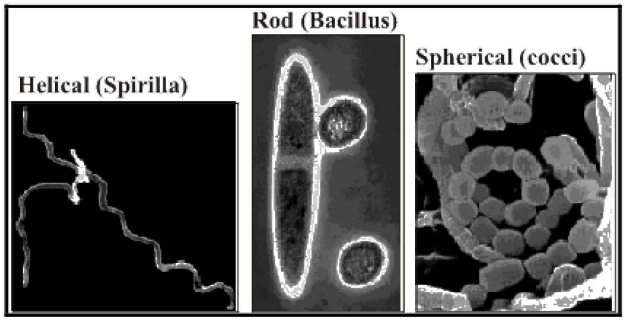


Fig. Shapes of Bacteria

Most of the bacteria have specific and definite shape wile few have different shapes. Those bacteria which have variety of shapes are called pleomorphic.

(1) Spherical or Oval Shaped Bacteria (*COCCI*)

These are spherical or oval shaped, and also called cocci, (sing: coccus). Almost all spherical bacteria lack flagella. These have different planes of division:

(i) One Plane:

The existence of cocci in pair and single plane is called diplococci.

(ii) Chain Plane:

The existence of cocci in a chain with single plane is called streptococci.

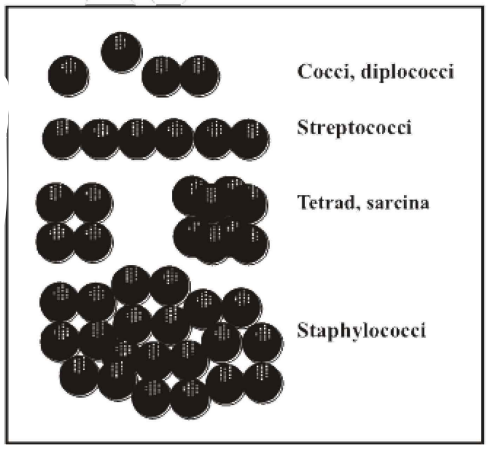
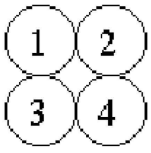


Fig. Cocci

(iii) Two Plane:

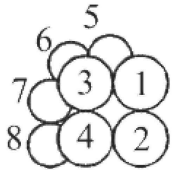
The existence of 4 cocci in two planes is known as ***tetrad*** or ***tetracoccus***.



Tetrad formation

(iv) Three Planes:

The arrangement of eight cocci in three planes (three dimensional structure or cube) is known as **Sarcina**.



Sarcina formation

(v) Irregular Cluster:

The arrangement of cocci in irregular grape like structure (cluster) is called Staphylococcus.

Examples: *Diplococcus pneumonia*, Cocci, *Staphylococcus aureus*.

(2) Rod Shaped (or) Bacilli

This is the **commonest bacterial shape**. The cells appear like tiny rods (or hyphens (–) under microscope. The rods are straight, cylindrical and always have rounded ends. Some bacilli have flagella.

(i) Chain Plane (Diplobacillus):

The arrangement of two bacilli in one plane is called Diplobacillus.

(ii) Chian Plane (Streptobacillus):

The arrangement of two bacilli in chain with one plane is streptobacilllus.

Examples: *Escherichia coli*

BACILLI:

Bacillus subtilis

Pseudomonas

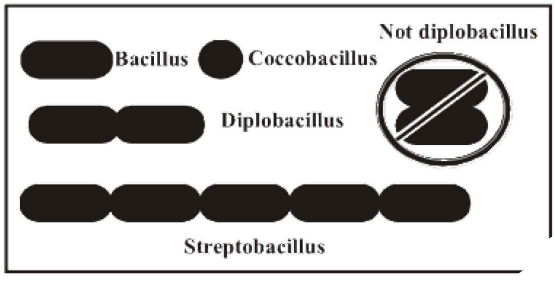


Fig. Spirilla

(3) Spiral Bacteria

These are least common bacteria. The cells of bacteria are wavy, spirally curved. These have three basic forms:

(i) Comma-Like Appearance (Vibrio):

Bacteria having slight curve and comma like appearance e.g *Vibrio comma*.

(ii) Twisted or Cork Screw Like:

Bacteria have many spirals and twisted like a cork screw. Spiral is thick and rigid. e.g., ***Spirillum***.

(iii) Flexible:

These bacteria have flexible spiral body. They have pointed ends e.g., ***Spirochete***.

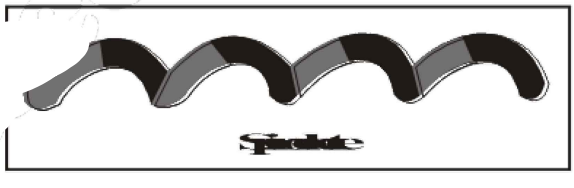


Fig. Spirilla

Q.6 Write a brief note on locomotion of bacteria.

Ans. LOCOMOTION

Bacteria have **flagella** as a locomotory appendages. "Flagella are hair like, long and fine appendages which come out through the cell wall and originates from basal body". A structure just beneath the cell membrane.

- Each flagellum has three parts i.e. filament, hook and basal body.

- Bacterial filaments are made up of a protein called Flagellin.
- Flagella are commonly found in Rod Shaped & Spiral Bacteria. "The bacteria without flagella i.e. Atrichous".
- There are two types of arrangement of flagella, (i) Polars (ii) Peritrichous. When flagella are situated at one or both ends of bacterium, they are called *Polar*:

(i) **Polar:** Polar is divided into followings types.

