AS-2969

B.Sc. (Hon's) I^st semester, Exam. -2013

Rural Technology

Diversity of Viruses, Bacteria, Cyanobacteria

SECTION - 'A'

(i) Viruses are -
(b) Acellular

(ii) TMV is : -
(a) RNA containg helical virus

(iii) Sessamum phyllody is caused by -
(c) Mycoplasma

(iv) Nitrifying bacteria convert -
(b) NH_3 into NO_3

(v) Cyanobacteria are -
(b) Oxygenic - phototrophic

(vi) Polar nodule found in -
(b) Heterocyst

(vii) Cephaleuros virescens is -
(b) Parasitic algae

(ix) Salmonella typhimurium is related with :-
(b) Transduction

(viii) Synzoospore found in :-
(a) Vaucheria

(x) Potash manufactured by :-
(a) Macrocystis

SECTION - B

(i) Classification of Viruses :-

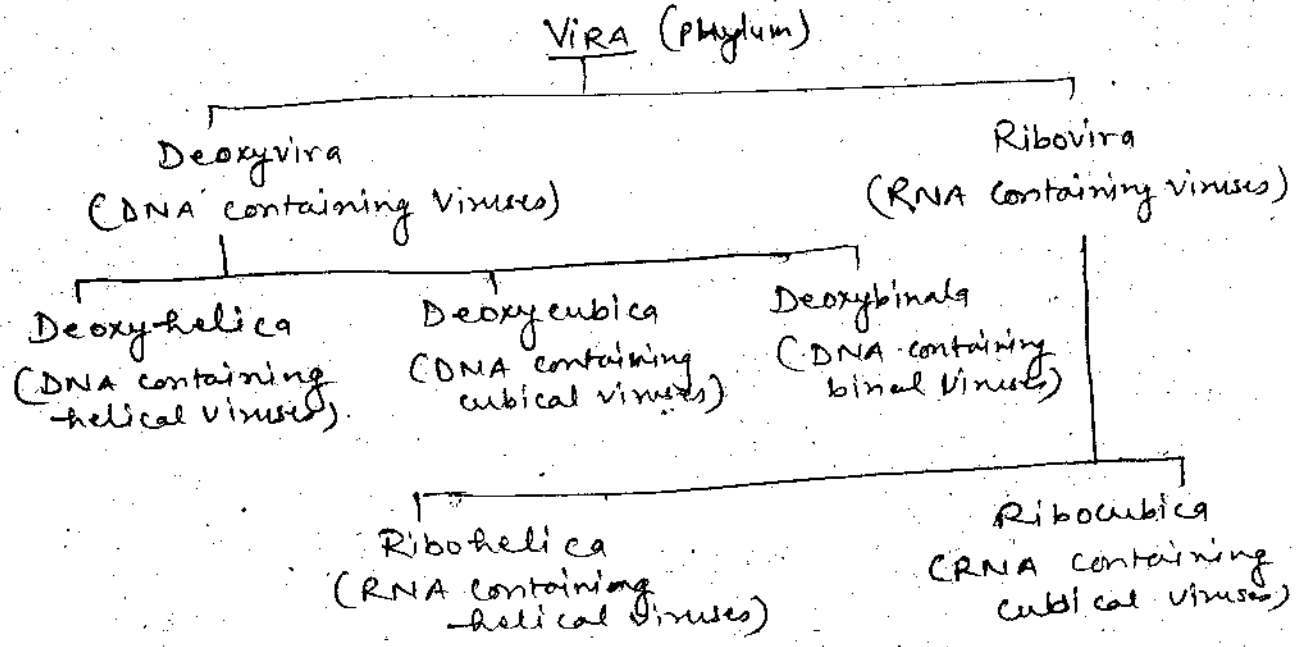
There are two general ways in which viruses may be classified. One is the classical monothetic hierarchical system applied by Linnaeus to plant and animals. This is a logical system in which divisions are made as to the relative importance of different properties which are then used to place a taxon in a particular phylum, order, family

genus etc. An alternative system proposed by Adanson (1763). He suggested that all known information should be used and that all characters should be considered equally important.

