CLASS - XI BIOLOGY - STUDY MATERIAL ON CHAPTER – 2

BIOLOGICAL CLASSIFICATION

Human beings have been classifying the organisms scientifically for their study purpose as well as non-scientifically like on the basis of need for food, clothes and shelter.

Aristotle was the first who gave more scientific view for classification. He classified plants into trees, shrubs and herbs on the basis of morphological characters. He also divided animals into two groups, those which had red blood and those that did not.

In Linnaeus' time a Two Kingdom system of classification with Plantae and Animalia kingdoms was developed that included all plants and animals respectively.

Drawbacks of 2 – Kingdom system:

- ✓ did not distinguish between the eukaryotes and prokaryotes.
- ✓ unicellular and multicellular organisms.
- ✓ photosynthetic (green algae) and non-photosynthetic (fungi) organisms.

Classification of organisms into plants and animals was easily done and was easy to understand, but, a large number of organisms did not fall into either category. Hence the two-kingdom classification used for a long time was found inadequate.

Besides, gross morphology a need was also felt for including other characteristics like cell structure, nature of wall, mode of nutrition, habitat, methods of reproduction, evolutionary relationships, etc. Classification systems for the living organisms have hence, undergone several changes over the time. Though plant and animal kingdoms have been a constant under all different systems, the understanding of what groups/organisms be included under these kingdoms have been changing; the number and nature of other kingdoms have also been understood differently by different scientists over the time.

- ❖ Earlier classification systems included bacteria, blue green algae, fungi, mosses, ferns, gymnosperms and the angiosperms under 'Plants' on the basis of cell wall in their cells.
- ❖ This placed together groups which widely differed in other characteristics.
- ❖ It brought together the prokaryotic bacteria and the blue green algae (cyanobacteria) with other groups which were eukaryotic.
- ❖ It also grouped together the unicellular organisms and the multicellular ones, say, for example, Chlamydomonas and Spirogyra were placed together under algae.
- ❖ The classification did not differentiate between the heterotrophic group – fungi, and the autotrophic green plants, though they also showed a characteristic difference in their walls composition – the fungi had chitin in their walls while the green plants had a cellulosic cell wall.
- ❖ When such characteristics were considered, the fungi were placed in a separate kingdom – Kingdom Fungi.
- ❖ All prokaryotic organisms were grouped together under Kingdom Monera and the unicellular eukaryotic organisms were placed in Kingdom Protista.
- ❖ Kingdom Protista has brought together Chlamydomonas, Chlorella (earlier placed in Algae within Plants and both having cell walls) with Paramoecium and Amoeba (which were earlier placed in the animal kingdom which lack cell wall).
- ❖ It has put together organisms which, in earlier classifications, were placed in different kingdoms.
- ❖ This happened because the criteria for classification changed.

- This kind of changes will take place in future too depending on the improvement in our understanding of characteristics and evolutionary relationships. Over time, an attempt has been made to evolve a classification system which reflects not only the morphological, physiological and reproductive similarities, but is also phylogenetic, i.e., is based on evolutionary relationships.

Ernst Haeckel (1860) introduced – 3 Kingdom system, Protista was added as 3rd kingdom in which all eukaryotic unicellular organisms were placed.

Herbert Copeland (1956) introduced – 4 Kingdom system, Monera was added as 4th kingdom in which all prokaryotic organisms were placed.

R H Whittaker (1969) separated Fungi from plantae kingdom and considered as a 5th kingdom.

Carl Woese proposed The three-domain system has also been proposed that divides the Kingdom Monera into two domains Archaebacteria and Eubacteria, leaving the remaining eukaryotic kingdoms in the third domain and thereby a six kingdom classification.

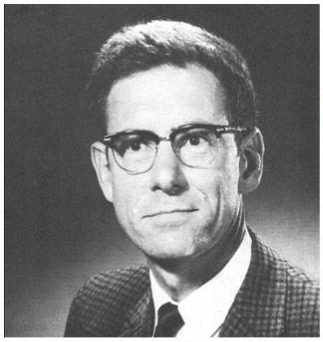
Cavalier Smith introduced 7th Kingdom as Chromista for some photosynthetic protists.