(a) ***Monotrichous:*** **Single flagellum** at one e.g. end. e.g., *Vibrio comma*.

(b) ***Lophotrichous:*** A **cluster of flagella** on one end e.g., ***Spirillum***.

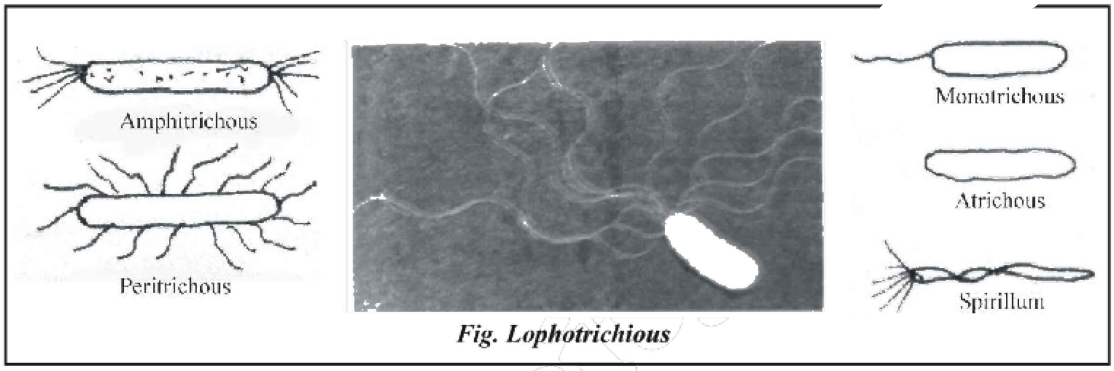
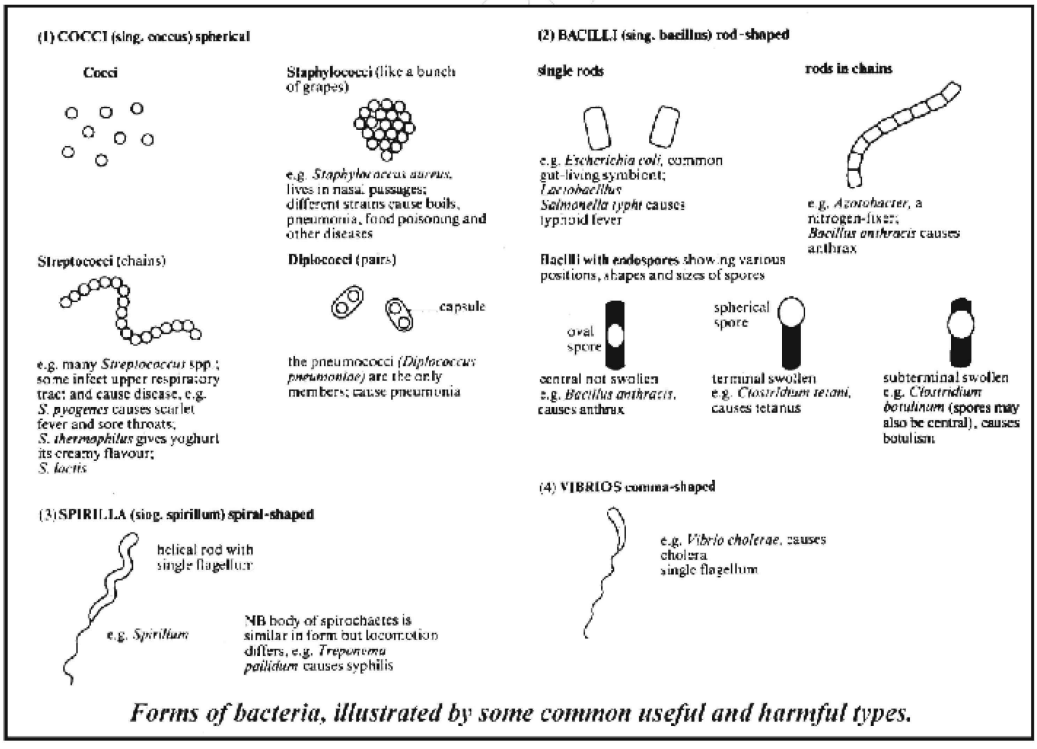


Fig. Lophotrichious



Forms of bacteria, illustrated by some common useful and harmful types.

(c) ***Amphitrichous:*** A cluster of flagella at both ends e.g.

(ii) Peritrichous: Flagella are arranged all over the cell e.g. *Typhoid bacilli.*

Cocci generally are without flagella, so they are called as ***Atrichous***. But very rarely have flagella.

Chemotaxis: Those bacteria which move away from chemicals, respond to chemicals are called chemotaxis. It is a type of behavior.

Q.7 Define pili & discuss functions of pilli.

Ans. **PILI**

Definition: *Small, hollow, non-helical filamentous appendages involved in attachment of bacteria are called pili.*

Characters:

(i) Chemically, pili are made by ***Pilin protein***

(ii) Pili are smaller and thinner than flagella.

(iii) True pili are only present on *gram-negative* bacteria (bacilli).

(iv) Pili are present on motile and non-motile bacteria.

Functions:

(i) Their function is *to adhere* (attachment) of bacteria to different things or surfaces.

(ii) An important function of pili of some bacteria involved *in conjugation* or *mating* process. These pili are called ***"Sex Pili"***.

Q.8 Define cell envelope, what are its basic structures.

Ans. **ENVELOPE**

"The outer layer of typical bacterial cell which consists of capsule, slime and cell wall is known as cell envelope".