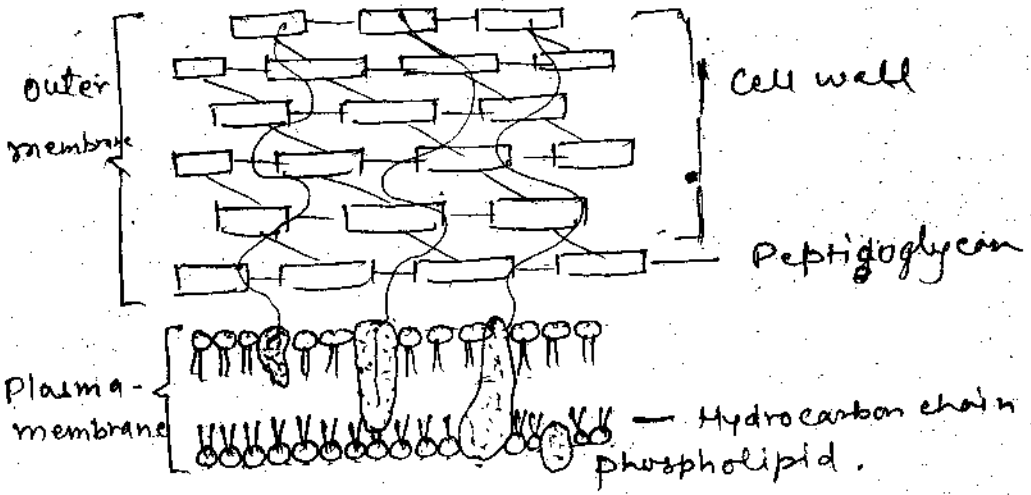
On the basis of types of host viruses may be classified as follows –

1) Plant Virus – Mostly they are RNA containing viruses depend upon plant for their multiplication.
2) Animal Viruses – Mostly DNA containg viruses attach on animal cell.
3) Bacteriophages – They complete their life cycle within the bacterial cell.

Lwoff et al (1962) proposed a system in which the kind of nucleic acid in the particle (DNA or RNA) the architecture and symmetry of the virus particles, the presence and absence of an envelope, the number of morphological subunits. –

