CELL MEMBRANE AND DIFFERENT CELL MORPHOLOGY

By:-
Vivek Kumar
M Sc Microbiology
Bangalore University

INTRODUCTION

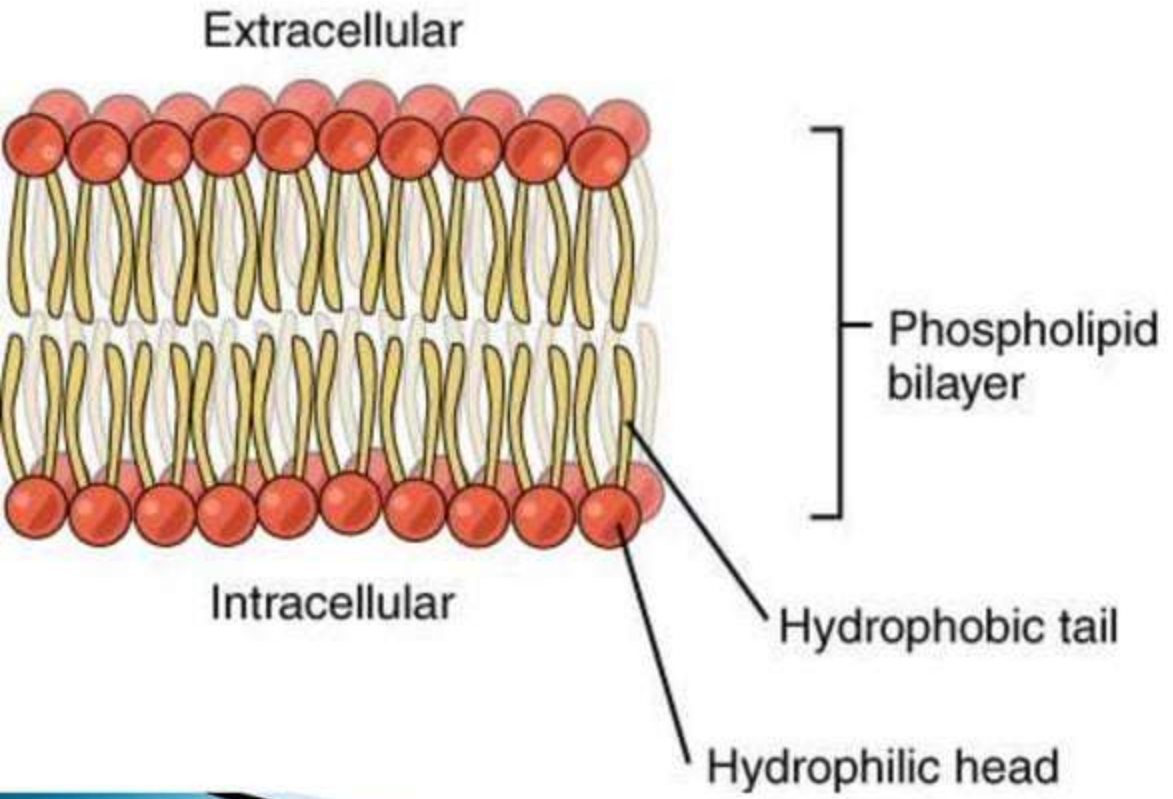
- Bacterial cell possesses a detailed internal structure.
- Membranes are an absolute requirement for all living organisms. That covers the surface of every cell and also surround most organelles within cell.
- Among the major characteristics of bacterial cells are their size,shape,structure,and arrangement. These characteristics constitute the morphology of the cell.

CELLMEMBRANE

FUNCTIONS

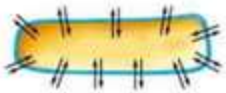
- Control permeability.
- Transport electrons and protons for cellular metabolism .
- Contain enzymes to synthesis and transport cell wall substance and for metabolism.
- Secrete hydrolytic enzymes.
- Regulate hydrolytic enzyme.

- Membranes contain both proteins and lipids.
- Bacterial plasma membrane usually have a higher proportion of protein
- Phospholipid bilayer is present .
- Are amphipathic: That have polar and non polar ends.
- The polar end is hydrophilic.
- The non polar end is hydrophobic.