Cell envelope is external to cell membrane (protoplasm). It is outer wrapping of bacteria.

COMPONENTS OF CELL ENVELOPE

(i) Capsule:

Some bacteria secrete materials (viscous) around the cell surface. This material is organized into specific structure i.e. capsule. It may contain units of Polysaccharides and Proteins. These may be separate or together in a capsule. Capsule is bound tightly.

Capsule is sticky in nature due to presence of gummy material. In some cases, lipid are also found.

(ii) Slime:

The loose and soluble shield of macromolecules which covers the bacteria is called as slime.

Functions:

- Slime becomes the reason of disease causing ability (i.e. pathogenicity).
- It protects the bacteria against engulfing i.e. phagocytosis.

(iii) Cell Wall

Cell wall is present beneath the extracellular substances. It is external to cell membrane or plasma membrane.

(a) Functions of Bacterial Cell Wall:

- Cell wall gives definite *shape* to cell
- It ***protects*** the cells.
- It provides ***rigidity***.
- It is 20 to 30% of dry weight of the cells.
- ***Cell wall is absent in mycoplasmas.***

(b) Chemicals of Bacterial Cell Wall:

Peptidoglycan (Murein) is a unique macromolecule of cell walls of most bacteria. Different kinds have different amount of peptidoglycan. In peptidoglycan, Glycan is a long chain framework, which is cross linked with peptidefragments.

The intact cell wall also has additional chemicals like sugar, teichoic acid, lipo-proteins, lipo polysaccharides. These chemicals are linked with peptidoglycan.

(c) Cell Wall of Archaobacteria

They do **not have peptidoglycan**. Bacteria contain protein, glycoprotein and polysaccharides.

(d) Cell Wall of Eubacteria

They have typical cell wall i.e. **peptidoglycan**.

(e) Cell Wall of Gram Positive Bacteria

The cell wall contains 50% **peptidoglycan** (of dry weight), **Techoic acid** and **Lipotechoic acid**. Thickness is 20 to 80 nm. No outer membrane present. Lipids are 1-4%. It is more permeable.

The cell wall of gram positive **retains the primary dye**. It retains the crystal violet stain. It is stained purple.

(f) Cell Wall of Gram Negative Bacteria

The cell wall contains only 10% peptidoglycan. **Lipoprotein** and **liposaccharides** are much present. It is thinner than gram positive cell wall. The gram negative wall is more complex. Between peptidoglycan region and outer membrane is present a periplasmic region. It is **less permeable**.

It **retains secondary dye**.

Q. Differentiate between the cell walls of Eubacteria and Archaebacteria.

(See c and d of Q.8)

Q. Differentiate between the cell walls of Gram +ve and Gram –ve bacteria.

(See e and f of Q.8)

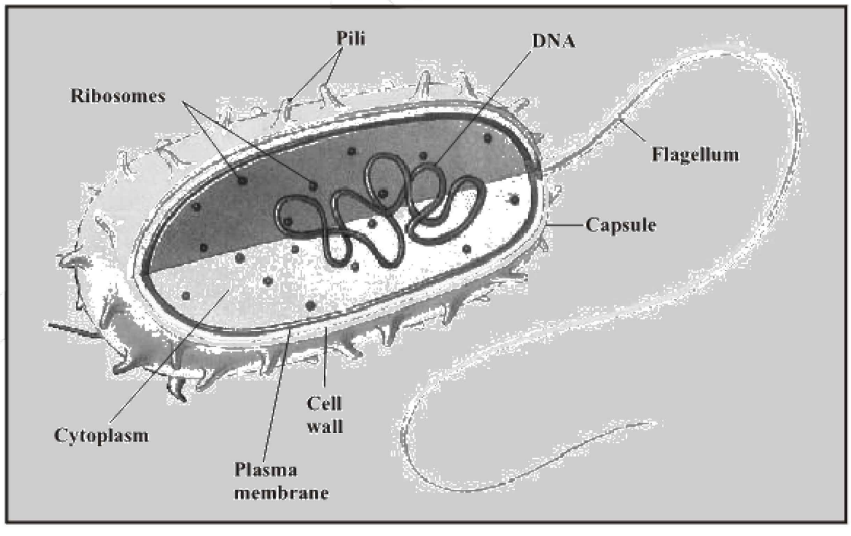


Fig. Typical cell of bacterium

Q.9 Differentiate between Gram +ve and Gram-ve Bacteria. (GRWOG)

Ans.

Gram positive	Gram negative
(i) Thicker (20-80 nm).	(i) Thinner
(ii) *Lipids* are commonly absent – less (1–4%).	(ii) Lipids are present (11 – 12%).
(iii) Few *amino acid* are present.	(iii) Several amino acid present.
(iv) 50 to 90% *peptidoglycan*.	(iv) 10% peptidoglycan.
(v) *Techoic* acid present.	(v) Techoid acid absent.
(vi) *Periplasmic* region absent (in few).	(vi) Periplasmic region present
(vii)	(vii) Lipopolysaccharide linked with peptidoglycan.
(viii) *Mesosome* more prominent.	(viii) Mesosome less prominent.
(ix) No true *pili*, commonly.	(ix) True pili present.
(x) Gram positive bacteria *retain crystal violet* stain, even treated with alcohol and acetone.	(x) Gram negative bacteria's stain decolorized, when treated with alcohol or acetone.
(xi) More permeable.	(xi) Less permeable.

Q.10 (a) Define cytoplasmic matrix and describe it.

(b) What do you know about nucleoid?