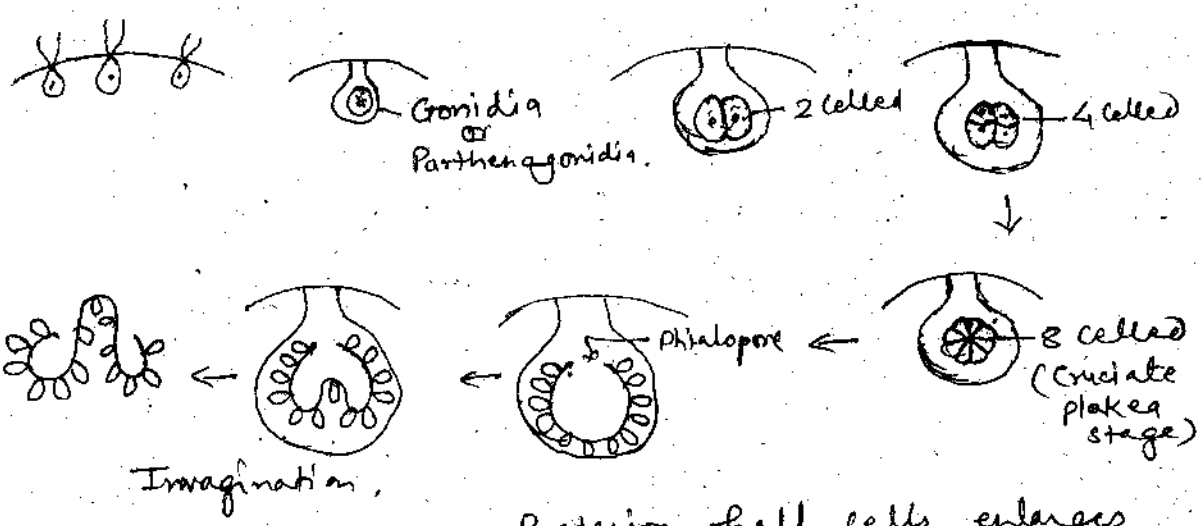


(ii) Gram +ve bacterial cell wall →



Structure of Gram positive bacterial cell wall

(iii) Asexual reproduction in volvox –

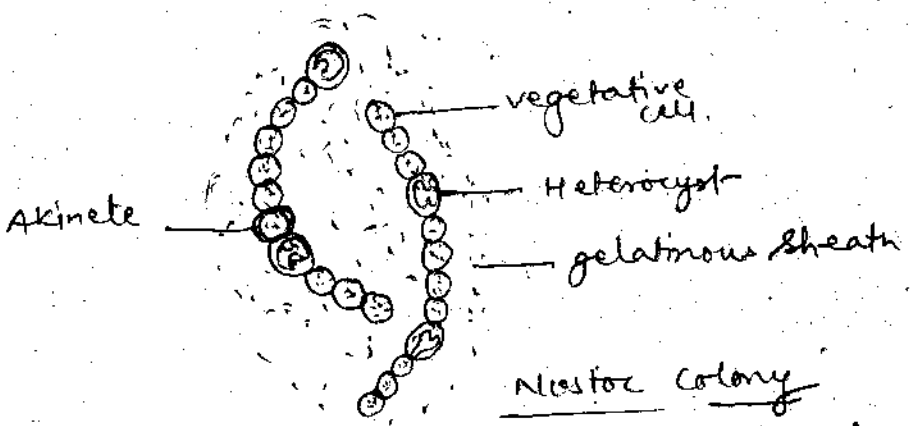


Posterior half cells enlarges in size about ten times and that of normal cell due to accumulation of more reserve food and withdraw flagella. It becomes rounded and known as Gonidia or parthenogonidia. Gonidial protoplast undergo longitudinal division to for two celled stage. After 2nd longitudinal division two celled stage form 4 celled likewise 8 celled stage is formed. Known as "cruciate plakea stage" After successive divisions hollow hemisphere is formed.

The hollow hemisphere has hole or opening called phialopore at anterior end. All the cells are arranged within periphery of the colony. Coenobium undergoes complete invagination

(iv) Characters of Nostoc –

1) Nostoc occur in fresh water ponds, pools, puddles and ditches, they are found in the form of mucilaginous masses free floating or attached among the grasses or other aquatic plants growing in the ponds.
2) Some species are found in the damp soil, some are on the wet bark of trees.
3) Filaments are found embedded in the mucilaginous envelope.
4) Each thread possesses many spherical cells and it becomes moniliform in appearance.
5) Each thread (Trichome) ensheathed by a gelatinous sheath.
6) The structure of cell is typical cyanophycean possessing chromo- and centroplasm.



Nostoc colony

(7) Each trichome has special type of cell known as heterocyst cell. Heterocyst is responsible for N_2 fixation.

(8) Reproduction takes place by following means –

(1) By Hormogonia → In favourable conditions the filament break in small pieces called the hormogone.

Each hormogone consists of 4 to 6 cells. Each hormogone is capable to give rise to a new filament.

2) Akinete - The akinetes are produced in mature colonies. They are formed in unfavourable conditions. The akinetes are developed in between the heterocyst of the filament. Each cell develops into a single akinete

(V) (a) Algae used as food and fodder —

More than 70 species of algae which are mostly brown or red algae are being used as food. People of China and Japan have long been using sea weeds as food e.g. Porphyra, Ulva, Chlorella, Chondrus, Nostoc are used in making soup and in flavoring meat. Porphyra is widely cultivated in shallow parts of the bays in the 'Odeal' especially in Japan. Chlorella is richer in protein and lipid contents and contains high concentration of vitamins. Vitamins A, B, C folic acid and niacin are found in them. Chlorella has very high nutritional value and so it is cultivated in Germany, Japan and US. The Rhodymenia (Red algae) called 'dulse' in Canada is also eaten. ~~The limitations in its use. The Rhodymenia~~ The hydrocolloids of Chondrus crispus (Irish Moss) are used in preparing ice creams. Laminaria saccharina called 'Kombu' is also eaten. It is rich in carbohydrates. Gracillaria and Gelidium are used in ice cream.

