

BACTERIA

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Bacteria: - Antonie Van Leeuwenhoek was discovered micro-organism (Bacteria, Protozoa, yeast) in (1632-1723).

- * He also known as father of microbiology.
- * True bacteria are called eubacteria, they are simple in structure and small in size.
- * He studied water, faeces, teeth scrapings etc.

General characters of Bacteria:-

- * Bacteria → small, simple, unicellular, primitive microorganism.
- * Distribution → Cosmopolitan, Air, soil, water, plant, animal.
- * Ultramicroscopic, Prokaryotes.
- * It is found almost everywhere. High Temp, low temp.
- * Shape → spherical, rounded, spiral, Rod shaped, filamentous.
- * Bacteria → Cell wall, hairlike structure pili. (Sex Pili).
- * Bacteria cell → Complete developed cell organelles are absent. like-chloroplast, mitochondria, golgi bodies etc.
- * Bacterial cell → DNA, plasmid, mesosomes are present.
- * Nutrition → Autotrophic, Heterotrophic, Symbiotic.
- * Reproduction → vegetative, Asexual, sexual.
- * Pathogenic nature → plant, animal - disease cause.
- * Bacterial staining Based → Gram +ve and Gram -ve.
- * Ribosome - 70s type, which are freely found in its protoplasm.
- * Physiology → chlorophyll present → photosynthetic, Respiration.

Other characters

- * Some time slime capsule layer is developed on cell wall.
- * They contain peptidoglycans with N-acetyl muramic acid and N-acetyl glucosamine in the cell wall which is absent in archaea & eukaryotes.

It is also contains pemetic acid (DAP). (2)

* The DNA is double strands DNA with circular chromosomes as well as genome.

* No Histone protein is found in bacteria.

* Bacteria mainly reproduced by binary fission.

~~* Bacteria mainly~~

* There is no sexual repn but seen in some bacteria conjugate to transfer their genetic materials to other bacteria.

* Extra genomic DNA are found in some bacteria. (plasmid).

* Some bacteria are motile and possess flagella on their cell surface which is made up of 8 parallel chains of flagell in protein.

Morphology of Bacteria:- (Size, shape and structure)

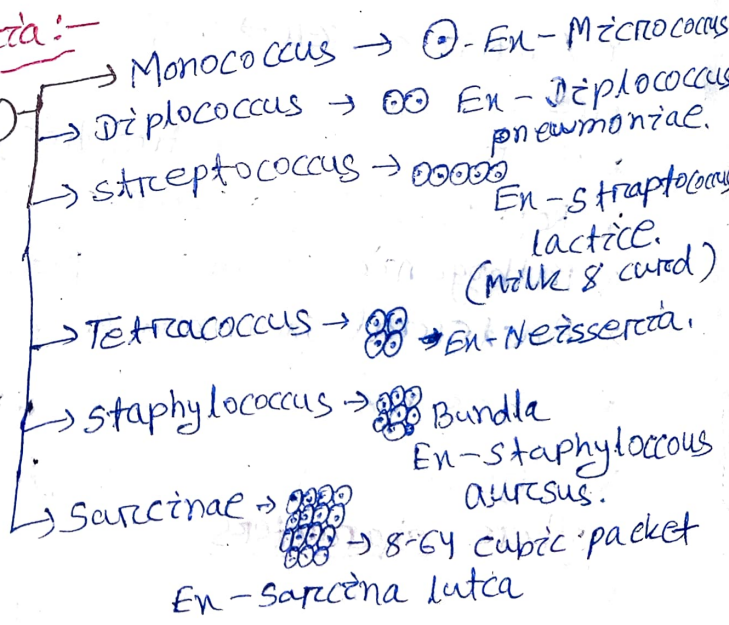
Size:- * The size of bacteria vary considerably. They are within 1μ to 5μ and the smallest bacterium is 0.15μ to 0.3μ .

* The largest bacterium found in cockroach is *Bacillus butschlii* which is 3.0μ to 6.0μ in width and 80μ in length.