Ans. (a) **Cytoplasmic Matrix**

Bacterium is a prokaryote, so membrane bounded cell organelles and ***microtubules*** (cytoskeleton) are absent in it.

"The substance between cell membrane and nucloid is called ***cytoplasmic matrix***". It is present in the form colloidal system. Several inorganic and organic solutes are present in a viscous watery solution.

It has no protoplasmic streaming. Endoplasmic reticulum, mitochondria and golgi bodies are also absent in bacteria.

Nuclear body, ribosomes, mesosomes, granules and nucleoid are present in cytoplasm or cytoplasmic matrix or 'cell pool'.

The plasma membrane and cytoplasmic matrix are collectively called ***chloroplast***. Thus cytoplasmic matrix (***cytoplasm***) is an important and major part of ***protoplast***.

(b) Nucleoid

There are ***no nuclear membrane and nucleoli*** in bacterial cell. ***Discrete chromosomes*** are also absent. But densely packaged DNA present. "Nucloid is an irregular shaped dense structure which is made up of DNA in the cytoplasm or bacterium". Generally, nucloid has a single, circular and double stranded DNA molecule. ***Nucleoid is a chromatin body***.

A long molecule of DNA is folded and fit inside the cell component as a 'nuclear body'. Due to single chromosomal structure they are haploid.

(b) PLASMIDS (Self-replicating circular DNA)

"Some ***extra genetic elements*** made up of DNA in the cytoplasm in free state and reproduce (autonomously) are called plasmis". (OR) The self replicating, circular DNA molecules with addition to chromosomes are called plasmids.

Characteristics:

- These are ***self-replicating***.
- Plasmids are not essential ***for bacterial growth*** and ***matabolism***.
- They have ***drug resistant*** ability.
- They have ***heavy metals***.
- Plasmids also have ***insect resistant genes***.

Q.11 Discuss Ribosomes, Mesosomes, Storage Bodies, Spores and Cyst.

Ans. (a) RIBOSOMES

Tiny granules ***composed of DNA and proteins*** and act as proteins factories are called ribosomes

Ribosomes of bacteria are 70S. These are found in cytoplasm in thousands. These are smaller than ribosomes of eukaryotes. In many cases, ribosomes are attached to plasma membrane.

Ribosomes are Protein Factories:

(b) MESOSOMES

(i) Structure: It may be in the forms of vesicles, tubules or lamella.

(ii) Definition: *"The vesicular and pocket like structures formed as **invaginations** of the **cytoplasmic membranes** in cytoplasm are called mesosomes".*

(iii) Functions:

- They help in ***DNA replication*** and cell division.

- ***Export exoenzymes*** (exo cellular eneyzmes).
- They have ***respiratory enezymes*** so act as respiratory site.
- They are ***analogous to mitochondria*** of eukaryotes.

(c) GRANULES AND STORAGE BODIES

(i) Storage Molecules:

Sometime, bacteria face unfavourable conditions, in this case, nutrients are short. Due to short supply of nutrients bacteria have storage bodies in the matrix. They store glycogen, sulphur, fats, and phosphates. In unfavorable conditions these storage molecules are used.

(ii) Waste Products:

Alcohol, lactic acid and acetic acid are waste materials of bacteria. Extra and unwanted are considered as waste products which are formed during metabolism.

(d) SPORES:

An ***asexual reproductive cell*** which germinates into new body is called spore.

Some species of bacteria produce spores. These are exospores and endospores.

(i) Endospores:

The spores ***inside the vegetative cells*** are called endospores.

(ii) Exospores:

The spores ***external to vegetative cells*** are called exospores.

DORMANCY OF SPORES:

Spores become dormant in unfavorable condition. It means spores have resistant ability to environment. As soon as, favourable condition is achieved then they grow. They resist to light, temperature and desiccation. Some endospores resist even to boiling.

(e) Cyst:

The ***peptidoglycan wall*** remains surrounded by multilayers ***exine*** around bacteria is called cyst. ***Multilayers structure*** is formed by lipo-polysaccharides and lipo-proteins. During cyst formation, a vegetative cell ***become deflagellated, sphere shaped*** and get ***surrounded by a coat***. It is not resistant to heat.

Q.12 What do you know about nutrition of bacteria?

Ans. NUTRITION

Energy is essential for growth and reproduction of bacteria, like other cells.

Bacteria are classified into two types on the basis of nutrition.

(a) Heterotrophic Bacteria:

Those bacteria which are ***unable to synthesize their own food*** and depend on host are called heterotrophic bacteria (or) heterotrophs. Heterotrophs are also of two types:

Parasites and Saprophytes

(i) Parasitic Bacteria (On Living Organism)

Bacteria which grow ***on or within living organisms*** are called parasitic bacteria. Most of them are disease causing (pathogen).

(ii) Saprophytic Bacteria (On Dead Materials)

Bacteria which grow ***on dead organic*** materials are called saprophytic bacteria.

SAPROPHYTIC BACTERIA AND HUMUS

"The organic material which is found by the partial decay of animals and plant is called humus". Soil is full of such humus. The soil bacteria commonly exist as a saprophytic bacteria. They decompose dead animals, plants and plant parts into humus. Saprophytic bacteria get simple substance as a food for energy. They have specific enzymes by which they decompose (break down) large complex molecules into simple and small molecules.

(b) Autotrophic Bacteria (Can make their food)

The bacteria that can synthesize their own organic compounds are called autotrophic bacteria. They have ability to utilize atmosphere (CO_2) and Nitrogen (N_2). They have independent existence in water and soil. Photosynthetic and chemosynthetic are two types of autotrophic bacteria.

