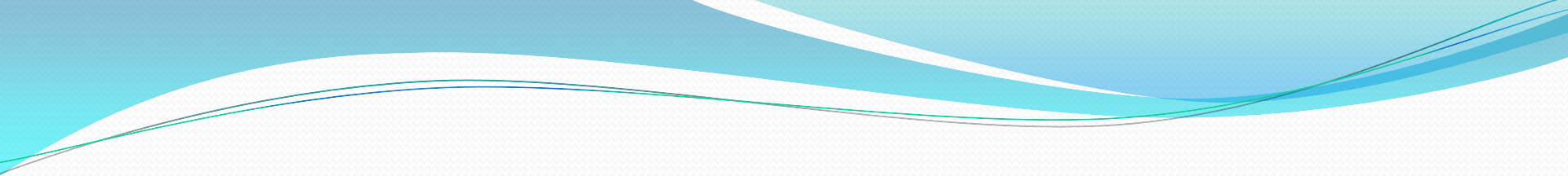


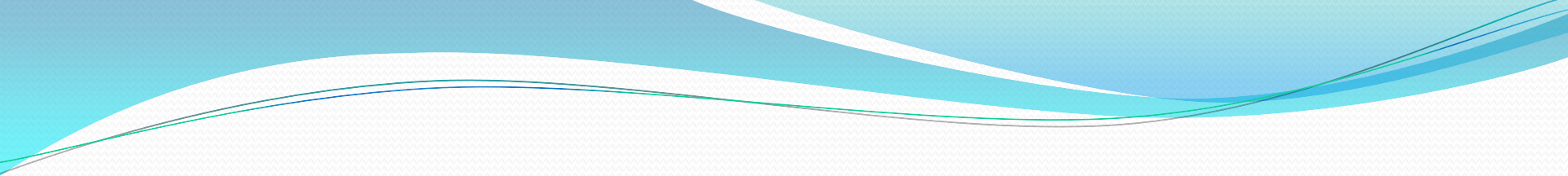
# **Bacterial Nutrition**

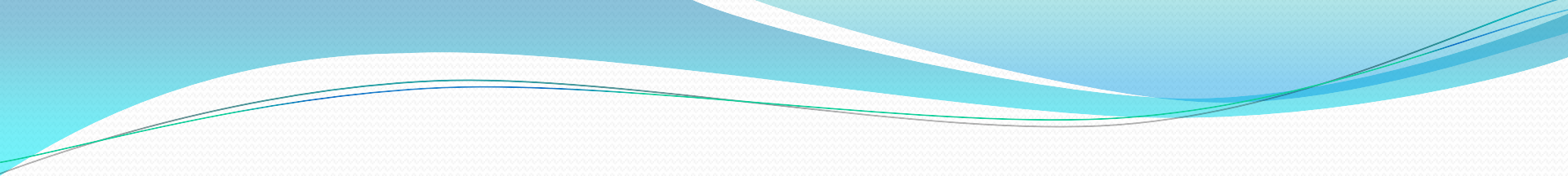
**Dr. Shehab A. Lafi**

# Bacterial Nutrition

**Microorganisms require nutrients and suitable conditions to grow . The main elements required for bacterial growth should be provided in the culture medium or host tissue .**

- 
- **Bacteria vary greatly to their requirements , regarding this category bacteria can be classified into the following types :**
  - **1-Energy source : According to this factor , Bacteria can be classified into :**

- 
- **Phototrophs** : These organisms use light ( Sun light ) as a source of energy ( The photochemical reactions act as a source of energy there).
  - **Chemotrophs** : They get energy from the chemical reactions like oxidation and reduction of chemicals like glucose .