The brown algae like Ascophyllum, Laminaria, Macrocystis and Sargassum are use as fodder and processed as commercial feed in Ireland and Scotland. Rhodymenia is grazed by sheep. The hens which feed on

Sea weed meal produce eggs rich in Iodine. (6)
Planktonic algae form the food for several fishes.

(b) Biofertilizers →

Many members of blue green algae have the ability to fix the atmospheric nitrogen in the soil. Soil is a living mass and apart from soil particles there are in it a number of bacteria fungi, algae and protozoa. Due to the nitrogen fixation ability of these organism they are considered as biofertilizers. Nostoc, Anabaena are used in rice field as biofertilizer whereas for leguminous crops various sp. of Rhizobium is used as biofertilizers. There are two types of N_2 fixers 1) Symbiotic 2) Non Symbiotic. Nostoc Anabaena, Acetobacter etc. are non-symbiotic N_2 fixers whereas Rhizobium is Symbiotic. Apart from this there are sea weeds rich in potash, soda and other minerals, so they are used as manure. This manure helps in soil binding. But it is poor in nitrogen and phosphorus than farmyard manure. The bluegreen algae are rich source of N_2 and phosphorus, so as mixture of blue green algae and sea weeds manures serves as good biofertilizers. Many algae produced extra cellular substances like amino acids and polypeptides which serve as a source of carbon and nitrogen for microorganisms which have an important role in nitrogen, sulphur and carbon cycle.

(vi) Brief Account of Nutrition in Algae →

Mostly algae are autotrophic, because they have principle pigment i.e. Chl. 'a' present in the grana of chloroplast. Few algae are heterotrophic (parasitic mode of nutrition). In algae various pigments are present like Chl 'a', Chl 'b', Chl. 'c' Chl 'd', Chl. 'e', xanthophyll, carotene, phycobilins, phycocyanine etc. Chl. 'a' is present in all photosynthetic (Autotrophic) algae where as Chl 'b' is present in class Chlorophyta, Chl 'c' is present in Bacillariophyta, Chl. 'd' is present in Rhodophyta and Chl 'e' is present in Xanthophyta.

Algae synthesize their food from inorganic materials such as carbon dioxide, water and minerals by means of photosynthesis. Chlorophyll is the most common pigment in all algae, though in many, the green colour of the plastids is masked by other pigments, such as fucoxanthin a yellow pigment which dominates in brown algae, whereas phycoerythrin and phycocyanin pigments are found in red algae and blue-green algae respectively. The algae also synthesize oil and protein from the carbohydrate which they manufacture and soluble forms of nitrogen and other minerals available in solution in the water in which they are found. The aquatic species of algae obtain water and carbon dioxide by osmosis and diffusion processes respectively, from the water in which they grow. This way the process of nutrition in algae is quite similar to that of ordinary green plants.

The algae like other chlorophyllous plants, require C, H, O, P, K, N, S, Ca, Fe and Mg and also traces of Mn, Bo, Zn, Cu and Co.

For certain algae, additional elements are required such as Si for diatoms and Mo for Scenedesmus.

The algae which grow in an entirely inorganic medium in the presence of light are known as photoautotrophic. In other words using light energy they synthesize their protoplasm from exclusively inorganic source. Several other algae require in addition certain vitamins, usually B-12, thiamine or biotin such algae are known as photoauxotrophic. A number of algae heterotrophic.

