Bacteria

Discovery

The bacteria were discovered by Leeuven van Hoek in 1673. He named them “Little Animal’. In 1773 a Denish scientist Fredrick Muller naemed them Bacilli. In 1850s French biologist Casimir Bavaine named them Bacteria.

Bacteria

The microscopic, unicellular, prokaryotic organisms characterized by the lack of membrane bound nucleus and membrane bound organelles. The bacteria are the descendants of the earliest form of the life and are unicellular prokaryotes or simple association of similar cells.

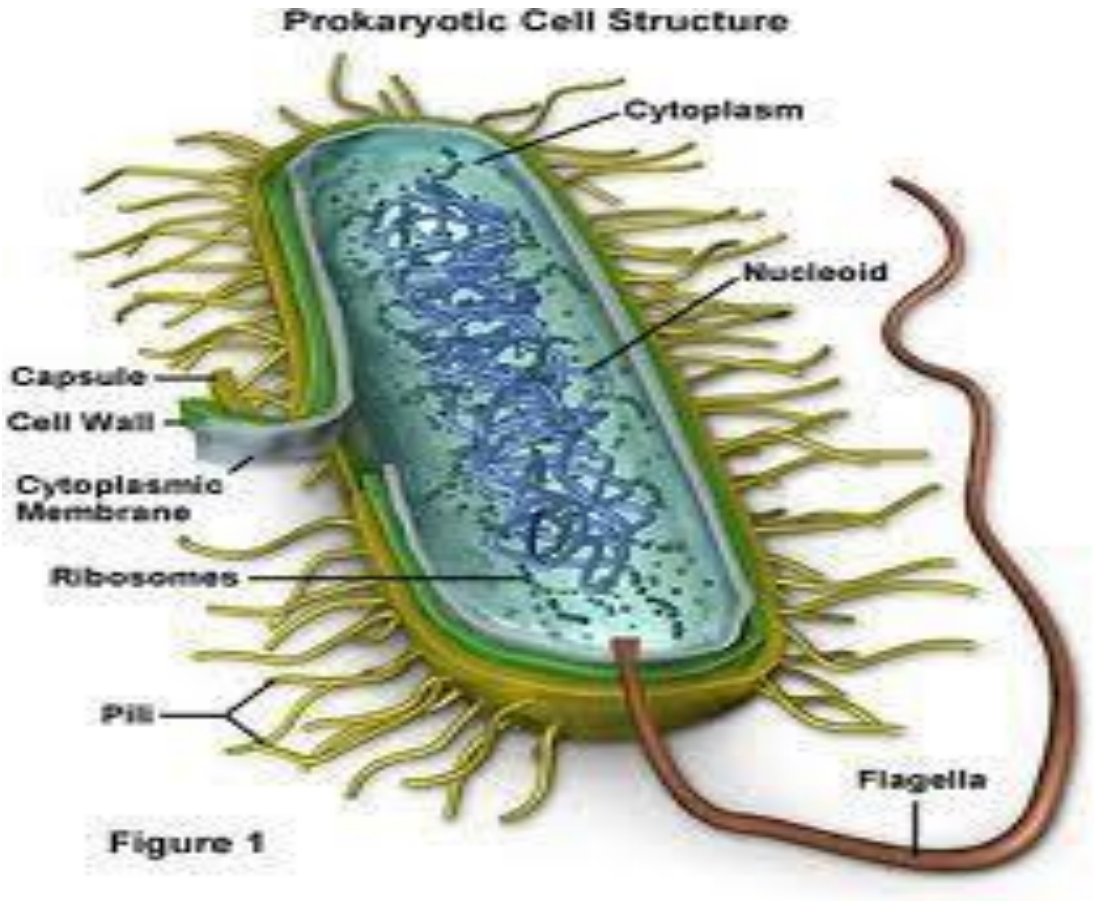
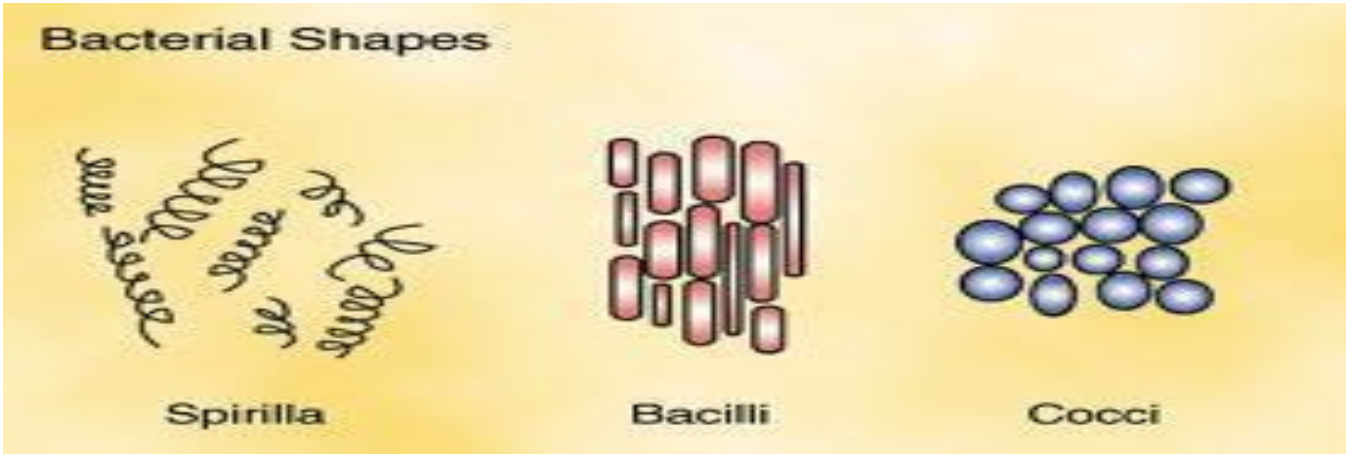