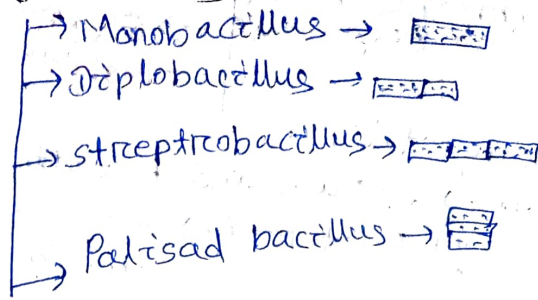
* The cocci vary from 0.5μ to 4.0μ in diameter and sporeilli can measure upto 500μ in length.

Shape of Bacteria:-

(i) Coccus (spherical)



(2) Bacillus shaped (Rod shaped)



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(3) Spiral shaped Ex- Spirillum



(4) Vibrio shaped → comma shaped →

(5) Filamentous bacteria →

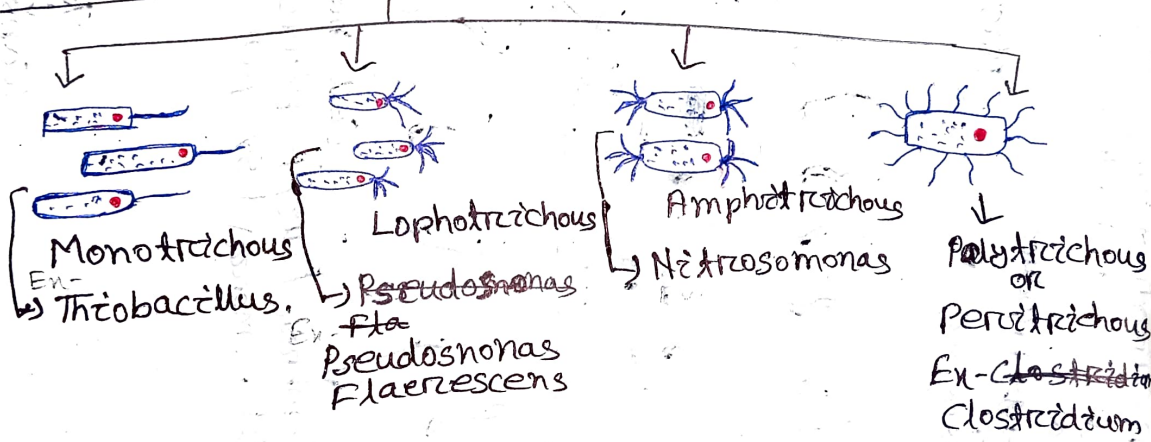
(6) Stalked →

(6) Budded →

* Motile and Non-motile Bacteria:-

(i) A-Trichous bacteria → Flagella absent- Non-motile Ex- ~~Pasteurella~~ Pasteurella

(ii) Motile Bacteria:- Flagella Present.



Structure of Bacteria cell:-

The Bacteria (Gk. stick) are simple, prokaryotic, unicellular and microscopic organisms.

→ Discovery → Anton Van Leeuwenhoek.

→ Ehrenberg → (1829 → bacteria).

→ Louis Pasteur → detailed study.

→ Rigid cell wall → contain → acetyl glucosamine, in certain → acetyl muramic acid.

→ Bacteria → diaminopimelic acid.