R.H. Whittaker (1969) proposed a Five Kingdom Classification (The most popular one).

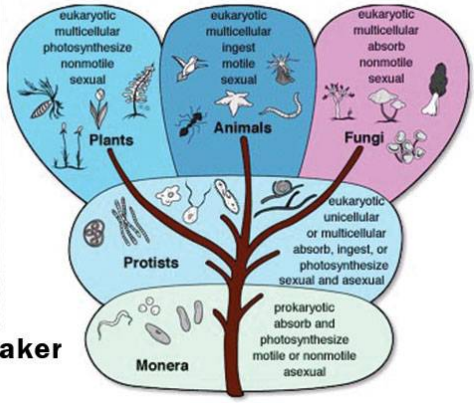
1. Monera 2. Protista 3. Fungi 4. Plantae 5. Animalia.

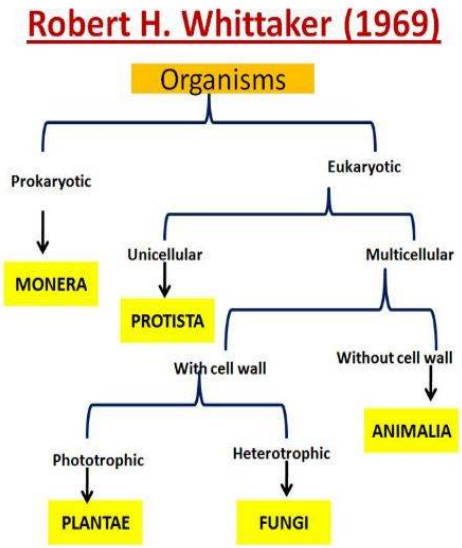
The main criteria for classification used by him include:

1. Cell structure 2. Body organisation 3. Mode of nutrition 4. Reproduction 5. Phylogenetic relationships.



Robert Harding Whittaker (1920 – 1980)