Extracellular
Phospholipid bilayer
Intracellular
Hydrophobic tail
Hydrophilic head

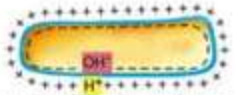
- Bacterial membrane in lacking sterols such as cholesterol.
- It contain pentacyclic sterol like molecule called hapanoid-stabilize the bacterial membrane
- Cell membrane are very thin structure about 5-10 nm thick
- Plasma membrane have a complex structure.

Functions of the cytoplasmic membrane(1)



Permeability Barrier — Prevents leakage and functions as a gateway for transport of nutrients into and out of the cell

Protein Anchor — Site of many proteins involved in transport, bioenergetics, and chemotaxis

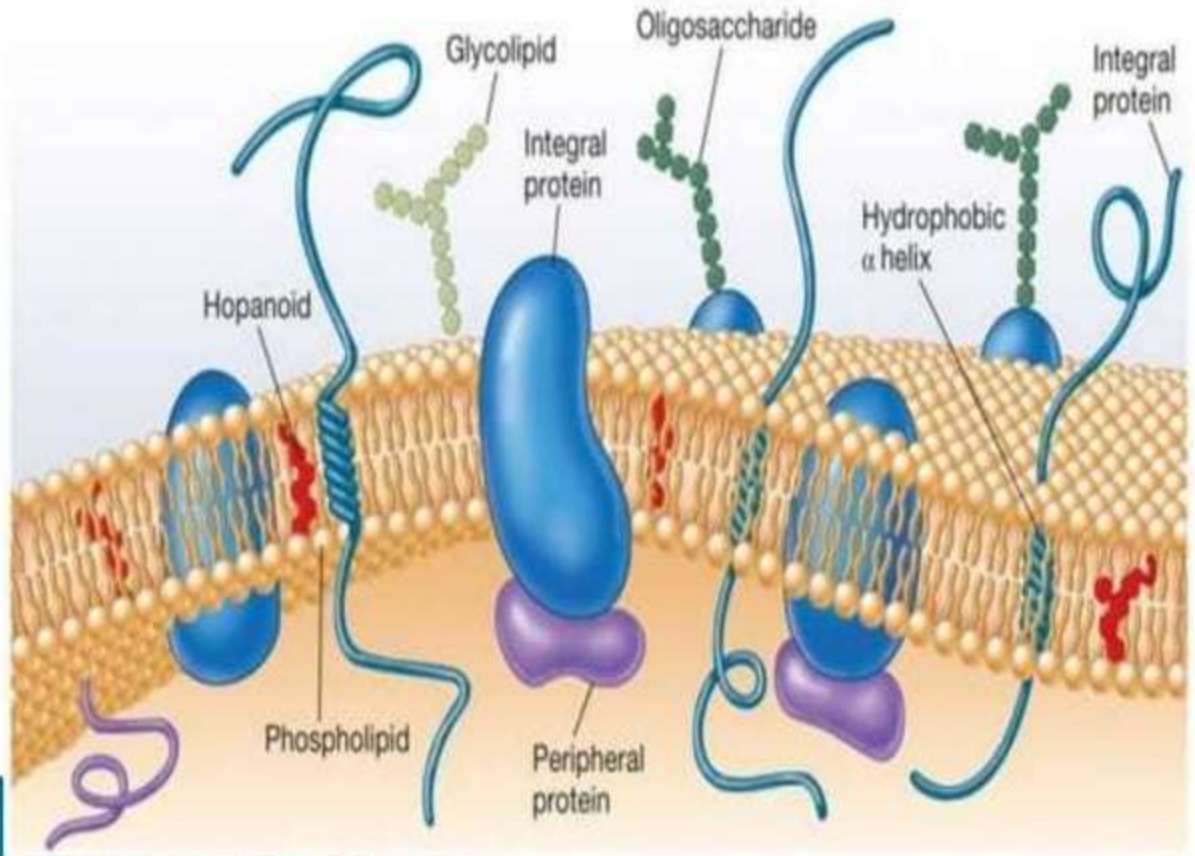


Energy Conservation — Site of generation and use of the proton motive force

FLUID MOSAIC MODEL

- The most widely accepted current model for membrane structure is the fluid mosaic model.
- Proposed by S.Jonathan singer and Garth Nicolsan.
- They distinquish two types of membrane proteins.
- Peripheral proteins: are loosely connected to the membrane and easily removed. They are soluble in aqueous solutions and make up about 20-30% of total membrane protein.
- Integral proteins: About 70-80% of membrane proteins are integral proteins. They are not easily extracted from membranes and are insoluble in aqueous solutions when freed of lipids. They are amphipathic.