Figure 1

Classification of Bacteria on the basis of Cellular morphology

The general appearance of an individual cell as seen under bright field

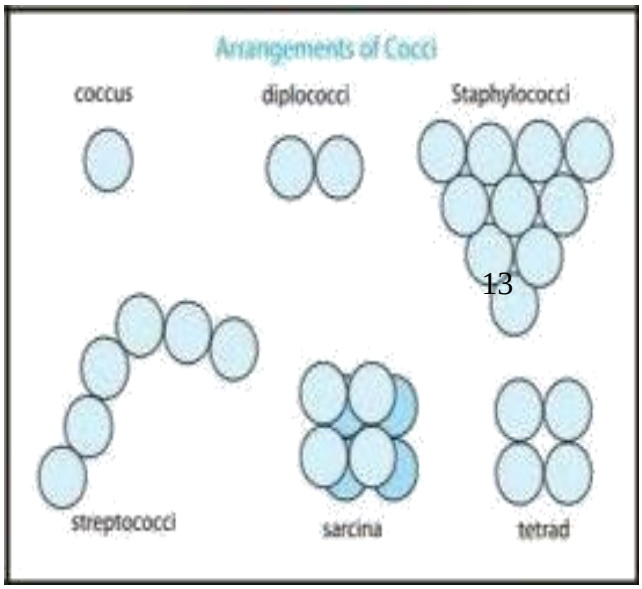


compound the microscopic is known as cellular morphology. Coccus (spherical) Bacillus (rod like) Spirillum (spiral) Filamentous

Bacilli

As suggested by Muller, the rod is known as bacillus. In various species of rod shaped bacteria, the cylindrical may be as long 20µm or as short as o.5µm.

Cocci



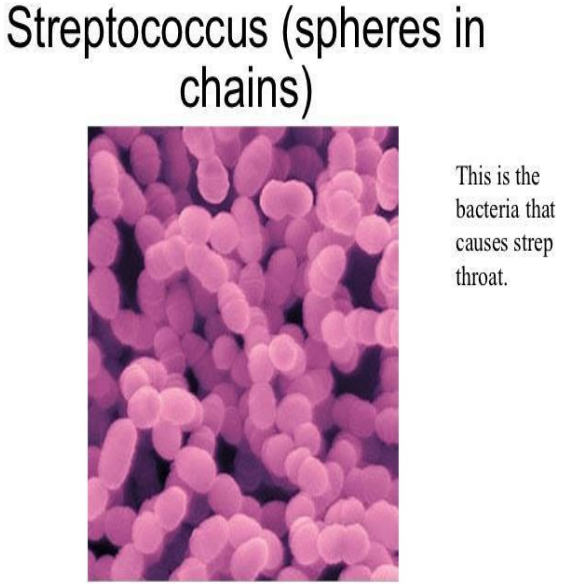
A spherically shaped bacterium is known as coccus, a term derived from greak kokkos, meaning, and berry. Cocci tend to be quite small being only 0.5µm to 1.0µm in diameter.

Diplococci

Those cocci that remain in pairs after reproduction are called diplococci.

Example.

1. Neisseria gonorrhoeae.
2. N. meningitidus.

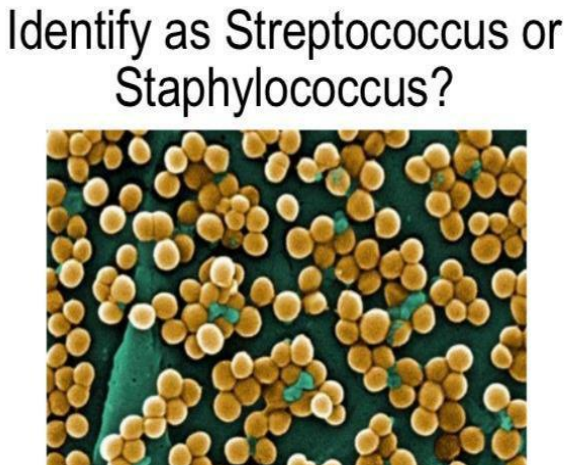


Streptococci

Cocci that remain in chains called streptococci.

Examples

1. Streptococcus pyogenes (involved) in strep throat)
2. S.mutans
3. (involved in tooth decay)
4. S.lactis
   (involved in producing dairy products such as yogurt)



Staphylococcus

The cocci which divide randomly and form irregular grapes like cluster of cells is called as staphylococcus.

1. Staphylococcus aureus

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Spirals

Spirals may take one of the following three forms.

Vibrios

They are the curved rods that resemble commas.