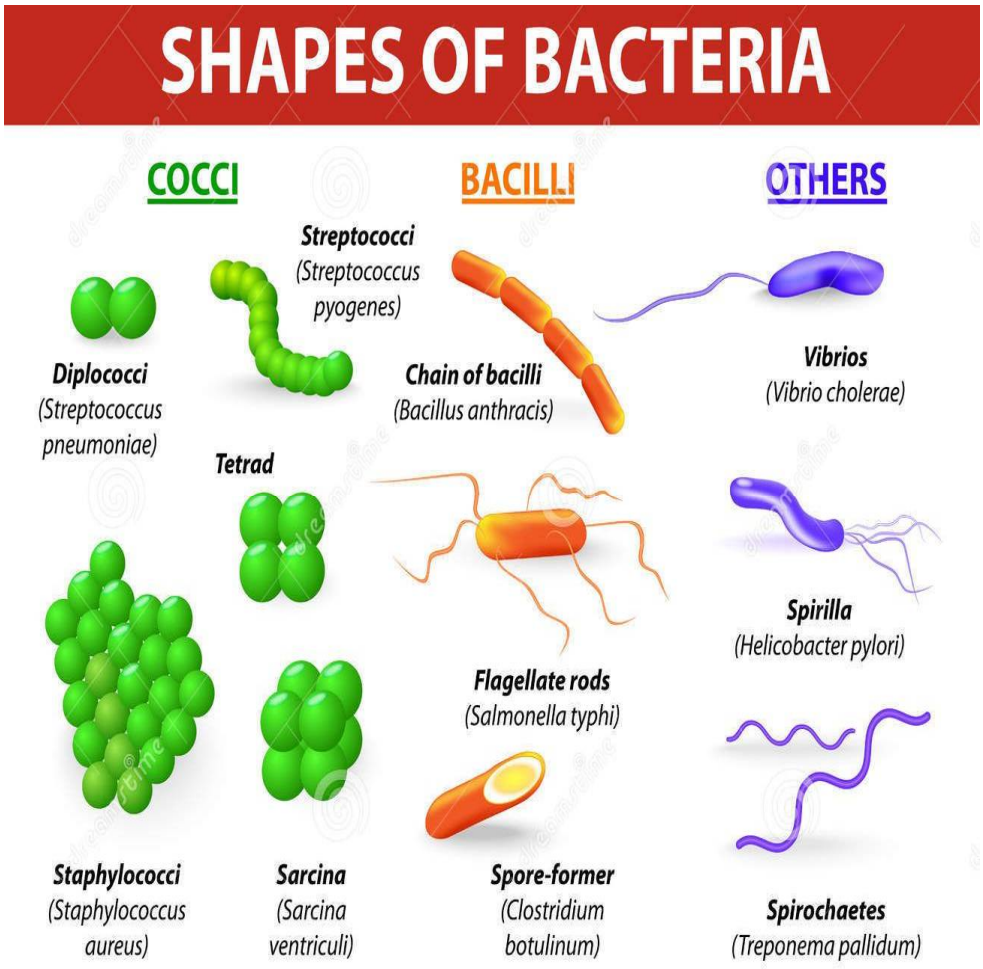


Distinguish Characteristics of the Five Kingdom of Life					
Kingdom	Cell Type	Nuclear Envelop	Cell Wall	Mode of Nutrition	Multi-Cellularity
Monera	Prokaryotic	Absent	Non-cellulose	Autotrophs or heterotroph	Absent
Protista	Eukaryotic	Present	Present in some forms	Photosynthetic or heterotroph	Absent in most forms
Fungi	Eukaryotic	Present	Chitin	Asorptive heterotroph	Present in most forms
Plantae	Eukaryotic	Present	Cellulose and polysaccharides	photosynthetic	Present in all forms
Animalia	Eukaryotic	Present	Absent	Ingestive heterotroph	Present in all forms

Kingdom	Monera	Protista	Fungi	Plantae	Animalia
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell organization	unicellular	unicellular	Multicellular and unicellular	Multicellular	Multicellular
Cell Wall	Present in most	Present in some absent in others	Present	Present	Absent
Nutritional Class	Phototrophic, heterotrophicor chemoautotrophic	Heterotrophic and phototrophic	Heterotrophic	Phototrophic	Heterotrophic
Mode of nutrition	Absorptive	Absorptive or ingestive	Absorptive	Mostly Absorptive	Mostly ingestive

KINGDOM MONERA includes Bacteria which are found everywhere. Hundreds of bacteria are present in a handful of soil, a drop of water, air and also in extreme habitats such as hot springs, deserts, snow and deep oceans where very few other life forms can survive. Many of them live in or on other organisms as parasites.

Bacteria are grouped under four categories based on their shape: the spherical Coccus (pl.: cocci), the rod-shaped Bacillus (pl.: bacilli), the comma-shaped Vibrium (pl.: vibrio) and the spiral Spirillum (pl.: spirilla)



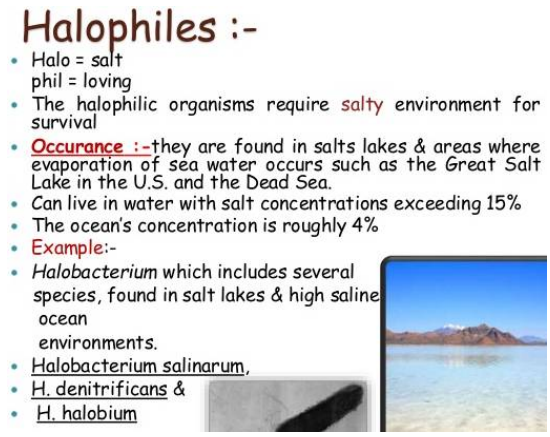
Though the bacterial structure is very simple, they are very complex in behaviour. Compared to many other organisms, bacteria as a group show the most extensive metabolic diversity.

Some of the bacteria are autotrophic, i.e., they synthesise their own food from inorganic substrates. They may be photosynthetic autotrophic or chemosynthetic autotrophic. The vast majority of bacteria are heterotrophs, i.e., they depend on other organisms or on dead organic matter for food.