Section – C

(i) Mode of Multiplication in Viruses :-

Viral multiplication or replication relates with the infection proces of the viruses. Two types of life cycles are noted in viruses –

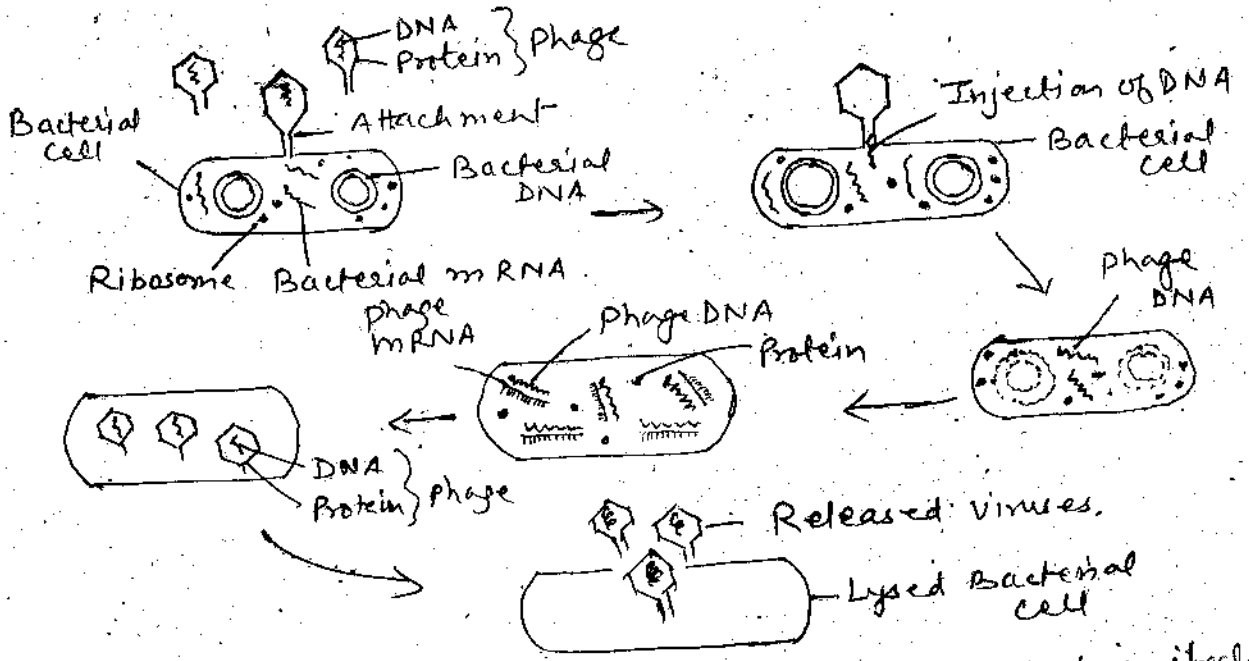
1. Lytic or Virulent :- Some viruses undergo multiplication as soon as they enter the host cell, resulting in lysis or breakdown of the host cell. Such viruses are called lytic viruses, and their mode of infection is said to be virulent, e.g. the T-even phages (T2, T4, T6).

2. Lysogenic or Temperate or Non Virulent :- Other types of viruses do not cause lysis or breakdown of the host cell. The viral chromosome becomes integrated with the host bacterial chromosome and is called a prophage. Such viruses are called lysogenic viruses and the mode of infection is said to be temperate. e.g. λ phage

LYTIC CYCLE : It is an orderly process and takes place in the following steps :-

1. Adsorption or Attachment
2. Digestion

3. Injection of DNA
4. Synthesis of early protein
5. Replication of viral nucleic acid & protein
6. Synthesis of Late protein
7. Assembly and maturation of newly formed virus
8. Release of Virus from the cell.



1. Adsorption or Attachment → The phage attaches itself to specific receptor site on the bacterial cell wall by means of its tail fibres.
2. Digestion of the Bacterial wall – The tail of virus comes in contact with bacterial cell wall due to bending of tail fibers. The tip of the tail contains an enzyme known as lysozyme. The lysozyme dissolves the cell wall and cause weakening of cell wall at the point of attachment.
3. Injection of DNA – The tail sheath contracts to half of its original size. The contraction of tail sheath forces the core tube to penetrate the cell wall of the host like a needle through the hole.
4. Synthesis of Early Protein → The phage takes the control of cellular activity of the host

immediately after the entry. The enzyme needed for phage DNA Synthesis are made shortly after infection are called "Early proteins". Early mRNA produces early proteins.