Example

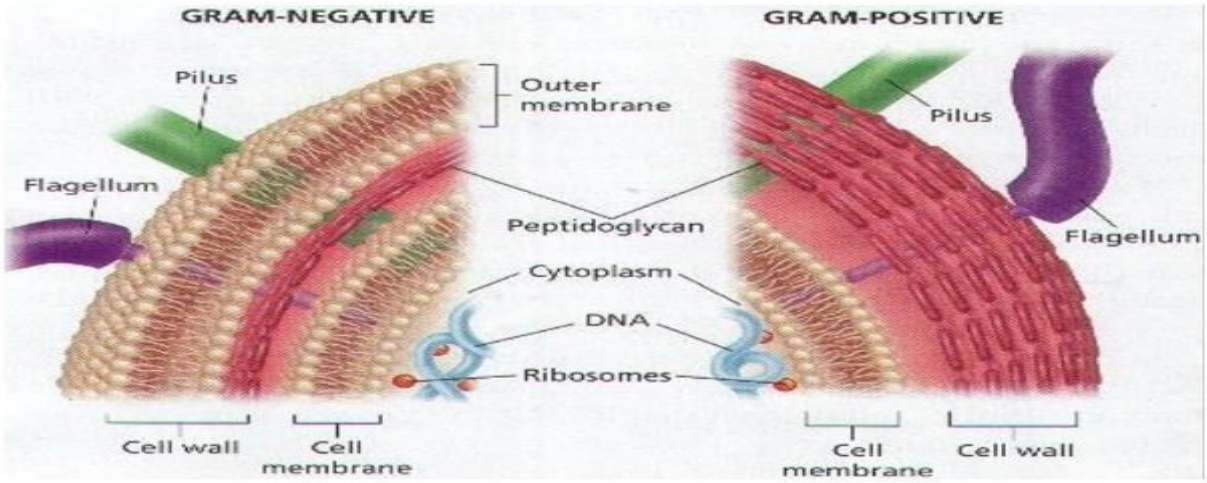
Vibrio cholerae (causing cholera)

Spirilla

They are helical shaped with a thick, rigid cell wall and flagella that assist movement.

Example

Spirillum volutan



Cell Wall of Bacteria:

With the exception of **mycoplasmas**, all bacteria have a cell wall. Function of cell wall is to protect the cell and determine it shape.

Chemical Composition of cell Wall:

The important component of bacterial cell wall is Peptidoglyan. **Peptidoglycan** is a large molecule and it contains two amino-containing carbohydrates

i) N-acetylglucosamine
ii) N-acetylmuramic acid.

These two molecules are joined by cross bridges of amino acid.

Cell Wall of Gram-Positive:

1-In these Gram-Positive bacteria peptideglycan is about 25 nm wide and contains and additional polysaccharide called **teichoic acid**.

2-About 60-90 % of cell wall is peptidoglycan.

Cell Wall of Gram-Negative Bacteria:

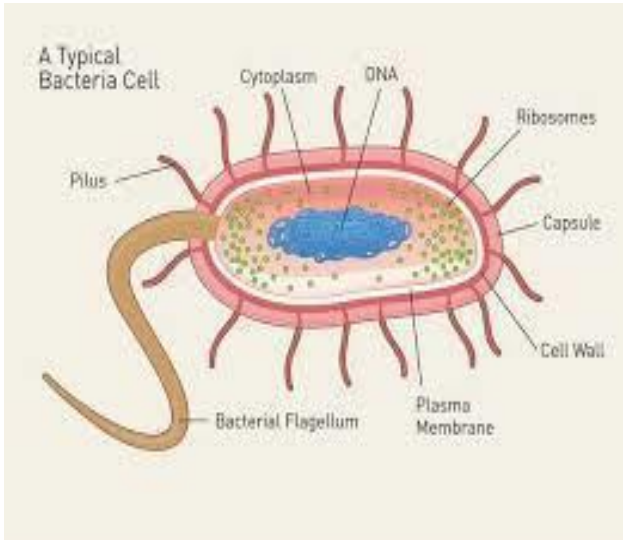
1-In Gram-Negative bacteria the cell wall is only 3 nm in thickness and contains no **teichoic acid**.

2-The cell wall in these bacteria contains various polysaccharide, proteins and lipids. This cell wall is more complex than that of Gram-positive bacteria.

The cell wall is surrounded by an outer membrane. The space between this membrane and cell wall is called **periplasmic** space. The **periplasmic space** contains a gel-like material called periplas

Capsule:

Many species of cocci and bacilli bacteria secrete a sticky, gelatinous layer of poly saccharides and proteins around the cell wall this layer is called Capsule. Spiral bacteria do not form capsule.



Glycocalyx:

The loose layer of capsule is called **Glycocalyx**. It contains a mass of tangled fibers of **dextrin**, a polysaccharide. These fibers help bacteria attach to the surface of the host.

Slime producing bacteria may render the food products unattractive and distasteful.

Cytoplasm

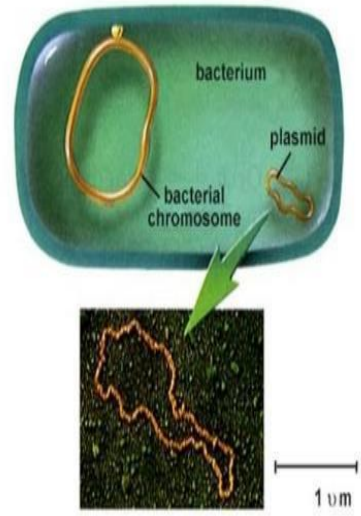
Inside the cell membrane lies the cytoplasm. It is semi-transparent and semi-fluid. It contains proteins, carbohydrates, lipids, nucleic

acids, salts, and inorganic ions, all dissolved in water.

Chromosome:

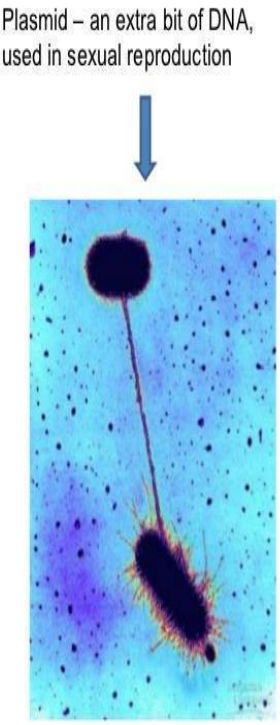
The bacteria have no distinct nucleus and are hence called Prokaryotes.