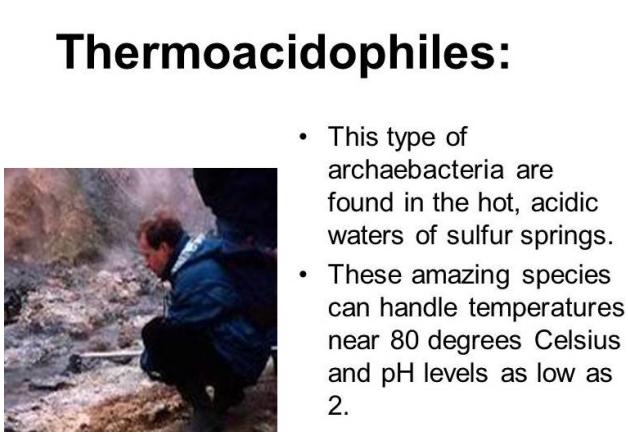
Archaebacteria

These bacteria are special since they live in some of the most harsh habitats such as:

1. Extreme salty areas (halophiles)



2. Hot springs (thermoacidophiles)

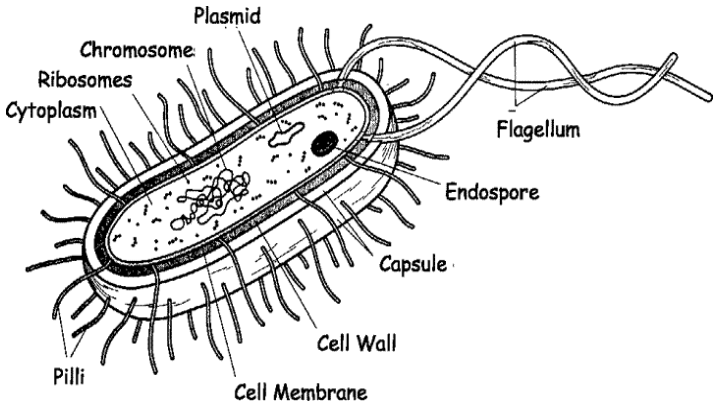


3. Marshy areas (methanogens).

Methanogens are present in the gut of several ruminant animals such as cows and buffaloes and they are responsible for the production of methane (biogas) from the dung of these animals.

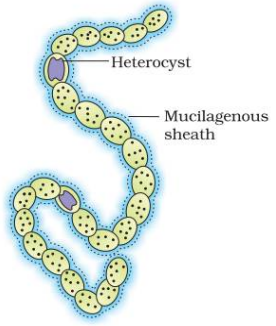
Archaebacteria differ from other bacteria in having a different cell wall structure and this feature is responsible for their survival in extreme conditions.