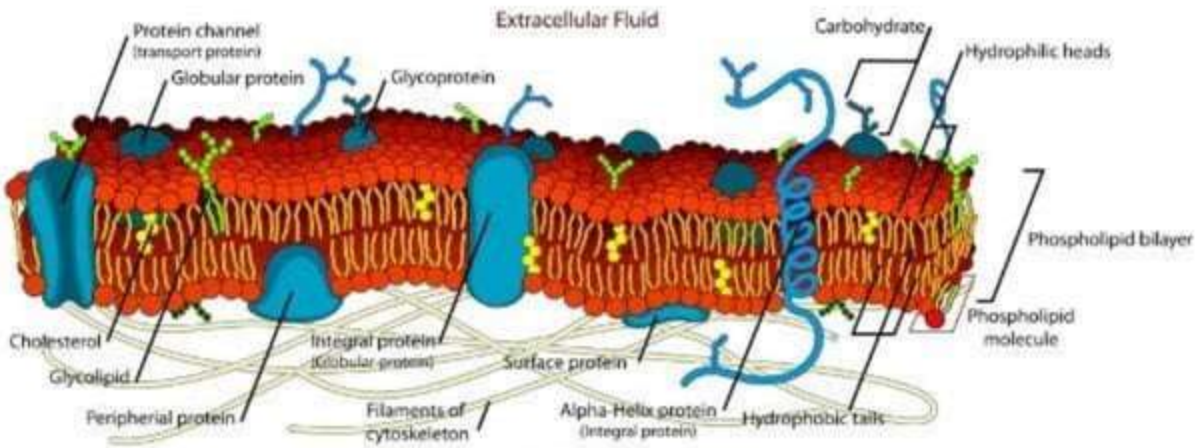
- The plasma membrane also serves as a selectively permeable barrier : it allows particular ions and molecules to pass, either into or out of the cell, while preventing the movement of others.


Glycolipid
Oligosaccharide
Integral protein
Integral protein
Hydrophobic α helix
Hopanoid
Phospholipid
Peripheral protein

Our current model of the cell membrane is called the **Singer-Nicholson fluid mosaic model**

Key features:

- Phospholipid molecules form a bilayer - phospholipids are fluid and move laterally
- Peripheral proteins are bound to either the inner or outer surface of the membrane
- Integral proteins - permeate the surface of the membrane
- The membrane is a fluid mosaic of phospholipids and proteins
- Proteins can move laterally along membrane



http://commons.wikimedia.org/wiki/File:Cell_membrane_detailed_diagram_en.svg?uselang=en-gb

Different Size , Shape and Arrangement of Bacterial cells

- Bacteria are prokaryotic, unicellular microorganisms, which lack chlorophyll pigments. The cell structure is simpler than that of other organisms as there is no nucleus or membrane bound organelles.
- Due to the presence of a rigid cell wall, bacteria maintain a defnite shape, though they vary as shape, size and structure.

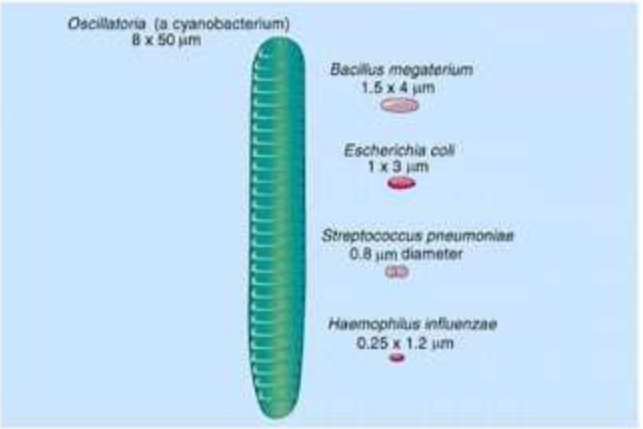
SIZE OF BACTERIAL CELL

- The average diameter of spherical bacteria is 0.5-2.0 micrometer.
- For rod shaped or filamentous bacteria length is 1-10micrometer and diameter is 0.25-1.0 micrometer.
- E.coli, a bacillus of about average size is 1.1-1.5micrometer wide by 2.0-6.0 micrometer long.
- Spirochetes occasionally reach 500 in length and the cyanobacterium.
- Oscillatoria is about 7 in diameter.