Bacterial chromosome lie suspended in the cytoplasm. It also lack protein.The chromosome region is called Nucloid.



Plasmids are also used in genetic engineering

Some bacteria form resistant endospores in response to unfavorable environmental conditions.



Plasmids:

They are extra-chromosomal rings of DNA. Although they contain few genes and are not essential for bacterial growth, plasmids are significant because many carry genes for drug resistance. For this reason they are often called R factors ("R" for resistance). They are very important in genetic engineering.

Ribosomes:

Ribosomes are bodies of RNA and protein. They are associated with the synthesis of protein.

Inclusion Bodies:

Globules of starch, glycogen or lipids in the cytoplasm are called Inclusion Bodies. They store nutrients for periods of starvation.

Volutin:

They are depots of phosphate. Volutins stain deeply with dyes such as methylene blue. Their presence in diphtheria bacilli assists

identification procedures.

Magnetosome:

It helps certain bacteria orient themselves to the environment toward their preferred habitat.

Cell Membrane

The cell membrane (also called the plasma membrane) is the boundary layer of the bacterial cell. It exists inside the cell wall in plants and bacteria.

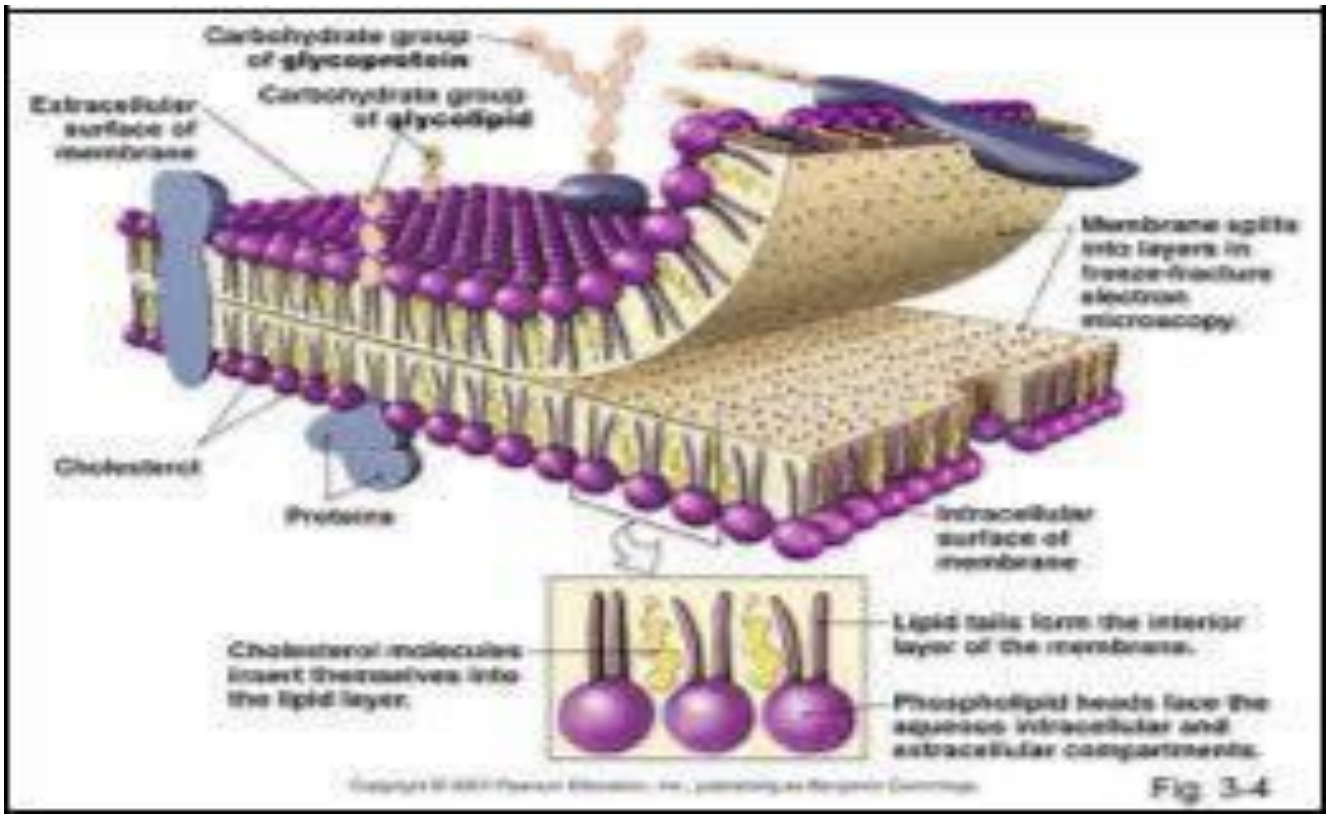
Cell Envelope

Some microbiologists combine the cell membrane, cell wall and capsule and term them Cell Envelope.

Chemical Composition:

Cell membrane contains approximately 60% proteins and 40 % lipids (mainly Phospholipids.)

Fluid Mosaic Model Of Cell Membrane:



Phospholipids Bi-layer:

The phospholipids molecules are arranged in two parallel layers called phospholipids bilayer.