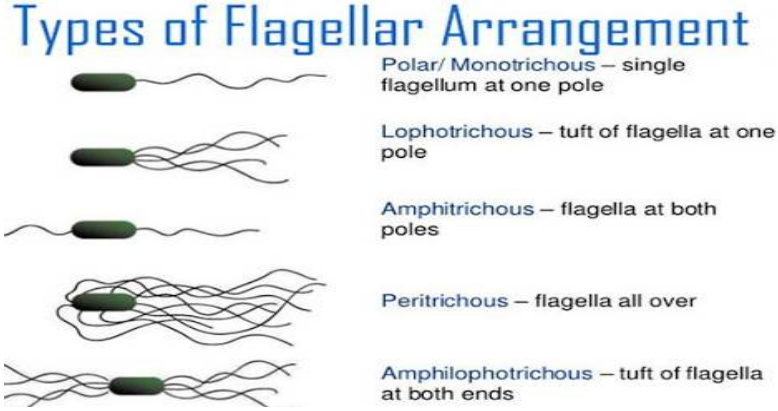
Eubacteria



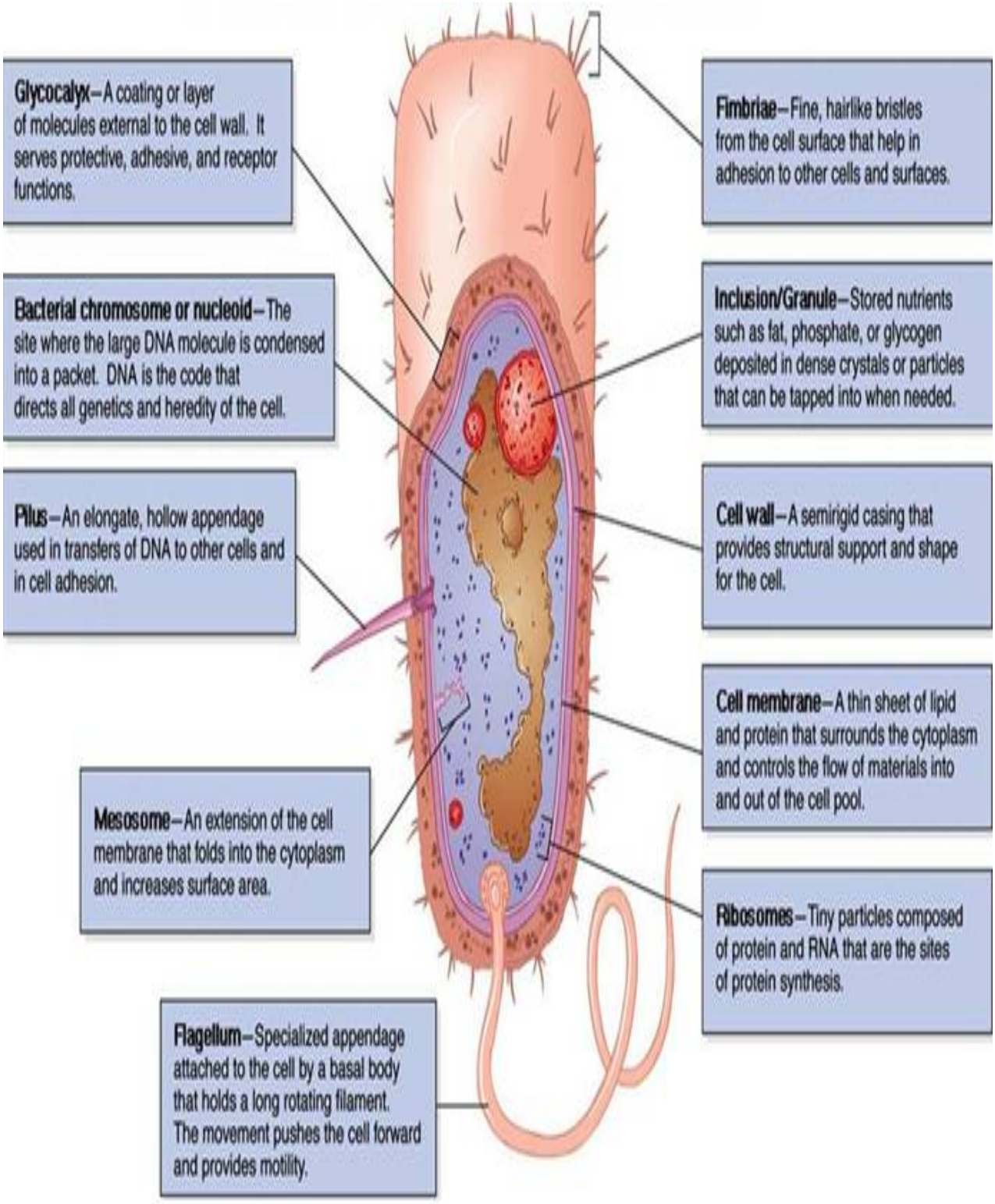
There are thousands of different eubacteria or 'true bacteria'. They are characterised by the presence of a rigid cell wall, and if motile, a flagellum or many flagella.

The cyanobacteria (also referred to as blue-green algae) have chlorophyll-a similar to green plants and are photosynthetic autotrophs. The cyanobacteria are unicellular, colonial or filamentous, freshwater/marine or terrestrial algae. The colonies are generally surrounded by gelatinous sheath. They often form blooms in polluted water bodies. Some of these organisms can fix atmospheric nitrogen in specialised cells called heterocysts (for Nitrogen fixation to maintain anaerobic environment) e.g., Nostoc and Anabaena.