(i) Photosynthetic Bacteria:

The bacteria in which **"bacteriochlorophyll"** is dispersed in cytoplasm and derive their energy from sunlight. So they have ability of photosynthesis.

But photosynthesis of such bacteria is different to plants. In bacterial photosynthesis, H_2S is raw material in place of H_2O and Chlorophyll is dispersed in cytoplasm, not in chloroplast. While sulphur is as a product instead of O_2. (e.g. Rhodospirillum), green sulphur bacteria, purple sulphur and purple non sulphur.

$$CO_2 + 2H_2S \longrightarrow (CH_2O)_n + H_2O + 2S$$

(ii) Chemosynthetic Bacteria:

Those bacteria which obtain energy from chemical reactions are known as chemosynthetic bacteria.

They oxidize ammonia, nitrate, nitrite, sulphur and ferrous iron and trap energy.

Nitrifying bacteria, iron bacteria, sulphur bacteria and ***hydrogen bacteria*** are examples of chemosynthetic bacteria. They are important in agriculture and soil fertility.

RESPIRATION IN BACTERIA

There are two kinds of respiration in bacteria. Aerobic respiration involves O_2 and in anaerobic respiration O_2 is not involved.

(i) Aerobic Bacteria:

The bacteria which ***respire in free oxygen*** are called aerobic bacteria. In other words, those bacteria which grow in the presence of O_2 are called aerobic bacteria.

(ii) Anaerobic Bacteria:

Those bacteria which can ***grow without O_2*** are called anaerobic bacteria.

(iii) Facultative Bacteria:

Those bacteria which ***can grow with or without O_2*** are called facultative bacteria. It means they can grow in the presence as well as in the absence of O_2.

(iv) Micro-Aero-Philic Bacteria:

Those bacteria which require very ***low amount of O_2*** for growth and reproduction are called microaerophilic bacteria.

Q.13 Discuss growth and reproduction of bacteria.

Ans. **GROWTH AND REPRODUCTION**

Growth means increase in number of cells, increase of volume and increase of weight of protoplasm. While in case of bacterial cell, it is increased in number of bacteria. It may be reproduction, because reproduction means multiplication of cells. The common type of reproduction is binary fission type asexual reproduction.

Binary Fission:

A type of asexual reproduction in which a cell is divided into two daughter cells is called binary fission:

Firstly, cell is enlarged.

Secondly, chromosome is duplicated and thirdly, plasma membrane is pinched inward at the center of the cell. At last, after equal distribution of nuclear material the cell wall (cross wall) is formed inward and separates into two cells (daughter cells).

Binary fission is found in all bacteria. Each daughter cell repeats the steps of: elongation, chromosomal duplication and cross wall formation.

Generation Time:

"The time interval between two cell divisions of a bacterium is called generation time. (It is also called population doubling time). For example, E.coli has 20 minutes generation time.

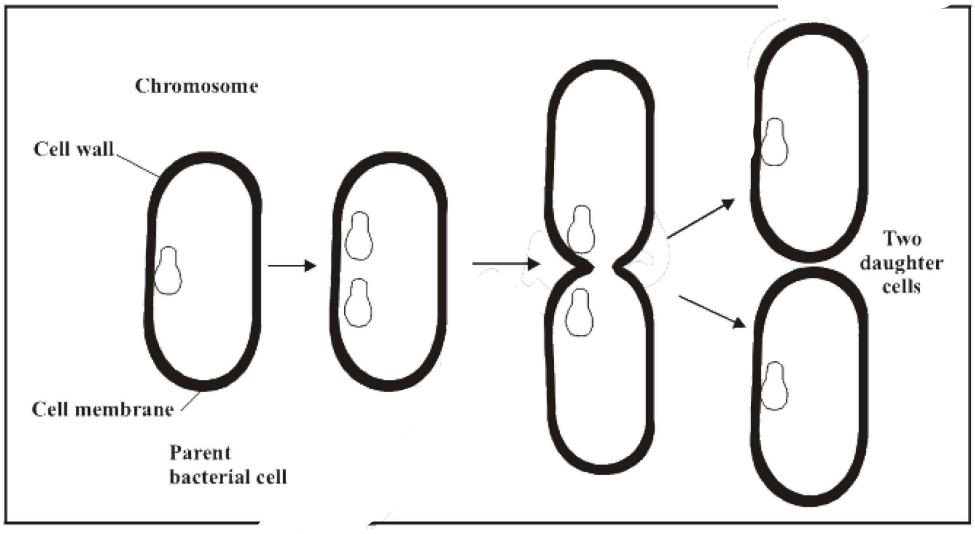


Fig. Binary Fission

GROWTH PHASES

(1) Lag Phases (*No Growth*): Bacterium prepare himself for division. No growth occurs.

(2) Log Phase (*Rapid Growth*): Fast growth occurs at this phase.

(3) Stationery Phase (*Equal Death and Birth*): In this phase rates of reproduction and death are equal.

(4) Decline Phase (*Extra Death*): Death rate increases and reproduction rate decreases.

There are no typical sexual reproduction and mitosis in bacteria. ***In some bacteria, the genetic material i.e. chromosomal material is transferred from one bacterium (donor) to another (recipient) bacterium through conjugating tube is called conjugation***.

In some cases Sex Pili or PILI are involved in conjugation.

So many ***recombinants are formed*** by conjugation. Thus recombinants having the ability to survive in different conditions.

Q.14 Write an account on the ecological and economic importance of bacteria.