- 
- **2- Carbon source : It is an essential element to all cellular structures and functions .**
  - **Two carbon dependent types are recognized here :**
    - a- Autotrophs : they use Carbon dioxide CO<sub>2</sub> as a carbon source.**
  - **CO<sub>2</sub> + sun energy   Organic compound,  
Photosynthetic bacteria and other free living  
organisms are included there.**

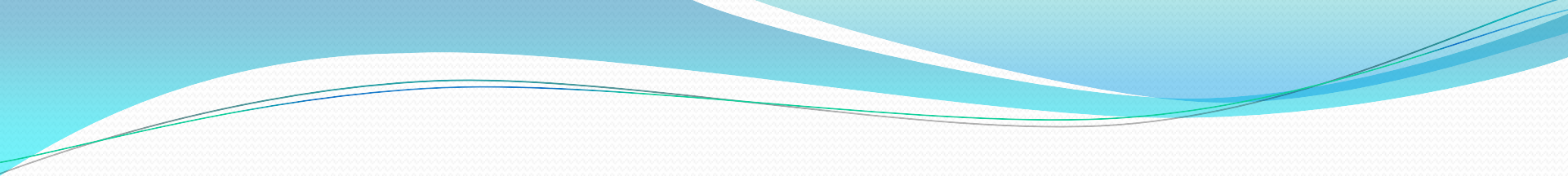


## **b-Heterotrophic organisms:**

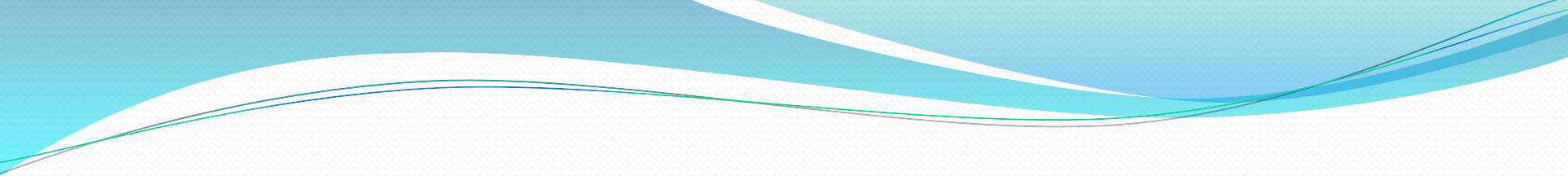
- **These organisms are able to use organic chemicals as a carbon source , most of bacterial pathogens are included within this group.**

### **3- Nitrogen source :**

- **It is an essential element in many cellular macromolecules , particularly proteins and nucleic acids as well as enzymes. Some microbes are able to use atmospheric nitrogen , other bacteria rely on inorganic compounds such as ammonia or nitrate salts.**

- 
- **4- Minerals : They are of two major types :**
  - **Non metallic mineral such as Sulphar , Phosphorus**
  - **Metallic type like Sodium , Cupper , Magnesium , Iron .**
  - **These are essential for bacterial physiological activities , they act as Coenzymes and Catalysts like  $Mg^{++}$  activates Kinase enzyme**