Chemosynthetic autotrophic bacteria oxidise various inorganic substances such as nitrates, nitrites and ammonia and use the released energy for their ATP production. They play a great role in recycling nutrients like nitrogen, phosphorous, iron and sulphur.



terotrophic bacteria are most abundant in nature. The majority are important decomposers. Many of them have a significant impact on human affairs. They are helpful in making curd from milk (Lactobacillus), production of antibiotics like Neomycin obtained from *Streptomyces fradiae* used as Broad spectrum, Streptomycin obtained from *Streptomyces griseus* used against Gram-negative bacteria and Tetracycline obtained from *Streptomyces rimosus* against Broad spectrum, fixing nitrogen like *Rhizobium* in legume roots, etc.

Some are pathogens causing damage to human beings, crops, farm animals and pets.

Cholera (caused by *Vibrio cholerae)*

Pneumonia (caused by *Streptococcus pneumoniae, Haemophilus influenzae and Klebsiella pneumoniae)*

Typhoid *(Salmonella typhi)*

Tetanus (*Clostridium tetani)*

Diarrhoea (caused by *Salmonella and Vibrio*)

Plague (caused by *Yersinia pestis*)

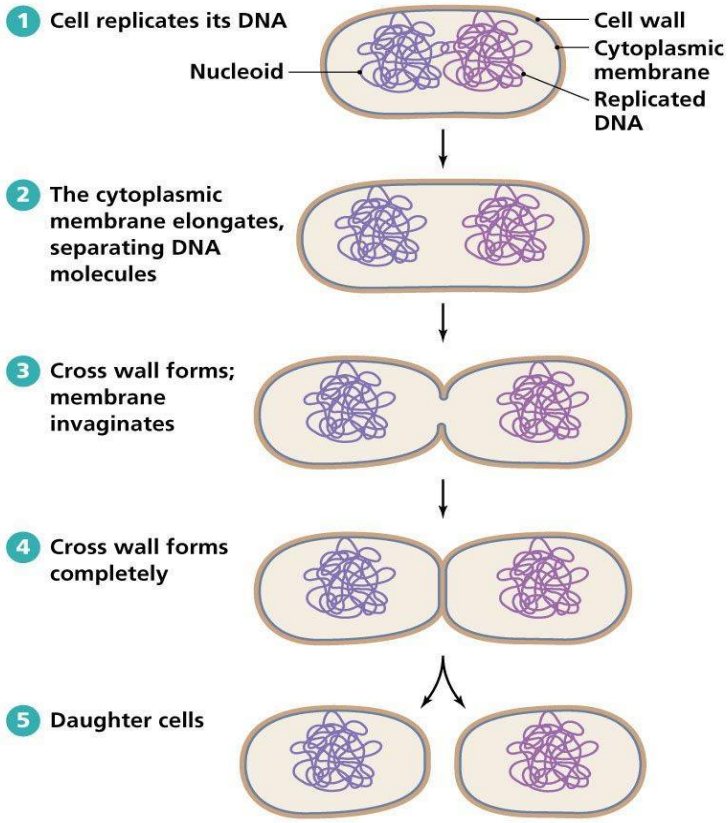
Tuberculosis (caused by *Mycobacterium tuberculosis*)

Syphilis (caused by *Treponema pallidium*)

Gonorrhoea (caused by *Neisseria gonorrhoeae*)

Citrus Canker (caused by *Xanthomonas axonopodis*) are well known diseases caused by different bacteria.

Bacteria reproduce mainly by fission.



Sometimes, under unfavourable conditions, they produce spores. They also reproduce by a sort of sexual reproduction by adopting a primitive type of DNA transfer from one bacterium to the other. (Transformation, Transduction and Conjugation)

The Mycoplasma are organisms that completely lack a cell wall. They are the smallest living cells known and can survive without oxygen. Many mycoplasma are pathogenic in animals and plants.