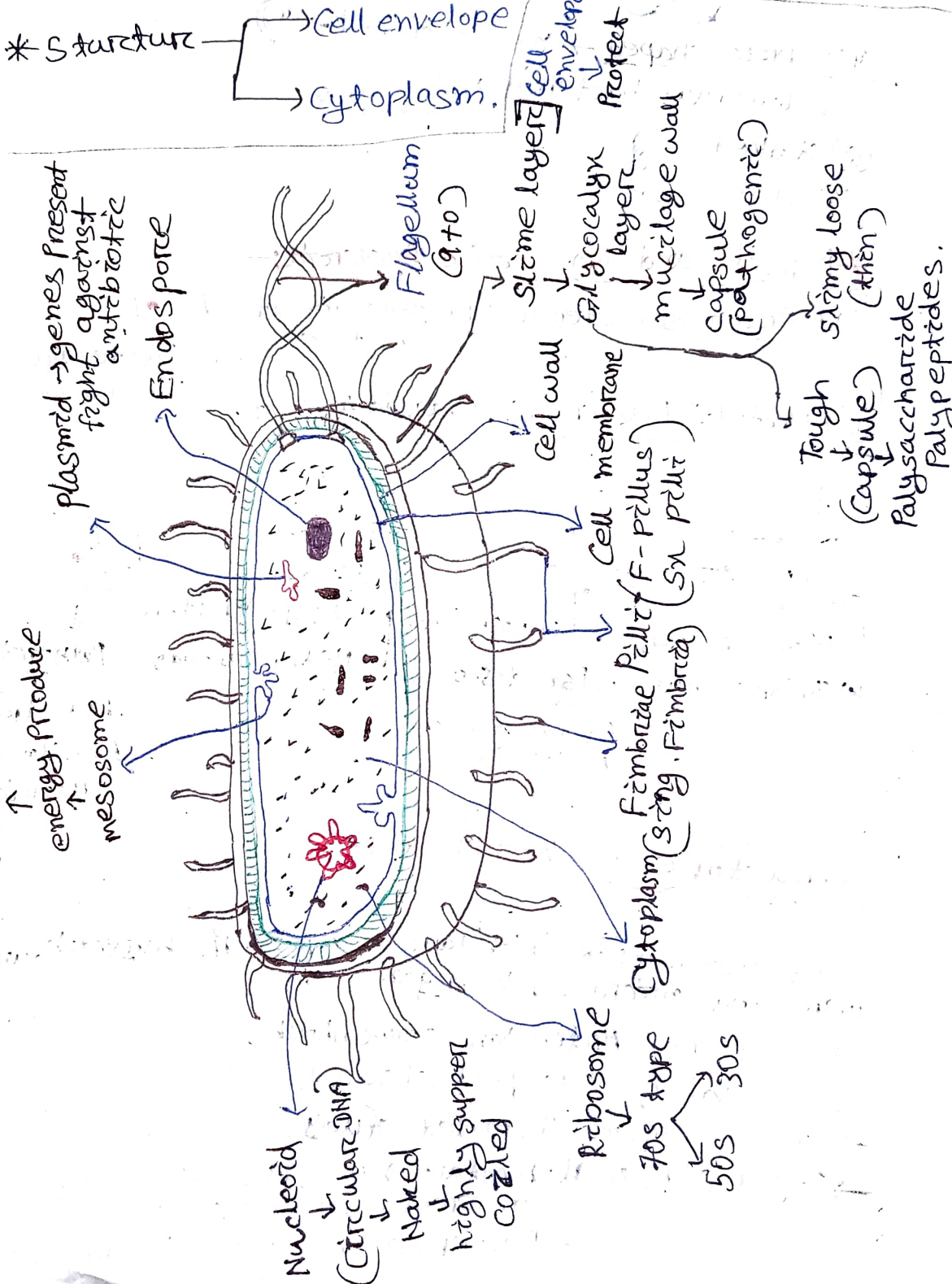
→ membrane bound cell organelles → ER, nucleus, ⁽⁴⁾ Golgi, mitochondria, plastids → are absent.

→ Prokaryotic.

→ length → 2-10 μm and breadth → 0.2 → 2 μm,

→ majority Bacteria → Heterotrophic, But in few bacteria → contain special pigment
Bacteria chlorophyll.

* Occurrence: - Found almost every place (90°C Temp) 2500 meters depth in water.



5) Structure of Bacteria cell in (Cell envelope)

→ Bacteria are unicellular prokaryotic micro-organism which divide by binary fission. They do not possess nuclear membrane and the nucleus consists of a single circular double-stranded DNA Helix.

