Dentistry college - first class
Medical biology- Lec.2
Lecturer – D. Hanan S.

Kingdom of Monera

The prokaryotes full into two major groups ; bacteria and archaeabacteria but most investigation have been directed into one group bacteria because many of archaebacteria representative are difficult to study in laboratory .

Bacteria (singular : bacterium) are large group of unicellular microorganism microscopic in size typically a few micrometers varies between 0.5 – 5 µm in length and 0.2 - 2 µm in width., have many different shapes and widespread on earth . The name of bacteria was derived from the Greek "bakt rion" , meaning small staff . A branch of microbiology interested with study of bacteria is called bacteriology.

History

Bacteria were first observed by Antoine Van Leeuwenhoek in 1676. using a single- lens microscope of his own design , he called them "animalcules". Louis Pasteur demonstrated in 1859 the fermentation process caused by growth of microorganism and this growth is not due to spontaneous generation . Robert Koch , was proved the germ theory and in 1910 Paul Ehrlich developed the first antibiotic by using dyes to stained *Treponema palliadium* a spirochetes that causes syphilis disease which result in killed this pathogen , with his work being the basis of the Gram stain later.

General characters of bacteria

1-Bacteria are microscopic, unicellular organisms and multiply by binary fission.

2-They live every where in nature in water (fresh ,salty) soil and air.

3-Some types live as saprophytes while others are parasites on plants , animals and human causing diseases .

4-They can form spores which are resistant to harsh condition like heat, rays ,temperature and dryness .

5- Pathogenic bacteria are only a small proportion but many of bacteria are positively useful of human for example some of them producing antibiotics like erythromycin and tetracycline others used as microbial insecticides protecting crops from certain insects pests. Some bacteria contribute a lot of food industry for example in the manufacture of butter , cheese and yoghurt by using certain bacteria to convert milk sugar lactose to lactic acid as will as the vinegar is produced from ethanol by bacteria action in addition to helping in kept the balance of ecosystem .

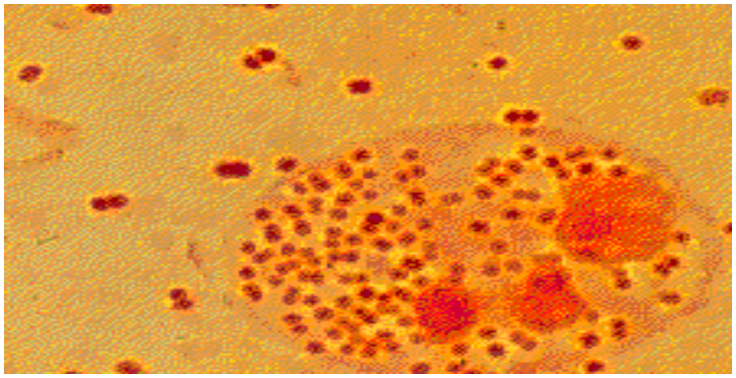
Morphology of bacteria

Morphology of bacterial cell are not always constant on contrary to higher organisms because it affected by many factors such as composition of media , temperature of incubation and pH values etc., so, the description of bacteria usually restricted to young actively growing cultures under the optimum conditions of growth but old cultures might show diverted characters of the organism.

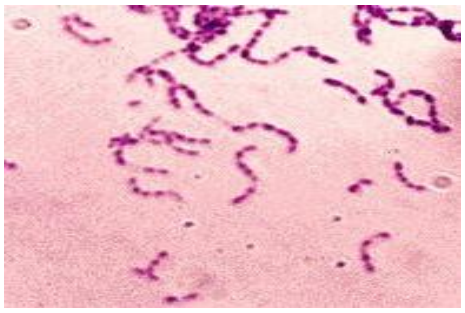
Viewed under the light microscope , most bacteria appear in variations of four different shapes :

1- Spherical bacteria (cocci)

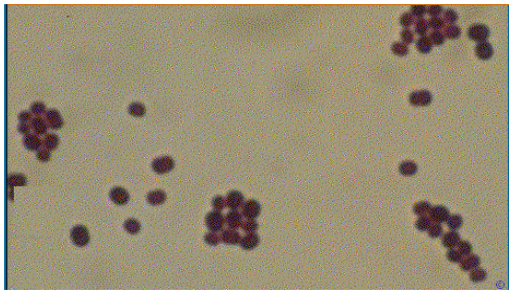
Cocci (coccus) a term derived from Greek (Kokkos) , they are usually round but they may be oval elongated have several groups arranged according to the manner in which the resulting cells attaches together after division such as pairs for example *Neisseria* sp.