Ans. **IMPORTANCE OF BACTERIA**

Ecological Importance

Bacteria live everywhere because they have ability to survive in all conditions. They can adjust itself according to environment.

(i) Gas Production:

Bacteria form CO_2 during aerobic and anaerobic respiration. H_2 is formed during fermentation of carbohydrates and amino acids. N_2 is formed during decomposition of nitrates and nitrites. *Bacteria form H_2S during decomposition of proteins.*

(ii) Role in Cycles:

Carbon and oxygen cycles are controlled by bacteria because of decomposition of remains of dead plants and animals. Denitrifying bacteria play role in *nitrogen fixations* and sulphur bacteria in *sulphur*.

Economic Importance

(i) In Industry: Butter, cheese or ghee manufacturing is based on bacterial activity.

(ii) In Drug Production: About 2220 antibiotics are produced from various bacteria.

(iii) In Food Technology: Bacteria produce vaccines, enzymes, vitamins, alcohols, acids.

(iv) In Biotechnology: Bacteria are used in production of vaccines, enzymes, vitamins, alcohols, acids etc.

(v) In Botulism/Food Spoilage: Food poisoning is occurred by bacteria. Food spoiling and pollution are also occurred by bacteria.

(vi) As Plant Pathogen: Bacteria cause many serious diseases in all groups of plants, e.g. Ear rot of wheat, stalk rot of maize etc.

(vii) As Human Pathogen: Typhoid, diphtheria, tuberculosis, cholera, plague, anthrax etc. are bacterial diseases.

(viii) As Animal Pathogen: Bacteria are fearful disease causing organisms of several animals.

Q.15 Write an account of different methods used for controlling microbes.

Ans. **CONTROL OF BACTERIA**

Control of bacteria is essential at home and industry levels. At medicine or drug level microorganism control is also very important. In case of disease controls, prevent the spoilage of food and protection of industrial products from bacterial attack are essential control for human beings.

Following methods are used for control:

(1) PHYSICAL METHODS:

Steam, dry heat, gas, *filtration* and *radiation* are used to control bacteria.

(a) **Sterilization:** All physical methods by which microorganisms are controlled, are known as sterilization.

(b) ***High Temperature:*** High temperature treatment is commonly used in labs. *High temperature becomes the reason of coagulations of proteins* of microorganism. Thus microorganisms are killed.

(c) ***Dry Heat:*** In case of dry heat, the *oxidation of chemical constituents* of microbes is occurred. It kills microorganisms.

(d) ***Moist Heat:*** *Coagulation of proteins* causes killing the microorganisms.

(e) ***Radiations:*** The radiations below 300 nm are useful to killing microorganisms. *Gamma Rays* are effective for sterilization. These are generally used.

(f) ***Membrane Filters:*** Membrane filters are also used for sterilization of sensitive compounds like antibiotics, seras and hormones. Mycoplasmos are filterable bacteria.

(2) **CHEMICAL METHODS**

The growth of bacteria or microorganisms may be controlled by the treatment of different chemicals. These chemicals may be *used to inhibit the growth* of bacteria on dead materials and living materials, in other words to kill the saprophytes and parasites. There are three types of treatment (i) antiseptic (ii) disinfectants (iii) chemotherapeutic.

(i) ***Antiseptics: (On living tissues)***

A substance that inhibits the growth and development of microorganisms. These substances are used on living tissues.

(ii) ***Disinfectants: (On non-living tissues)***

These chemicals are *used on non-living materials and vegetative cells* (no sexual cells or parts) for killing and inhibition of the growth of microorganisms. *Halogens, phenols, hydrogen peroxides, potassium permaganates, alcohols* and *formaldehydes* etc. are used as disinfectants.

(iii) Chemotherapeutic Agents and Antibiotics

"Treatment of diseases by chemical agents is known as chemotherapy". To control the diseases, different kinds of chemicals are used. It may be *anti-allergic* and antibiotic etc.

Antibiotics are used at broad spectrum level to control the diseases. *Antibiotics are those chemicals which are obtained from living organisms and used to kill the harmful organisms.*

Examples: Penicillin, tetra-cycline, sulfonamides.

Some famous drugs which are used as antibiotics	⟶ Septran, Amoxil, Ampiclox, Lincocin, Kanamycin, Penicillin etc.

Q.16 Write down the contributions of Pasteur in the progress of Immunization and Vaccination.

Ans. **IMMUNIZATION & VACCINATION**

Vaccines play important role ***to increase the immunity in organisms***. Vaccines in injection or drops form stimulate, and in case of response ***antibodies are formed***. ***Antibodies resist to pathogens or antigens***. Antibodies are source of resistant in body. Resistant is created by vaccines. This resistant power acts as immunity.

Pasteur introduced many methods of cause and preventions of infectious diseases.

Isolation of Chicken Cholera Bacteria:

Firstly. Pasteur isolated the bacteria which cause the chicken cholera.

Secondly, Pasteur grew chicken cholera in a pure culture in lab.

He used the basic techniques of MR. KOCH. He proved his work and repeated his experiments.

Inoculation:

Pasteur ***inoculated healthy chickens*** with his pure culture. But chicken remained healthy. It was surprising. No disease was appeared after inoculation.

Conclusions:

In some cases, only fresh culture of bacteria becomes the reason of disease. Old ***culture of bacteria lost its virulence***.

Achievements:

The less virulent bacteria became the reason of the production of antibodies. Antibodies are produced in response to stimulate of antigens. So less virulent stimulate to produce the antibodies.