- The bacterium, Epulosicium fishelsoni, can be seen with the naked eye (600 micrometer long by 80 micrometer in diameter).
- One group of bacteria,
- called the mycoplasms, have individuals with size much smaller than these dimensions. They measure about 0.25 and are the smallest cells known so far they were formerly known as pleuropneumonia-like organisms(PPLO).
- *Mycoplasma gallicepticum* with size of approximately 200-300 nm are thought to be smallest bacteria.

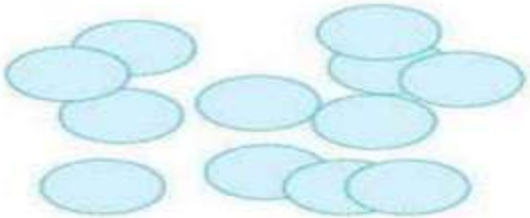
- *Thiomargarita namibiensis* is largest bacteria gram negative.
- *Proteobacterium* found in the ocean sedimets off the coast of Namibia. Usually it is 0.1-0.3 nm (100-300)across, bigger cells have been observed up to 0.75 mm (750micro meter).
- Thus a few bacteria are much larger than the average eukaryotic cell(typical plant and animal cells are around 10-50micro meter in diameter).

Size relationships among prokaryotes



Shape of bacterial cell

- When viewed under light microscope, most bacteria appear variations of three major shapes: the rod (bacilli),the sphere(coccus) and the spiral type(vibrio). In fact,structure of bacteria has two aspects, arrangement and shape.



Cocci

Bacterial Morphology Arrangement

1. Bacilli
   a.Streptobacilli
   b. Bacilli

2. Cocci
   a. Cocci
   b. Doplococci
   c. Streptococci
   d. Staphylococci
   e. Sarcina (3D)
   f. Gaffkya(2D)

Bacterial Morphology Arrangement

3 Spirl

a. Vibrio

b. Spirillum

c. Spirochete

BACILLI

- Or bacillus for a single cell
- Are rod shaped bacteria

- SPIRILLA
- Or spirillum for a single cell
- Are curved bacteria which can range from gently curved shape to a corkscrew-like spiral.
- Many spirilla are rigid and capable of movement. A special group of spirilla known as spirochetes are long,slender,