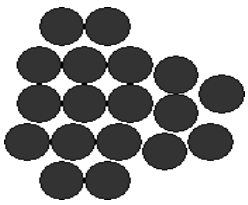


Or chains like *Streptococcus sp.*



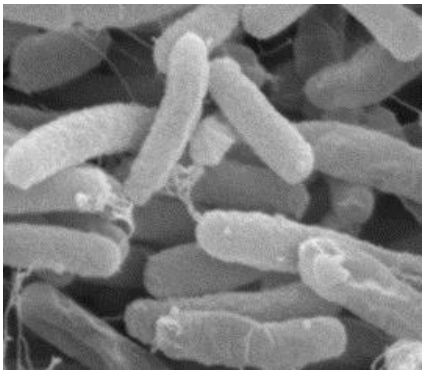
Or clusters such as Grape like irregular clusters ex. *Staphylococcus*



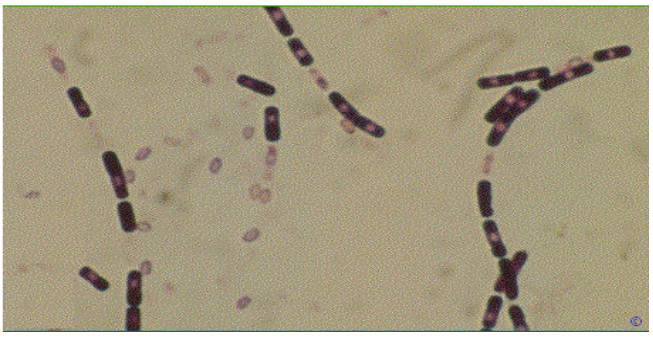


2 - Rod shape (Bacilli)

The shape of cells like rod or bacilli on the base of cell arrangement for example Bacilli *like E. coli , Salmonella*



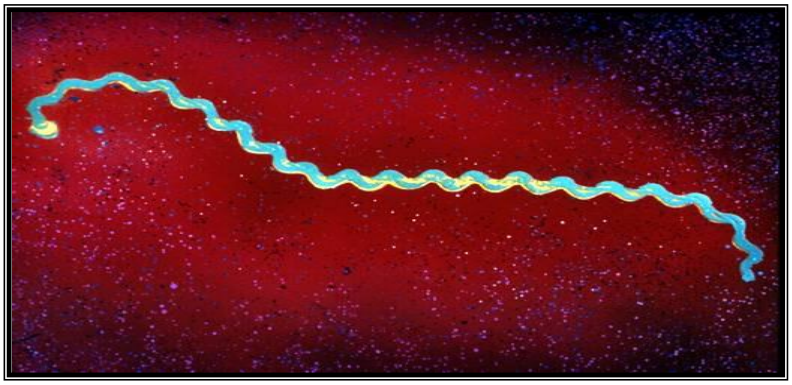
Or Streptobacilli ex. *Bacillus anthrax*



Or Coma shaped bacilli like *Vibrio cholera*

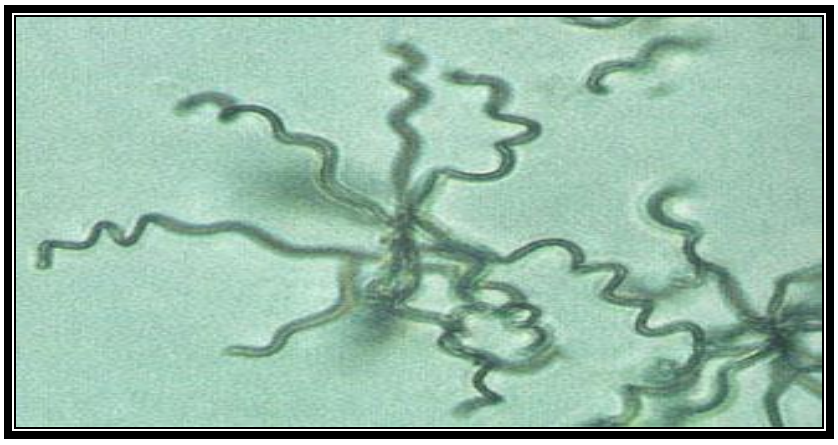
3- Spirilla

Have a corkscrew shape with rigid cell wall and hair like projections called flagellum that assistant movement Ex. *Treponema , Spirochete* .