Antibodies are source of resistant of an individual against the diseases.

It protect the host against infection.

Application of Inoculation Principle:

He used inoculation method with attenuated or less virulent to prevention of anthrax. He worked again and again to achieve the effective results. Ultimately, this attenuated culture is called bacterial vaccine.

KEEP IN MIND

"Vaccine is a suspension of attenuated or killed microorganisms for prevention of infectious disease".

"A vaccine prepared from live material cultured under adverse conditions for loss of their virulence but retention of their ability of induce".

Vaccine term is derived from "***Vacca***". Vacca is a ***Latin word***, and ***vacca means cow***. Thus immunization with attenuated culture of bacteria is known as Vaccination.

Pasteur also made a vaccine for ***hydrophobia*** or ***rabies***.

Rabies is causea when rabid dogs or cats etc. bite to a person.

Q.17 Define Immunity, Immunization, Vaccination and Antibiotics.

Ans.

(i) Immunity (Resistant): The resistant power against antigens or bacteria and viruses is known as immunity.

(ii) Immunization (Creation of resistance): The creation of immunity i.e. production of antibodies in the individual in response to vaccine is known as immunization.

(iii) Vaccination (Dead pathogen): Supply of ***suspension of inactive or dead pathogens to create the immunity*** in the living body is called vaccination.

(iv) Antibiotics (Obtained from living bodies): The chemical substances ***which are obtained from living bodies*** and used to kill the other disease causing organisms are called antibiotics.

Q.18 (a) What are characteristics of antibiotics?

(b) What problem can arise due to misuse of antibiotic?

Ans. **USE AND MISUSE OF ANTIBIOTICS**

(a) Charactersistics:

A chemical substance produced by a microorganism, which has the capacity to inhibit the growth of (or kill) other microorganisms is called antibiotic.

- Anti-biotic is a Greek word. So ***anti*** *means* ***against*** and ***bios*** *means* ***life***.
- Antibiotics are ***chemotherapeutic chemicals***.
- These are used for the ***treatment of infectious diseases***.
- Actually antibiotics are ***formed from living cells***.
- These are ***effective against the wide range of pathogens i.e. bacteria***.
- Certain ***bacteria, Actinomycetes and fungi are major source of antibiotics***.
- Some antibiotics are ***artificially prepared*** in the labs.

(b) Side Effects of Antibiotics.

- Antibiotics must be used according to the advice of Doctor. Coarse and regular intervals must be prescribed by Doctor.
- Everybody must avoid self medication and over dose. Self medication and over dose may be dangerous for health.
- Misuse may be the ***reason of extra resistance of pathogens***.
- Interact with human metabolism.
- Antibiotics like ***penicillin cause allergy; streptomycin cause deafness*** and can affect on auditory nerve. Tetracycline cause decolorization of teeth in children.

Q.19 Describe the general characteristics of cyanobacteria.

Ans. **CHARACTERISTICS OF CYANOBACTERIA**

Cyanobacteria are also called *cyanophyta* and blue green algae.

(i) **Habit:** Cyanobacteria have variety of shapes i.e., ***unicellular, colonial,*** and ***filamentous***.

(ii) **Cytology:** These are ***prokaryotes***. ***Cell wall is formed*** by ***lipo-polysaccharides***, lipo-proteins and peptidoglycan like Gram –ve bacteria.

(iii) **Habitat:** They may be ***terrestrial***, ***subaerial***, alkaline soil, moist rocks.

(iv) **Size:** 1 to 10 μm range of diameter is found.

(v) **Structure/Form:** Unicellular, colonial, filamentous and tricnomous structures are common. Chain of cells (trichome) is surrounded by *mucilage layer*.

(vi) **Locomotion:** Movement is occurred by ***Gas Vesicles***

(vii) **Gliding:** Gliding movement present in filamentous form and gas vesicle movement occurs in water.

No flagella are found.

(viii) **Nutrition:** These are ***autotrophs*** because photosynthesis occurs in it. Photosystem-II and chlorophyll a present in cyanobacteria. Photolysis of H_2O (water as donor) in the process of photosynthesis. O_2 is formed as a product of reaction. Photosynthetic pigments and electron transport chain like components are located in thylakoids membranes linked with Phyco-bili-somes.

(ix) **Pigmentation:** ***Phycobilins*** act as accessory pigments while blue pigment is *phycocyanin*. CO_2 is assimilated through calvin cycle.

(x) **Reclamation of Food Material:** Glycogen (polysaccharide) is reserve food material in blue green algae.

(xi) **Reproduction:** Asexual reproduction takes place by (i) ***Binary Fission*** (ii) ***Multiple Fission*** (iii) Fragmentations (iv) ***Budding*** (v) ***Akinete*** (vi) ***Heterocysts*** and (vii) ***Harmogonia***.