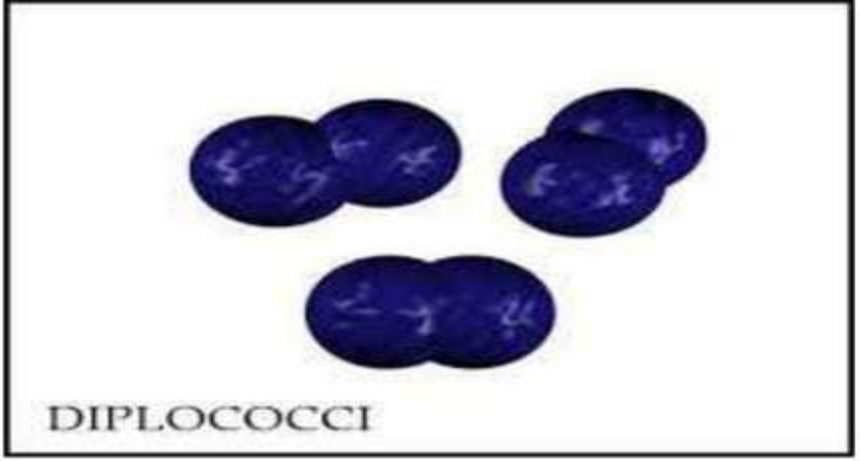
Arrangement of cocci

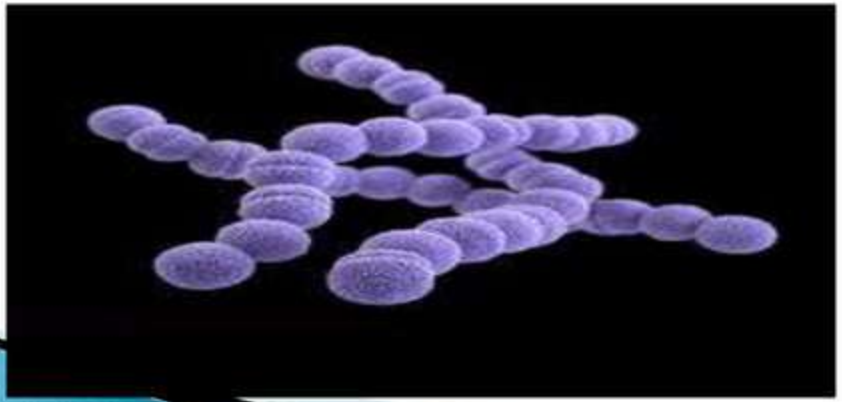
Diplococci

- The cocci are arranged in pairs.
- Examples: *Streptococcus pneumoniae*, *Moraxella catarrhalis*, *Neisseria gonorrhoeae*, etc..

Streptococci

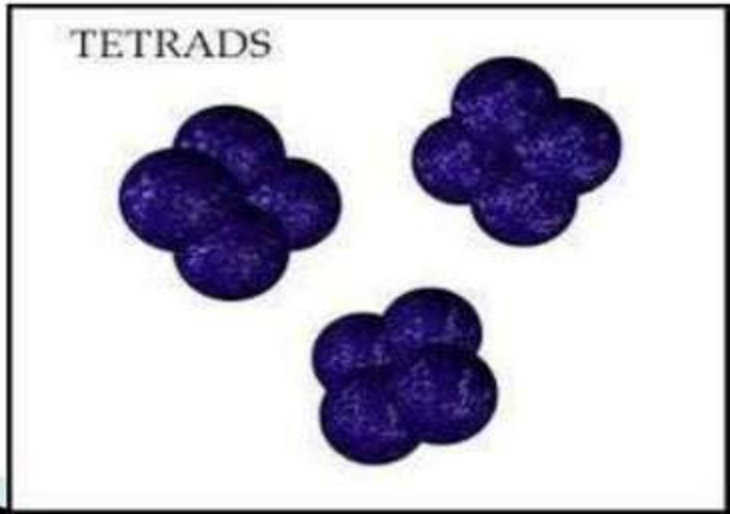
- The cocci are arranged in chains, as the divide in one plane
- Examples: *Streptococcus pyogenes*, *Streptococcus agalactiae*.


DIPLOCOCCI



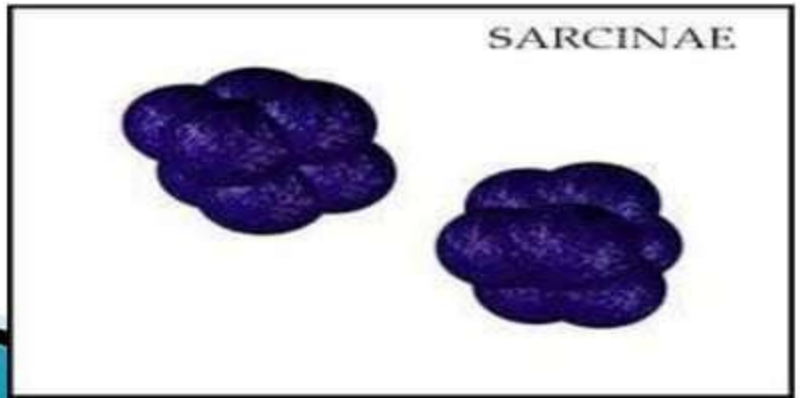
Tetrads

- The cocci are arranged in packets of four cells, as the cells divide in two plains.
- Examples: *Aerococcus*, *Pediococcus*, *Tetragenococcus*



Sarcinae

- The cocci are arranged in a cuboidal manner,as the cells formed by regular cell divisions in three planes and remain in groupes cube like groups of eight.
- Examples: *Sarcina ventriculi*, *Sarcina ureae*.