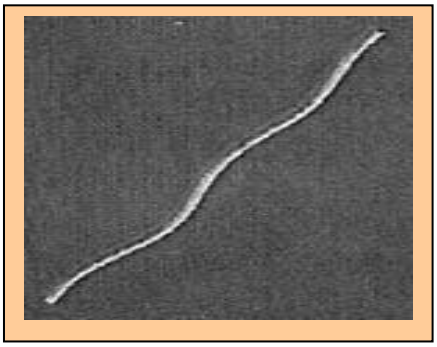
4 - Filamentous bacteria

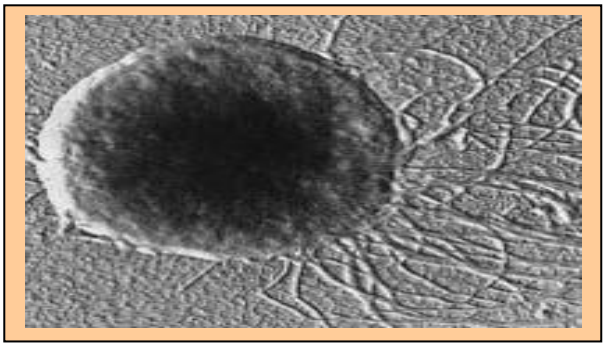
The body of this type consist of mycelium which resembles a mass of branched thin non – septate hyphae similar to that of fungi such as *Actinomycetes* as seen in figure below .

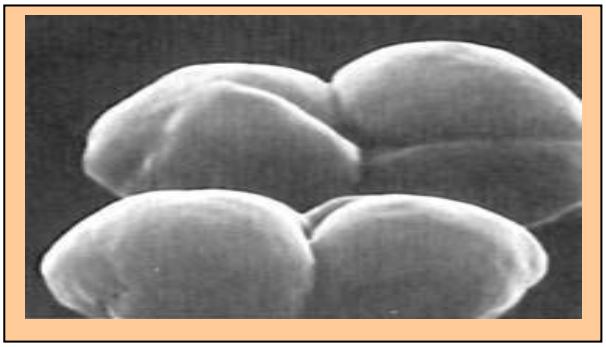


Archaeabacteria

it's a tiny prokaryotic cells like bacteria , usually less then one micron long Fortunately, the electron microscope can magnify even these tiny microbes enough to distinguish their physical features. The archaeal shapes are quite diverse , some are spherical, a form known as coccus, and these may be perfectly round or lobed and lumpy. Some are rod-shaped, a form known as bacillus, and range from short bar-shaped rods to long slender hair-like forms. Some oddball species have been discovered with a triangular shape, or even a square shape like a postage stamp .







Archaea may have one or more flagella attached to them, or may lack flagella. The flagella are hair-like appendages used for moving around, and are attached directly into the outer membrane of the cell. Like bacteria, archaeans have no internal membranes . As with other living things, archaeal cells have an outer cell membrane that serves as a barrier between the cell and its environment. Within the membrane is the cytoplasm, where the living functions of the archean take place and where the DNA is located. Around the outside of nearly all archaeal cells is a cell wall, a semi-rigid layer that helps the cell maintain its shape and chemical equilibrium. All three of these regions may be distinguished in the cells of bacteria and most other living things, but when you take a closer look at each region, you find that the similarities are merely structural, not chemical , for instance the cell walls of all bacteria contain the chemical peptidoglycan.

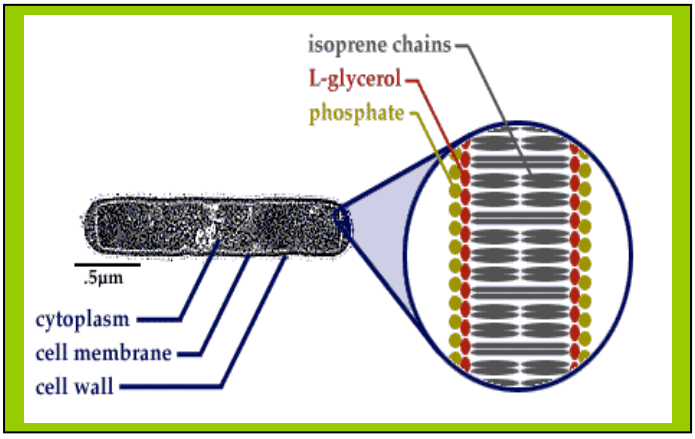


Fig. Basic archaeal structure

Prokaryotes and Eukaryotes

There are fundamental differences in eukaryotic and prokaryotic cell structure and gene expression; the defining difference is the presence of a nuclear membrane surrounding the genetic material of eukaryotes, but not prokaryotes , below there are a Comparison of eukaryotic and prokaryotic cells:

Characteristic	Prokaryotes Bacteria	Eukaryote	
		Animal	Plant
nuclear membrane	no	yes	yes
plasma membrane	yes	yes	yes
cell wall	yes	no	yes
ribosome	yes	yes	yes
endoplasmic reticulum	no	yes	yes
Golgi complex	no	yes	yes
lysosomes	no	yes	yes
peroxisomes	no	yes	yes
nucleolus	no	yes	yes
mitochondria	no	yes	yes
chloroplasts	no	no	yes
cilia/flagella	yes	yes	no
microtubules	no	yes	yes
actins filaments	no	yes	yes
chromosome	single	multiple	multiple

The microscope

Microbiology usually is concerned with organisms so small they can not be seen distinctly with naked eyes but under microscope , so , it is an important to understand the types and how the microscope works.