(5) Replication of Viral nucleic Acid and Protein → The phage DNA replication starts after latent period of 20 minutes. The nucleotides resulting from the breakdown of bacterial DNA are used for in the replication of phage DNA, after that multiplication of phage DNA starts. The phage DNA synthesis takes place at the expense of bacterial DNA and RNA.

(6) Synthesis of Late Protein → The new proteins formed after phage DNA synthesis is known as late proteins. The late mRNA produces late protein. The late proteins include coat proteins and the phage lysozyme or Endolysins.

(7) Assembly → The phage assembly is a sequential process. The late protein wrap itself to over the viral genome to form new bacteriophages. Several hundreds of new viruses are produced.

(8) Release of Virus from the Cell → The phage lysozyme or endolysins causes weakening of bacterial cell wall. The release of the phages takes place by sudden bursting and rupturing of the cell wall.

(11) Lysogenic Cycle → Temperate phages leads its life cycle in two different ways; virulent & non virulent. The non virulent infect host bacterium but do not multiply and produce lysis. The relationship of this bacteriophage with the bacterium is temporarily non virulent, so it is called temperate phage. They undergo synthesis replication with the host DNA. The viral DNA becomes a part of the host chromosome and is called the prophage.

(ii) Structure and Reproduction in Mycoplasma →

Nocard and Roux (1928) discovered mycoplasma, from pleural fluids of cattle suffering from bovine and cattle's leuropenumonia. These are wall less gram negative. They are also called PPLO (pleuopneumonia like organisms).

Mycoplasma are typical prokaryotes that occur saprotophically in soil, sewage water and in decaying organic matter. Some mycoplasma occur parasitically in plants, animals and human beings. The pathogenic mycoplasma causes disease.

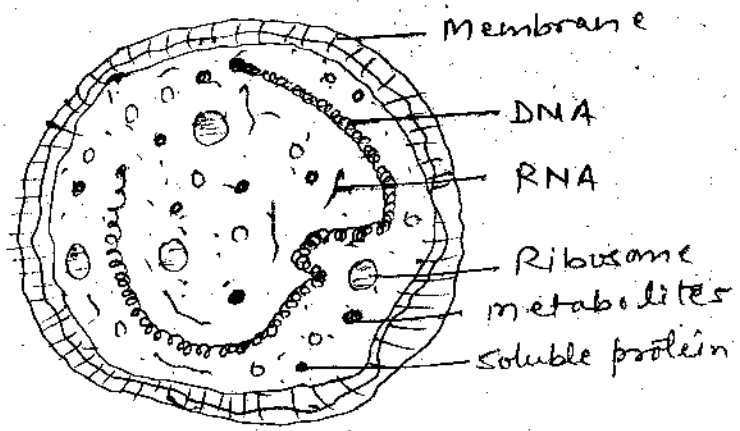


Fig:- Mycoplasma

Mycoplasma are smallest independent replicating prokaryotes. They do not have any cell wall. The protoplasm is surrounded by cytoplasmic membrane. They are highly pleomorphic. These are known as a "Jokers" of the plant kingdom because they keep changing their shapes.

The cells are composed of 40-60% protein on dry weight basis. Diaminopimelic acid is completely absent. The carbohydrates contribute little (0.1%) to the total dry weight. RNA content varies from 1.5 to 7%. The lipid comprise 8 to 20%.

The typical cell consists of ~~lai~~laminar membrane surrounding a cytoplasm packed with ribosomes, fibrillar DNA and occasionally empty vesicles. The chromosome is circular.