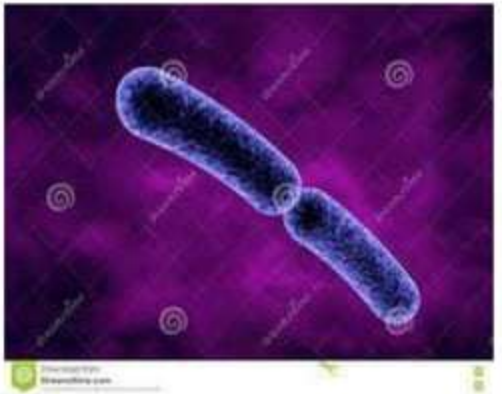
Staphylococci

- The cocci are arranged in grape like clusters formed by irregular cell divisions in three plains
- Examples: Staphylococcus aureus

Arrangement of Bacilli

Diplobacilli

- Most bacilli appear as single rods.
- Diplobacilli appear in pairs after division
- Examples of single rod: Bacillus cereus
- Examples of diplobacilli: Coxiella burnetti, Klebsiella rhinoscleromatis



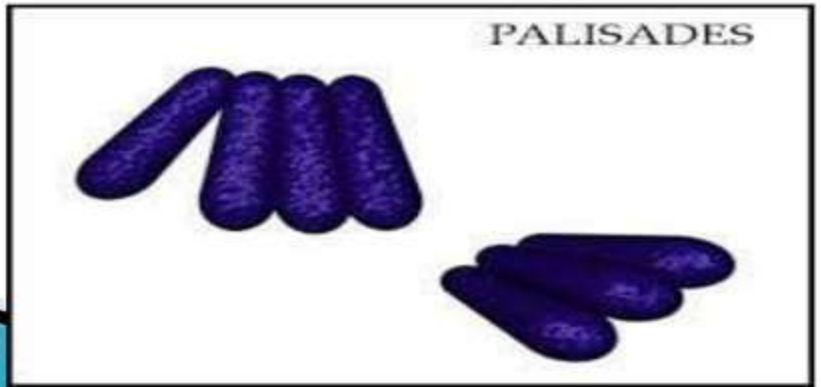
- Streptobacilli
- The bacilli are arranged in chains, as the cells divide in one plane.
- Examples: Streptobacillus moniliformis

Coccabacilli

- These are so short and stumpy that they appear ovoid.
- They look like coccus and bacillus
- Examples:Haemophilus influenzae,Gardneralla vaginalis, and Chlamydia trachomatis.

Palisades

- The bacilli bent at the points of divisions, resulting in a palisade arrangement resembling a packet fence and angular patterns that look like chinese letters
- *Examples*: *Corynobacterium diphtheriae*



Arrangement of spiral bacteria

Vibrio

- They are comma shaped bacteria with less than one complete turn or twist in the cell.
- Examples: Vibrio cholerae

Spirilla

- They have rigid spiral structure. Spirillum with many turns can superficially resembles spirochetes. They do not have outer sheath and endoflagella, but have typical bacterial flagella.
- Examples: Campylobacter jejuni, Helicobacter pylori, Spirillum winogradskyi.

Spirochetes

- Spirochetes have a helical shape and flexible bodies. Spirochetes move by means of axial filaments, which look like flagella contained beneath a flexible external sheath but lack typical bacterial flagella.
- Examples: Lepto spira species, Treponema pallidium.

COCLUSION

- Cell membranes are an absolute requirement for all living organisms.
- Most widely accepted current model cell membrane structure is plasma membrane.
- The morphology of bacterial cell mainly constitutes size shape and arrangements.

BIBLIOGRAPHY

- Ananthanarayan&Paniker's.2013.Text book of Microbiology,9th edition. Universities Press,India.Pg.No-9-16.
- Madigan M,Martinko J,Parker J.2002.Brock biology of Microorganisms,10th edition. Prentice Hall.Pg.No-74-91.
- Prescott,Harley,Klein.2004.Microbiology,6 th edition.Mc Graw Hill Science\Engineering\Math Hard cover.Pg.No-46-49.