Protein Globules:

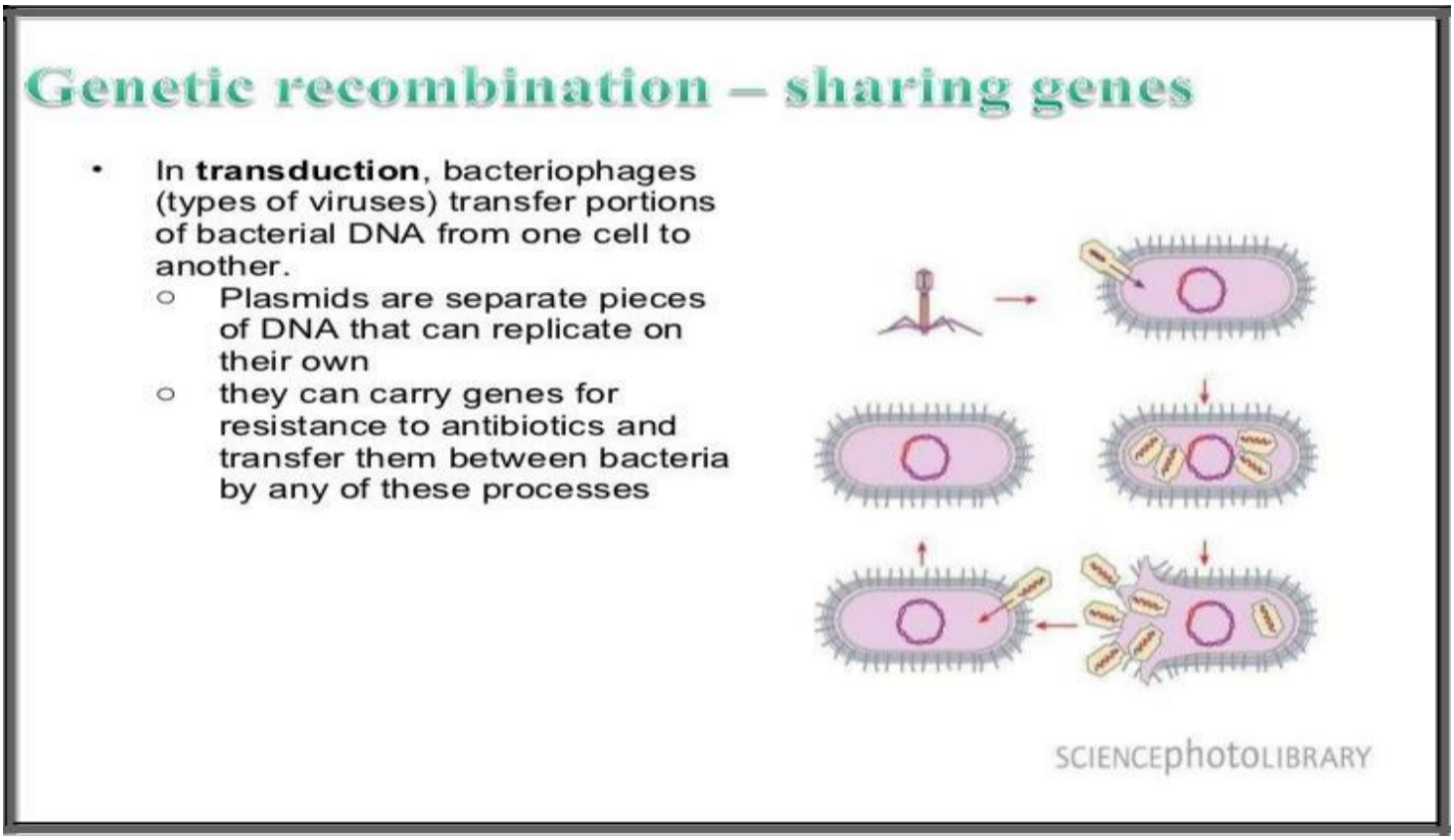
The proteins molecules are arranged as globules floating like icebergs at or near the inner and outer surfaces of the membrane. Some globules extend from one surface of the membrane to the other. This model of the membrane, called the fluid mosaic model.

This molecule accounts for the membrane's appearance under the electron microscope and helps how it allows passage of certain substances.

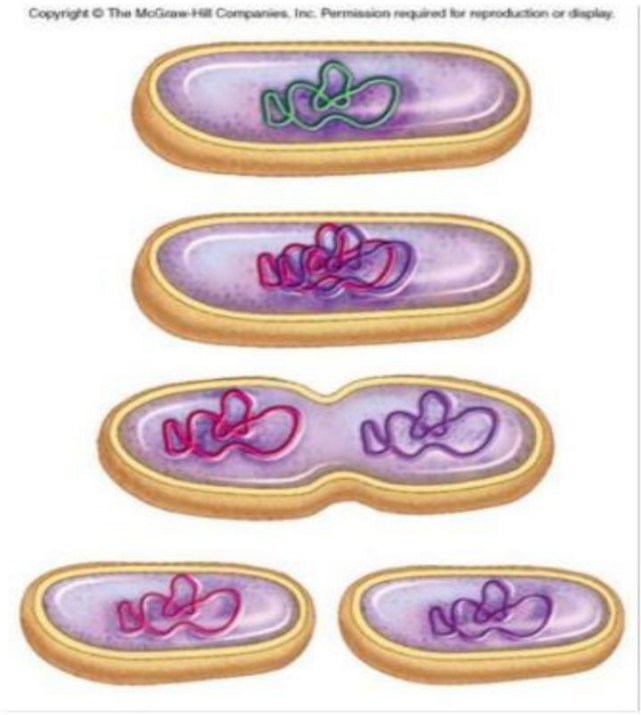
Movement of Molecules Across the Cell Membrane:

1- Lipid-soluble molecules dissolve in the phospholipids layer and pass through the membrane.

2- Acids and nitrogenous bases, which do not dissolve in lipids, move through protein passageways.