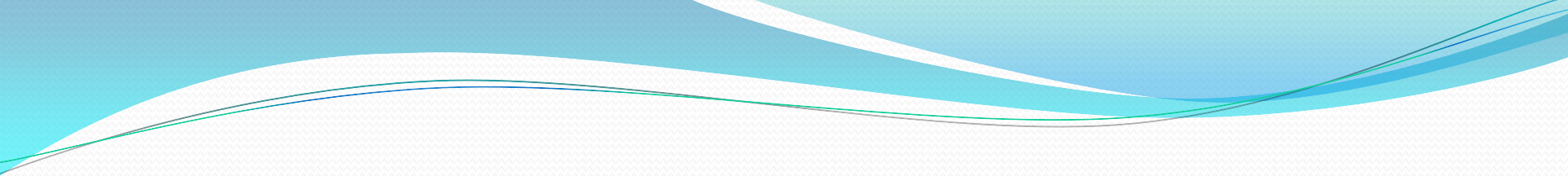


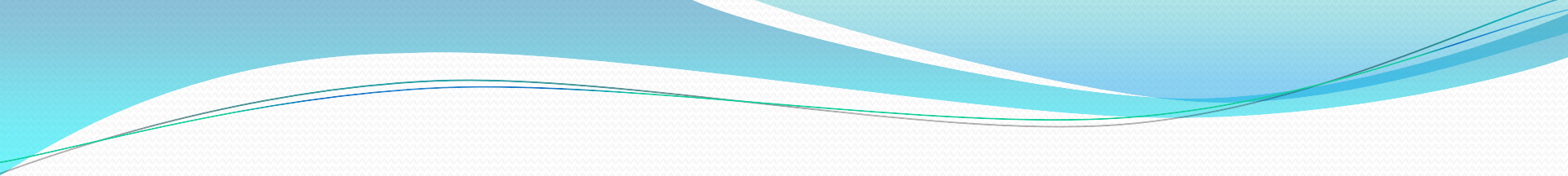
**5-Water : All cells require water in their media So that low molecular weight nutrients can cross the cell membrane with water.**

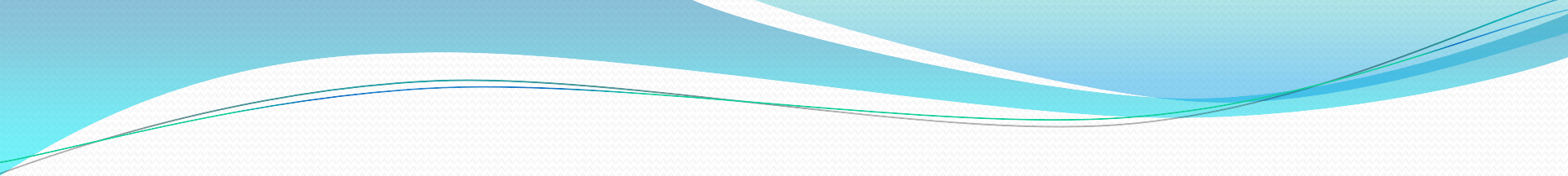
- **6- Vitamins :they are organic compounds that are important in minute concentrations for the cell activities.**
- **7- Accessory nutritional requirements:**
- **These are required by certain bacterial types , e.g..  
Haematin factor and NAD factor required for *Haemophilus influenza* .**

# Physical factors Affecting Bacterial Growth :

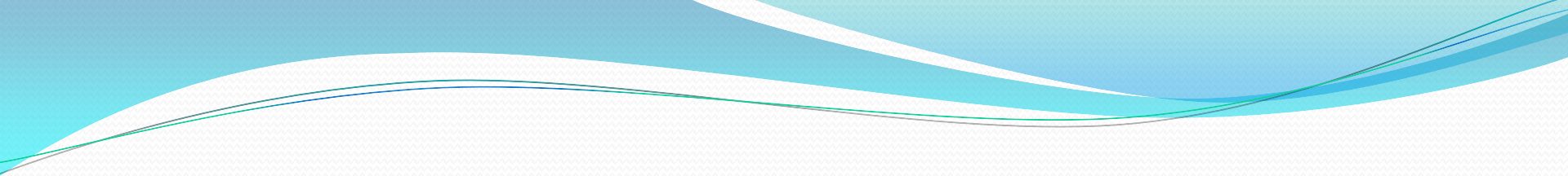
**Moisture :** It is necessary for the growth as described in water necessity . Desiccation kills most of microorganisms except spores and Mycobacteria like TB bacilli.

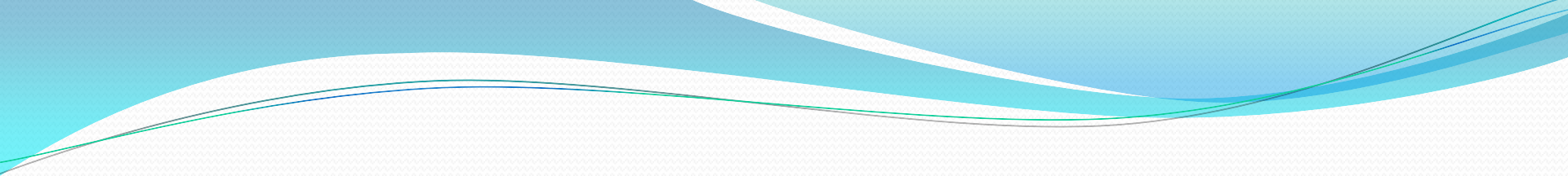
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- **Temperature:** it is an important factor due to its influence on the cell reactions and integrity. The optimal temperature for parasitic bacteria is 37°C, many saprophytes of bacteria in water and soil may grow between 25-40 °C. According to temperature, bacteria can be classified into :
  - **Psychrophilic bacteria :** It includes bacteria that grow at low temperature , 0-5 °C .