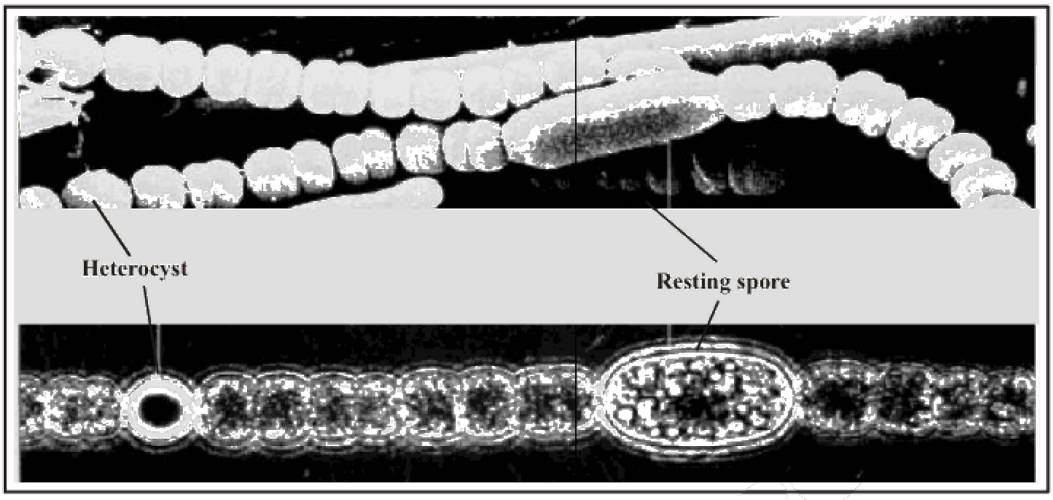


Fig. Cyanobacterium Anabaena

Q.20 Discuss useful and harmful aspects of cyanobacteria. (OR)
What do you know about economic importance of cyanobacteria?

Ans. (a) ECONOMIC IMPORTANCE OR BENEFITS

Replacement of Alkaline Soil: Cyanobacteria help in the reclamation of alkaline soil. Thus soil becomes useful.

Nitrogen Fixation: Structure like heterocyst play important role in the fixation of atmospheric nitrogen.

Oxygen Releaser: During photosynthesis oxygen is released into environment.

Pollution Indicator: Certain cyanobacteria i.e. oscillatoria act as pollution indicatiors.

As Symbiont (Symbiosis): Cyanobacteria become partner in symbiosis. *"Symbiosis is the mutual beneficial relationship between different groups of organisms"*. ***Symbiont means beneficial partner***. Cyanobacteria have association with protozoa, fungi angiosperms and gymnosperms.

In case of fungi and cyanobacteria, both partners make a compound plant i.e. ***Lichen***. Lichen are formed by symbiosis between fungi and algae. In it, Cyanobacteria is photosynthetic, it provides food while fungi provides protection *Cycas* and *Cyanobacteria* have association.

(b) HARMFUL EFFECTS OF CYANOBACTERIA

Formation of Water Blooms: In aquatic habitat, they form water blooms. They become the reason of unpleasant smell. Pollution takes place in this environment.

Extra Suspended Matter: Extra amount of organic matter is suspended in water medium. The consumption ability of water is decreased.

Toxic Effects: Cyanobacteria release toxic materials. Living bodies of environment are disturbed and cause morality.

Killing Effect: When water is drank, the drinking of water of cyanobacterial habitat becomes the reason of death of other animals. Water has toxins which are secreted by cyanobacteria.

Q.21 Write an account on NOSTOC.

Ans. **NOSTOC**

Habitat: Nostoc is found in ***terrestrial*** and subaerial habitat. It is also found on moist rocks and cliffs. It is widely distributed in the universe.

Filaments/Trichomes: Bead like masses are arranged in filaments and trichomes.

Filaments/trichomes are unbranched.

Cell Structure: Nostoc has spherical and sometime cylindrical and barrel shaped cells in filament.

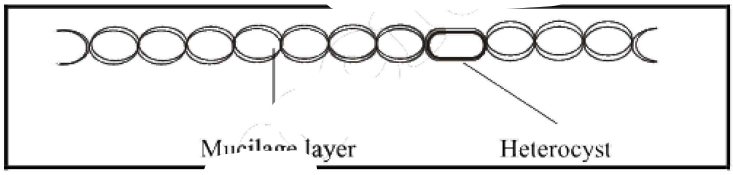


Fig. Trichome of Nostoc

BODY/TRICHOME'S SPECIAL FEATURES

Heterocyst:

(***Hetero*** means ***different; cyst*** means ***deposits*** on wall).

The thick walled yellowish cells, dissimilar to other cells, and help in nitrogen fixation plus asexual reproduction are known as heterocysts.

These are found in intervals in the trichome.

Harmogonia:

They help in fragmentation. Trichome breaks near heterocyst and form hormogonia.

REPRODUCTION:

Nostoc has ***no sexual reproduction***. Asexual reproduction takes place by means of hormogonia and akinete.

(i) Harmogonia:

When a filament break at different points then a small filament is formed or germinated form ***akinete*** is called harmogonium. In fact, ***breaking occurs due to decay*** of cells of trichome or filament, then new filaments are found as ***hormogonia from akinete. Ultimately, hormogonia develop into filament.***

(ii) Akinete:

"A ***thick walled spore*** which has ***ability to dormant*** (rest) in unfavourable condition and grow into new organism in favourable condition is called Akinete". Akinete has also the ***ability to store the food*** which it used in unfavourable conditions during resting phase.

Cyanobacteria are produced asexually by akinetes too.

Q.22 Write short notes on the followings:

(i) Heterocyst (ii) Harmogonia

Ans. (i) Heterocyst

Any of the large cells that occur at intervals in the filaments of certain species of blue green algae.

- They do not contain chlorophyll.
- They have ***much DNA***.
- Narrow pores are present on poles.

Fig. Trichome showing heteroyst

- Heterocysts are involved in ***nitrogen fixation***.
- They may be ***asexual reproductive*** cells.

(ii) Harmogonia

A short filaments of more or less spherical cells that may formed on germination of akinete ... certain cyanobacteria.

- They move by the streaming of mucilage along the surface.
- When hormogonia reach on suitable place of favourable conditions then germinate into filament.