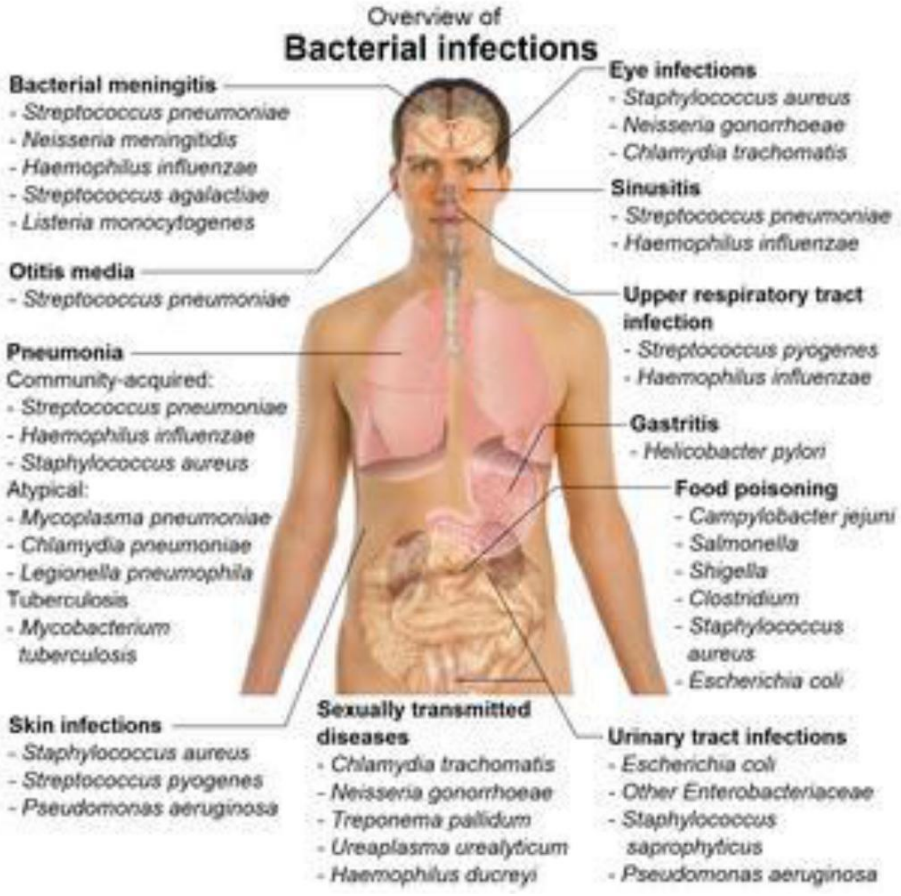


II. Reproduction in Prokaryotes



Binary fission is the splitting of a parent cell into two daughter cells; it is asexual reproduction in prokaryotes.

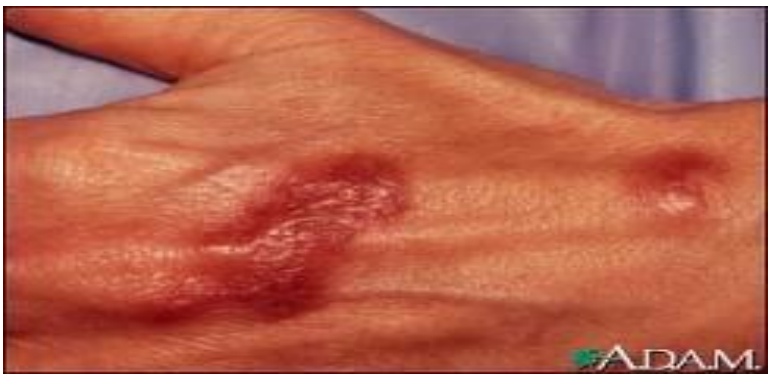
DNA makes a copy of itself, then cell splits

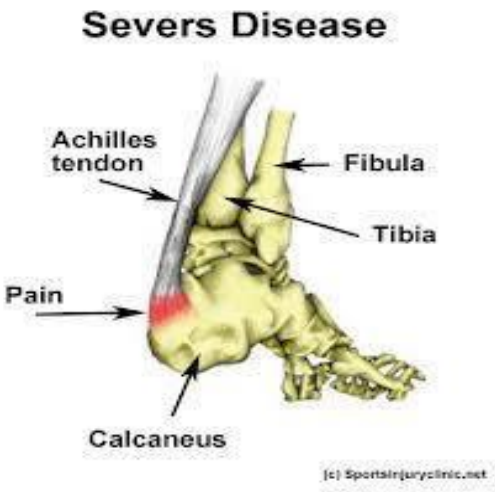


INFECTION AND DISEASE

The Host-Parasite Relationship

Infection





It is the relationship between two organisms, the host and the parasite, and the competition for supremacy that takes place between them.

A host whose resistance is strong remains healthy and the parasite is either driven from the host or assumes a benign relationship with the host. By contrast, if the host loses the competition, disease develops

Disease:

Disease may be conceptualized as any change from the general state of good health .

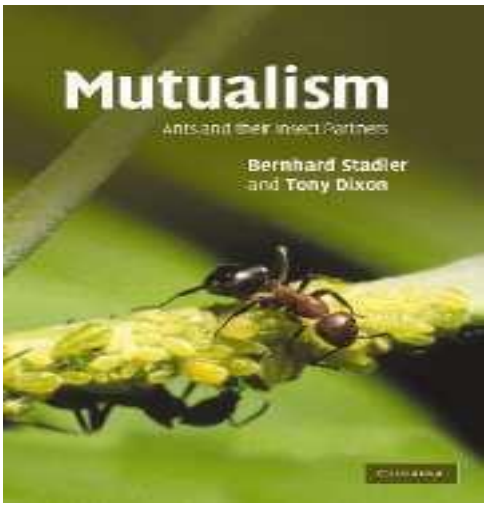
It is important to note that disease and infection are not synonymous; a person may be infected without becoming diseased.