- 
- **Mesophilic bacteria** :they grow within the range of 20-40 C , this group includes pathogenic bacteria which grow at 37C.
  - **Thermophilic bacteria**: This group of microorganisms resists higher temperature ( Above 50C ).



**Osmotic pressure : Cell wall and cell membrane • protect cell from the effect of different contents of the medium like salts . For most species the maximum salt concentration is 5-12 % , some bacteria resemble an exception known as Halophilic bacteria like Vibrio and others that found in sea water .**

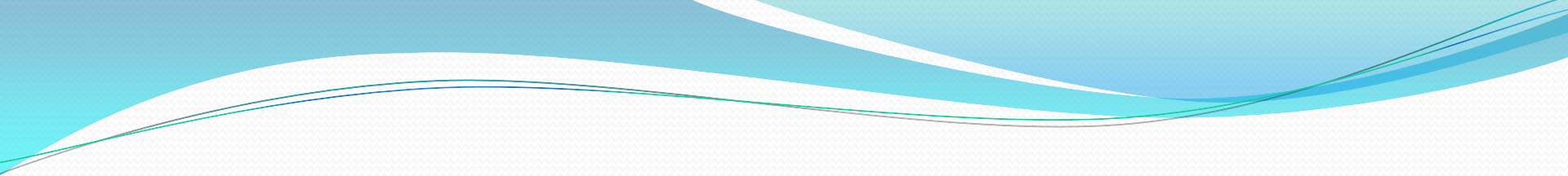
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- **Aeration ( Gas requirements):** Ability of bacteria to grow in the presence of oxygen depends on the possession of respiratory chain or enzymes necessary for Oxidation –Reduction activities . according to oxygen demands , bacteria are classified into :
  - **Aerobic bacteria ( Strict Aerobic bacteria ) :** These bacteria grow only in the presence of oxygen such as aerobic Bacillus .

- 
- **Strict Anaerobic Bacteria:** These organisms grow under atmosphere of  $\text{CO}_2$  ( Absence of Oxygen ) like *Clostridium* group .
  - **Facultative Anaerobic Bacteria :** These bacteria
  - Can grow with or without oxygen such as *E. coli* .
  - **Microaerophilic Bacteria :** These organisms grow well with relatively low concentration of oxygen like *Neisseria* .



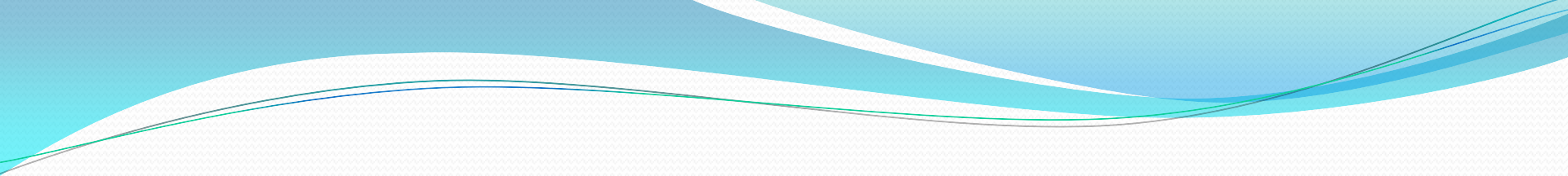


**5-Hydrogen Ion Concentration (PH): Each •  
organism needs a certain PH for its growth, some  
bacteria resist acidity such as Lactobacilli while  
other organisms tolerate alkalinity like *Vibrio  
cholera*.**