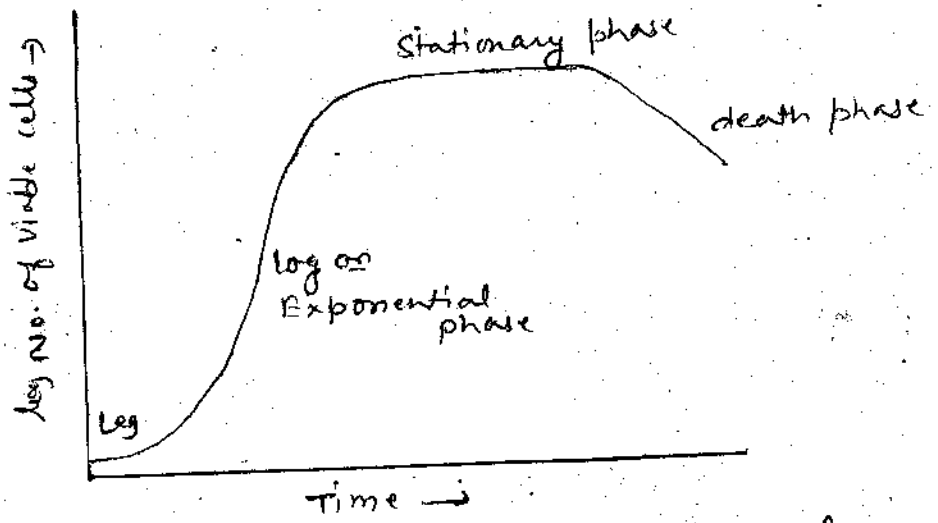
Reproduction:- Mycoplasma cells divides unevenly. The large cell contains elementary bodies

Or minimal reproductive units. They are commonly formed inside the mature cells. These can pass through bacteria retaining filter. The cell divides by binnary fission.

(iii) Bacterial Growth –

Growth is the self multiplication of living material the protoplasm it self. Growth is an increase in size, (volume or length) due to cell divisions and subsequent enlargment. It is an increase in dry weight of bulk of an organism associated with development. In any biological system growth can be defined as "an orderly increases of all the chemical constituents of an organism.

Under favourable conditions, the bacterial cells doubles at regular intervals, because each of the two daughter cells produced by a division has the same ability of growth as the parent cell. If the population started from a single cell, the first few divisions are synchronous every cell divides more or less simultaneously, so that the number of cells in the population, the times of division soon become random, and the number of cells in the population then increases in a continuous fashion.



Four phases of the bacterial growth cycle are recognized:

1. Lag phase - The length of lag phase is dependent on some factors!

→ age of culture inoculum
  old culture — long lag
  young culture - short lag.

→ Size of inoculum
  few cells - long lag
  many cells - short lag

→ Environment -
  pH, temperature, gases and salinity
  Sub optimum - long-lag
  optimum - short lag.

2. Exponential (logarithmic phase) phase → The exponential phase of growth is a pattern of balanced growth whereas all the cells are dividing regularly by binnary fission.

3. Stationary phase → Exponential growth can not be continued forever in batch culture (e.g. a closed system such as a test tube or flask)

4. Death phase - When nutrition exosted and population could not get proper nutrition then death ~~occur~~ of bacterial cell occur.

(iv) Mode of Reproduction in Cyanobacteria -

(a) Vegetative Reproduction - It takes place by several methods —

(i) By cell division → This is only the known method of propagation in the order chroococcales. The cell become constricted in the middle and ultimately divides giving rise to two individuals.

(ii) Fragmentation of Colony → The colonies are fragmented in to small bits. Each such bit develops into a colony by division of the cells in different planes.

(iii) Fragmentation of Filament –
In the family Oscillatoriaceae the filament break into small fragments.

(iv) By hormogonia → Inside the sheath the trichomes are fragmented and hormogonia are formed, which develop into new individual.

(v) Akinete → Sometimes some of the cells of filamentous genera accumulate food, become thick walled and are called akinete. Each akinete develop into a new individual.

(b) Asexual Reproduction –

(i) Endospore → Endospores are produced inside the cell. During the formation of these spores the cytoplasm of the cell become cleaved into several bits. These bits later become endospore and are liberated. Each spore germinates into a new plant.

(ii) Exospore → Such spores are produced outside the cell by constriction. In the case of "Chamaesiphon", the exospores are developed from the terminal end of the plant in continous succession.