The Normal Flora

The normal flora is a population of microorganisms that infect the body without causing disease.

The relationship between the body and its normal flora is an example of a symbiosis.

Mutualism:



In some cases the symbiosis is beneficial to both the body and the microorganisms. This relationship is called mutualism.

Species of Lactobacillus live in the human vagina and derive nutrients from the environment while producing acid to prevent the overgrowth of other organisms.

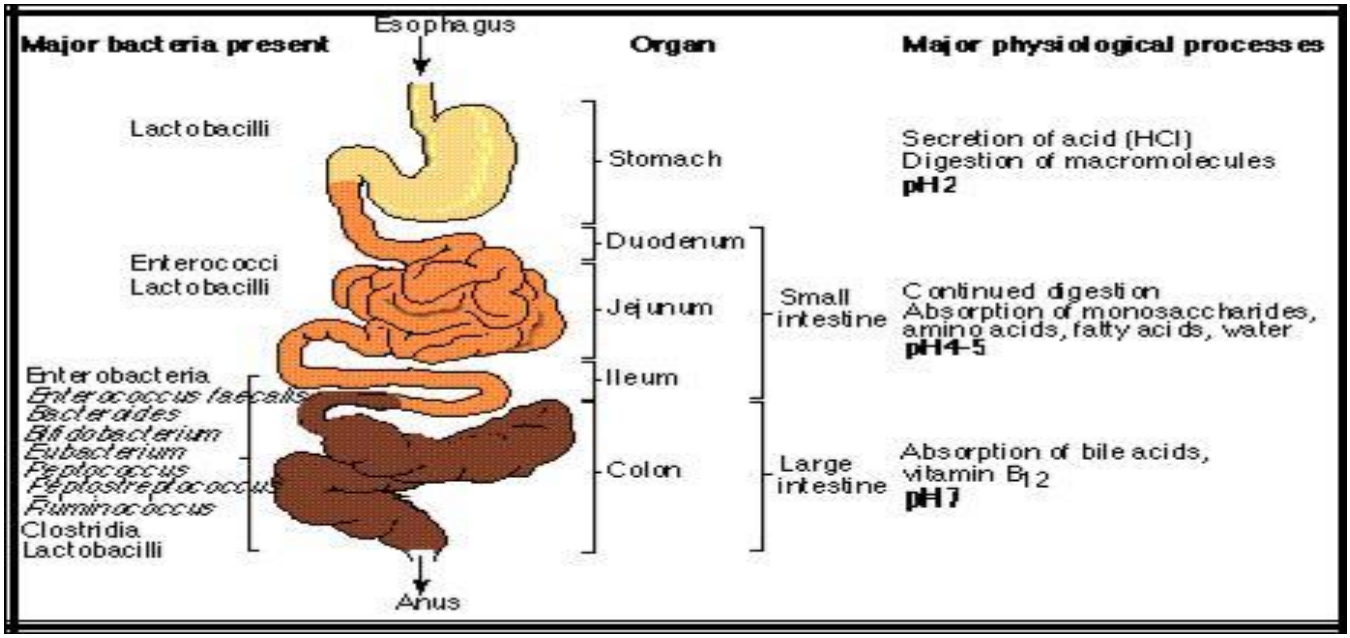
Commensalism:

In some cases, the symbiosis is beneficial only to the microorganisms, in which case the symbiosis is called commensalism. Escherichia coli is generally pre sumed to be a commensal in the human intestine.

Symbiotic Relationships

Relationship	Definition	Examples
Commensalism	Only the bacteria benefit; Human host not harmed	*Corynebacterium* species *Mycobacterium* species
Mutualism	Both the bacteria and human host benefit	*E. coli* species in large intestine
Parasitism	Only the bacteria benefit; Human host harmed	Pathogenic bacteria

Occurrence of Normal Flora



A normal flora may be found in several body tissues.

1-Skin:

On the skin, for instance, there are various forms of viruses, fungi, and bacteria, particularly staphylococci and Propionibacterium acnes.

2-Oral Cavity:

The oral cavity commonly contains members of the genera Neisseria, Leptotrichia, and Bacteroides, as well as many diphtherialike bacilli (diphtheroids), fungal spores, and streptococci.

3-Respiratory Tract:

The upper respiratory tract is the site of all these organisms, as well as pneumococci and species of Haemophilus and Mycoplasnia. These organisms may cause respira. tory disease if the body defenses are compromised.

4-Small and Large Intestine:

Later part of the small Intestine and the large intestine abound with microorganisms. Bacteroide species are numerous, together with Clostridium spores, various streptococci, and a number of

Gram-negative rods including species of Enterobacter, Kiebsiella, Proteus, and Pseudomonas. Escherichia coli is a well-known resident of the intestine, as is Candida albicans, the yeast.

5-Vagina:

In females, Lactobacillus is a notable component of the vagina; other organisms may be located near the urogenital orifices in both males and females.

6-Blood and Urine:

The blood and urine are usually sterile unless disease is in progress.

7-Stomach:

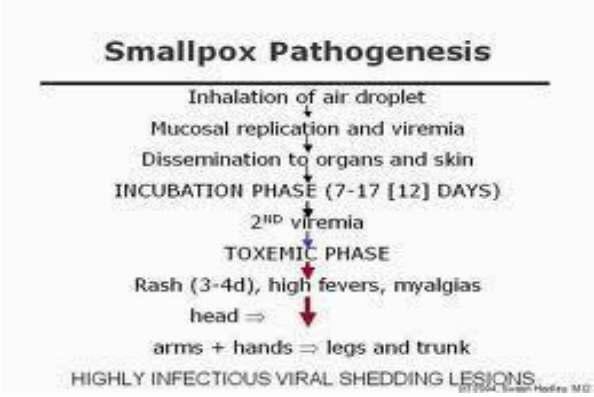
The stomach in humans is generally without a normal flora mainly due to the low pH of its contents.