(1) Flagella → These are long-filamentous and 12-30 μm in length. Contain → Contractile Protein Flagellin, → Help in locomotion.

(2) Fimbriae or pili:- These are thin, short filament (4 to 8 nm) → (Pilin protein) ↓ made up.

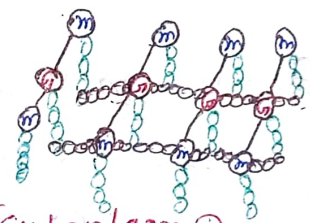
(3) Capsule:- Outer covering. Jelly-like material surrounds the cell wall.

→ Only present in some bacterial species.
→ made up of polysaccharide, polypeptide.

(4) Cell wall:- It is a tough and rigid structure of peptidoglycon with accessory specific material, (e.g → LPS, teichoic acid) → Give shape.

* The peptidoglycon is composed of alternate units of N-acetyl muramic acid and N-acetyl glucosamine residues, cross linked with tetra-peptide subunits.

- ① → N-Acetyl muramic acid
- ② → N-Acetyl glucosamine



Cell of +ve Bacteria

Structure of Bacteria in (Cytoplasm)

(5) Cytoplasmic membrane or (cell membrane)

* The cytoplasmic layer → boundary layer of the protoplast.
* It is thin (5-10 nm) elastic and semipermeable layer.

In section:- It appear as a triple-layered structure, consisting both organic of a bilayer region of phospholipid molecules, with polar heads on the surface and fatty acyl chains towards the inner side. Protein → embedded

↓
in the lipid Bilayer

Function:-

- * Transport.
- * Energy Production.
- * Polymer Production.

(6) Cytoplasm of Bacteria:

The cytoplasm is colloidal system containing both organic and inorganic substance. It lacks mitochondria, golgibodies, ~~est~~ E.R, Centrosome absent.

* It contains many Ribosome, few mesosomes etc.

Ribosome → 70s → having two subunits $\begin{cases} \rightarrow 50s \\ \rightarrow 30s \end{cases}$
→ site of protein synthesis.

Mesosomes → These are multi-laminated localized infoldings of the cytoplasmic membrane into the cytoplasm. number - 2.

→ site of Respiration, photosynthesis pigment.

(7) Chromatophores! - These are pigment bearing structures found in photosynthetic bacteria.

(8) Genetic material of Bacteria! - The genetic material is present both in nucleoid and plasmid.

→ plasmid! - Bacterial cytoplasm may contain some genetic material excepting the genome called plasmid or episomes.

* Plasmid → ring like dsDNA molecules.

* ~~Plasmid are following type. Based~~

Gram stain / Gram staining

* This method is used to distinguish and classify Bacterial species in two large groups. i.e

(1) Gram Positive (g+ve)

(2) Gram Negative (g-ve)

* Discover → Hans Christian gram.

* Gram staining differentiates Bacteria by the chemical and physical properties of their ~~retro~~ cell walls.

(1) Gram Positive! - The g+ve cells have a thick layer of Peptidoglycon in the cell wall that retains the P-stain → Crystal Violet.

(7) (2) Gram Negative :- The g-ve cells have a thinner peptidoglycon layer that allows the crystal violet to wash out on addition of ethanol. They are stained pink or red by the counter stain, commonly Safranin or Fuchsin.

→ Gram stain



(Iodine → Mordant)

(Alcohol 95% → Decolorize)

(Crystal violet → P-stain)

Step 1 → Dry and Fix by heat.