A- Compound light microscope

several types of light microscope are commonly used in the Lab. :

1-*The bright – field microscope*

The ordinary microscope is called bright – field microscope because it forms a dark image against a brighter background , it is consist of two series of lenses objective and ocular lenses which function together to resolve the image (fig.) . The resolving power : is the distance that must separate two point sources of light if they are to be seen as two distinct image .With this microscope , specimens are render visible because of the differences in contrast between them and the surrounding medium ,dyes can be used to stain cells or their organelles and increase their contrast so, they can be easily seen in this microscope . This microscope generally employ a 100- power objective lens with a 10- power ocular lens , thus magnifying the specimen 1000 times .

1 millimeter (1mm) = 1000 micrometer
1µm =10.000 angstrom (A◦)
1nm =10 A◦

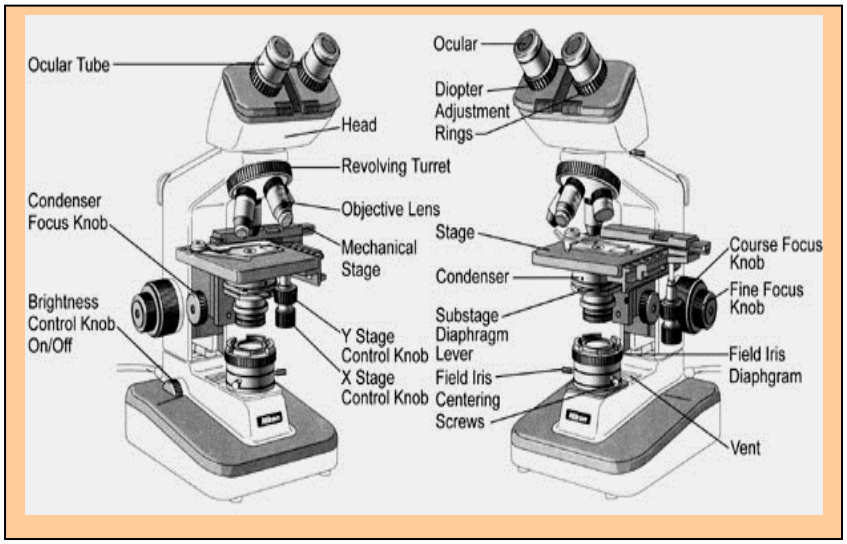


Fig. : The bright – field microscope

2-*Dark – field microscope*

It is an ordinary microscope to which a special condenser is attached , the condenser serves to intensify illumination of the examined specimen through narrow area , this creates a " dark field" that contrasts against the high light edge of the specimens and results when the oblique rays are reflected from the edge of the specimen upward into the objective of the microscope .This technique has been useful for observing organisms such as *Treponema palladium* a spirochetes which is less than 0.2 µm in diameter .

3- *Phase- contrast microscope*

It is an ordinary microscope in which modified objective lenses and condensers are used to permit direct examination of living cells without fixation or staining, this microscope takes advantage of the fact that light waves passing through transparent objects such as cells emerge in different phases depending on the properties of the materials through which they pass .

4- *Fluorescence* microscope

The fluorescence microscope is used to visualize specimens that fluoresce , which is the ability to absorb short wavelengths of light (ultraviolet) and give off light at a longer wavelength (visible) .

The principle use of this microscope is a diagnostic technique called the fluorescent – antibody (FA) for example Ab . to bacteria *Legionella* are chemically labeled with a flurochrome and then added to microscope slide containing a clinical specimen , if the specimen contains *Legionella,* the fluorescent- Ab. will bind to Ags., on the surface of the bacterium , causing it to fluoresce when exposed to ultraviolet light .

B- The Electron microscope

The high resolving power of the electron microscope has enabled scientists to observe the minute details structures of prokaryote and eukaryote cells .The superior resolution of the electron microscope is due to the fact that electrons have a much shorter wavelength than photons of wavelength .

There are two types of electron microscope :

1- Transmission electron microscope (TEM)

It is a first to be developed that employs a beam of electrons projected from an electron gun directed and focused by an electromagnetic condenser lens on a thin specimen , as the electron strike the specimen they are differentially scattered by a number and mass of atoms in the specimens , some electron pass through the specimen , gathered and focused by an electromagnetic objective lens . TEM can resolve particles 0.001µm apart , viruses with diameter 0.01 -0.2 µm can be easily resolved .

2- Scanning electron microscope (SEM)

SEM is generally has a lower resolving power than TEM , however , it is particularly useful for providing three – dimensional images of the surface of microscope objects , it can resolve features as small as 5nm.The interaction of electrons with the specimens results in release of different forms of radiation eg. secondary electrons from the surface of the material , which can be captured by an appropriate detector , amplified and then imaged an a television screen .