Introduction of Normal Flora in the Neonates:

Organisms of the normal flora are introduced when the child passes through the birth canal. Additional organisms enter when breathing begins and upon first feeding. Within two to three days most organisms of the flora have appeared. During the next few weeks, contact with the mother and other individuals will expose the child to additional microorganisms. The normal flora remains throughout life, undergoing changes in response to the internal envi ronment of the individual.

Pathogenicity

Pathogeniclty refers to the ability of a parasite to gain entry to the host's tissues and bring about a physiological or anatomical change resulting in a change of health and thus disease.



Pathogen:

An organism having pathogenicity. The symbiotic relationship between host and parasite is called parasitism.

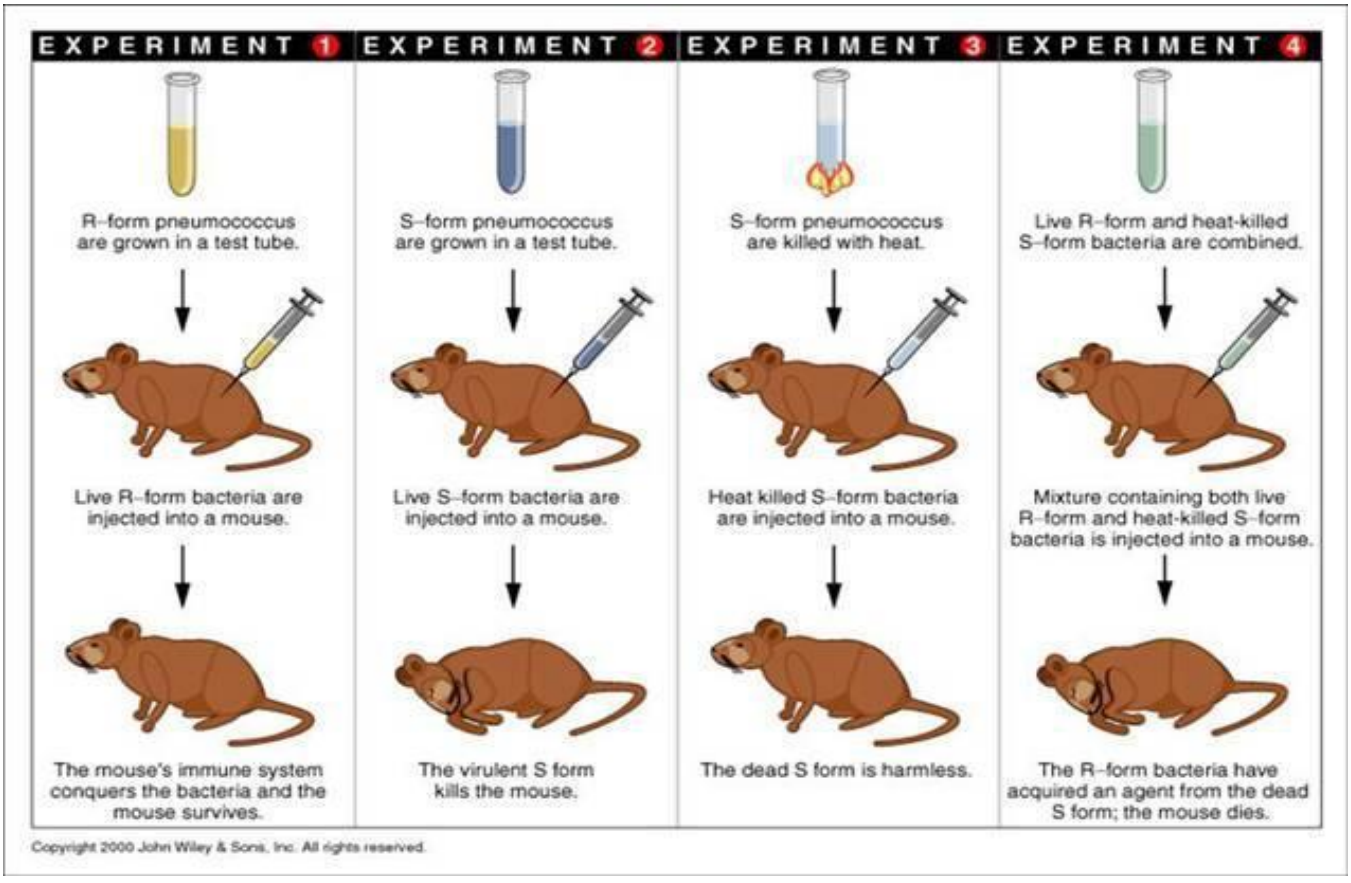
Parasites vary greatly in their pathogenicity.

Virulency:

The word virulence is used to express the degree of pathogenicity of a parasite.

Virulent:

An organism such as the typhoid bacillus that invariably causes disease is said to be highly virulent. Parasites of cholera, plague, and typhoid bacilli are well known for their ability to cause serious human diseases.



Moderately Virulent :

Organism such as Candida albicans that sometimes causes disease is labeled “moderately virulent.”

Avirulent:

Certain organisms described as avirulent, are not regarded as disease agents. The lactobacilli and streptococci found in yogurt are examples.

Opportunistic:

Certain commensals become parasites when the body’s normal defenses are suppressed. They invade the tissues and express their pathogenicity.