Step 2 → Crystal violet

Step 3 → Gram's Iodine

Step 4 → Alcohol 95%

all ↓ micro-organisms

Step 5 → Safranin

Violet colour → g+ve

Pink/Red colour → g-ve

Difference betⁿ G+ve and G-ve Bacteria

Character	G+ve	G-ve
(1) Cell wall	Thick (150-200 Å)	Thin (75 - 120 Å)
(2) Lipids in "	2-4% low	15% Higher
(3) Teichoic Acid in "	Present	absent
(4) Lipopolysaccharides "	absent	Present
(5) Sialic acid in "	absent	Present
(6) Magnesium Ribonucleate	Present	absent
(7) Periplasmic space	absent	Present
(8) Outer membrane	absent	Present
(9) Susceptibility to penicillin	very high	low
(10) Gram staining	Blue/purple	Red/pink
(11) Peptidoglycon layer "	multilayer/thick	thin layer
(12) Resistance to physical destruction	very high	very low
(13) Example	Escheria Coli, Pseudomonas	Streptococcus Pneumoniae

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(14) Amino acid	few amino acid present	Present all amino acid
(15) Muramic acid	large amount	less amount
(16) Polar flagella	absent	Present
(17) Sensitivity for antibiotic	Penicillin	Streptomycin
(18) Resistance with alkalis 1% KOH	not dissolved	dissolved
(19) Porcins	absent	Present
(20) Isoelectric range pH.	2-5-4	4-5-5-5

Similarities b/w +ve / -ve Bacteria

- (1) Both are Bacterial cell.
- (2) Both groups are prokaryotic.
- (3) Both lack membrane bounded organelles.
- (4) Both group contain → plasmid.
- (5) Both groups possess prokaryotic.
- (6) Both groups present flagella.
- (7) Both group contain peptidoglycon layer in cell wall.
- (8) Both group undergo Binary fission as a mode of asexual reproduction.

Main note

Gram +ve Bacteria

- (1) Cell wall appears thick and homogeneous.
- (2) Peptidoglycan comprises upto 90% of the cell wall which is more rigid.
- (3) Beside peptidoglycan there are teichoic acid other polysaccharides and proteins in the cell wall.
- (4) Teichoic acid are the main surface antigens.
- (5) More sensitive to wall attacking antibiotic like penicillin.

Gram -ve Bacteria

- (1) Cell wall appears thin and trilayered.
- (2) Peptidoglycan comprises 10% so it is less rigid.
- (3) Beside peptidoglycan there are phospholipid protein and lipopolysaccharide. Teichoic acid are absent.
- (4) Lipopolysaccharides are main surface antigens.
- (5) Less sensitive to wall attacking antibiotic like penicillin.

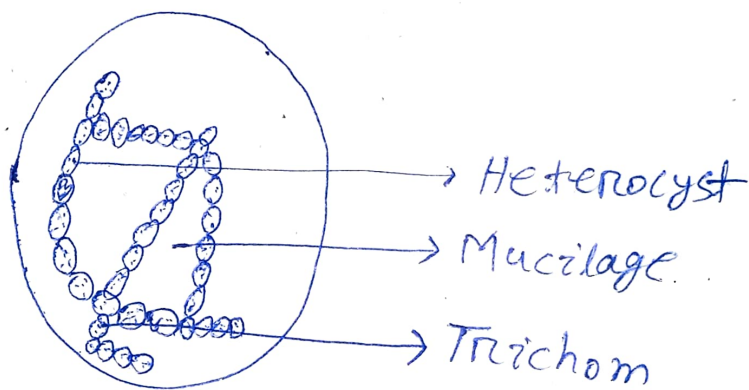
NOSTOC

(9)

Systematic Position - Division - Cyanophyta
Class - Cyanophyceae
Tribe - Hormogoneae
Order - Nostocales
Family - Nostocaceae
Genus - Nostoc
Species - muscorum.

Occurrence: - It is filamentous form of both terrestrial and aquatic habitats. It found in fresh water. Generally found in rice field in moist soil or it sub-merged in water and it also found in ponds and ditches.

Structure of colony: -

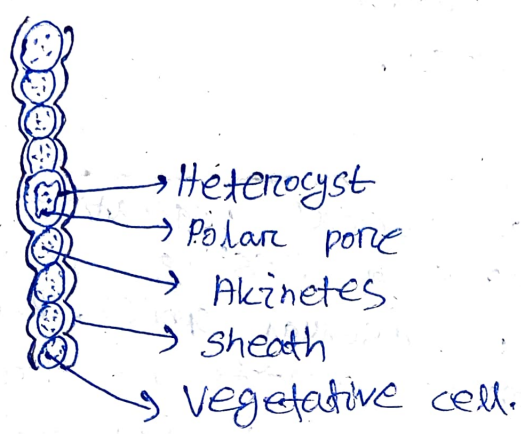


The whole colony is three dimensional structure. It may be circular, oval, irregular in shape. Each colony appears like a bluish green or yellowish mass of seeds.

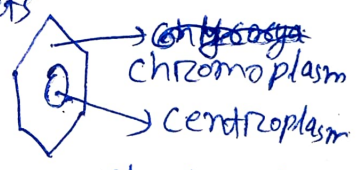
Structure of Trichom: - The trichom is multicellular in structure. Each trichom is composed of numerous rounded or oval cells. The trichoms are found colourless empty looking spherical or barrel shaped cells called heterocyst. One heterocyst

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are intercalary in position. In heterocyst there are two pores known as polar pores which are connecting for ribosome transfer. When the heterocyst nature on nodules are formed which are known as polar nodules. Under certain condition vegetative cells here and there in the stichom may become greatly enlarged stored with food materials and greatly thicks to become resting bodies called the akinetes.



Structure of a cell:- The cell consists of a cell wall and protoplast cell wall consists of cellulose and pectin. The protoplast is vaguely defined into the outer. The pigmented cytoplasmic region called the chromoplasm and the inner colourless region is known as centropoplasm. The chromoplasm is coloured due to presence of pigments phycoerythrin, chlorophyll a chromoplasm consists of cyanophyceae starch, or droplets and the centropoplasm consists of chromatin granules (DNA, RNA). It is similar to the nucleus without nuclear membrane.



Reproduction:- In Nostoc reproduction reproduces vegetatively by three methods.

- (i) Colony formation
- (ii) Hormogonia formation
- (iii) Akinetes formation or resting spore.

(ii)

(i) Colony formation:- The nostoc colony as it gets larger frequently breaks up into flat expansive as a result of storms and other disturbance. Each of the grows upto the size of the parent colony.

(ii) Homogonia formation:- Short segments of living cells called homogonia. The filament without heterocyst is separated by separation disc. when the cell dead it is dissapare then the filament separated from each other and it become isolated.

(iii) Akinetes or Resting spore formation:-

Such a special vegetative cells are called akinetes or resting spore. These are one type of asexual spores. During unfavourable condition it consists of thick walls. It is not usually to find all the cells but between two heterocyst and it occasionally the entire fruchom converted into akinetes. And during favourable condition each akinetes germinates to a new filaments or a Nostoc.

Question - core paper - I

1/2

No-1

- I - The main food storage in cyanobacteria is _____
- II - Nostoc belongs to the order _____
- III - The vegetative cell that is differentiated to a heterocyst is known as _____
- IV - chains of rod shaped bacteria are called _____
- V - The incomplete zygote is called _____
- VI - The multicellular structure consisting of chain of cells is called as _____
- VII - Metachromatic granules contain _____
- VIII - plasmids were first discovered by _____
- IX - single flagellum, the bacteria are called as _____
- X - The protoplasm is distinguished into outer ~~and~~ peripheral pigmented zone called _____

No-2 (2-3 sentence)

- 1 - What are the components of cell wall of bacteria ?
- 2 - Write two difference between bacterial flagella and archaeal flagella.
- 3 - What are the photosynthetic pigments in cyanobacteria ?
- 4 - Name two bacteria which are used as biofertilizers.
- 5 - What is spheroplast ?

- Give an account of general characters of bacteria.
OR

Write note on:-

- (a) - Transformation
- (b) - Role of bacteria in biotechnology.

Give an account of the economic importance of blue-green algae.

OR

Write note on:-

- (a) - Nostoc
- (b) - Gram stain.