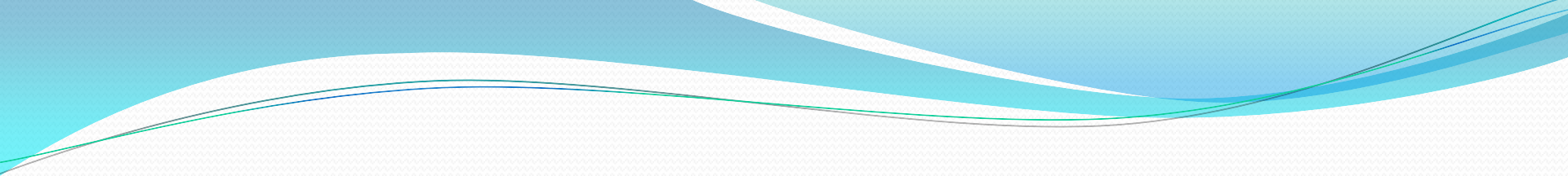
- 
- **6-Light and other Radiations : some organisms require darkness for their growth like Scotochromogens of Mycobacteria . While other types need light to grow like photochromogens .**
  - **Uv, X ray, IR And laser radiations are bactericidal . in addition to that Ultrasonic and sun light kill bacteria also.**

# **Bacterial growth :**

**Bacterial growth means an increase in the bacterial number during a certain time . Each bacterial cell takes a time to be double, this time is known as Duplication time or Mean Generation time.**



**. Bacteria are different in their duplication time , rapid growing bacteria has short generation time(minutes ) like E. coli while the slow growing organisms possess long generation time ( hours – Days ) like *Mycobacterium tuberculosis*.**



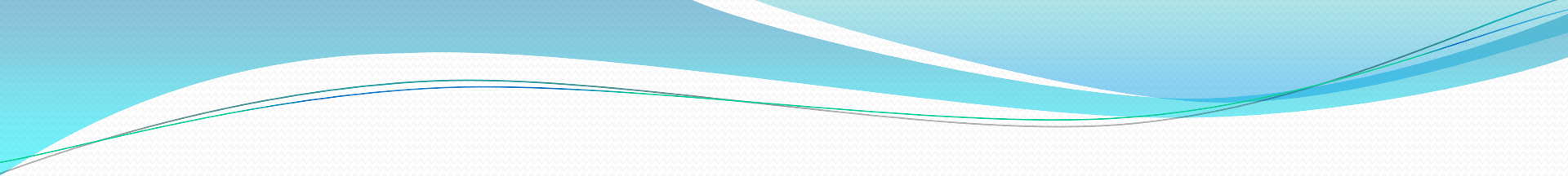
**Each bacteria when inoculated in suitable medium under suitable conditions , it will grow and it will show difference in its yielded number during a certain period. When the number is plotted with time it will show an exponential curve known as Growth curve.**

# Growth curve phases

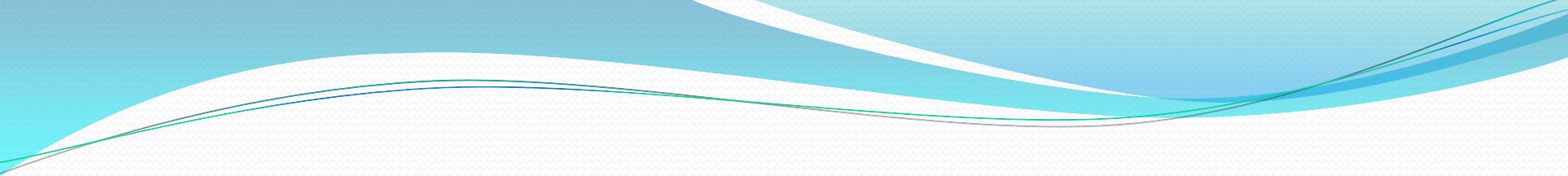
**Lag phase:** In this phase there is no real • duplication or multiplication of the bacterial cells though they show an increase in metabolic activity. The duration of this phase varies according to the conditions and number of bacteria in the inoculums ( inoculums size ).



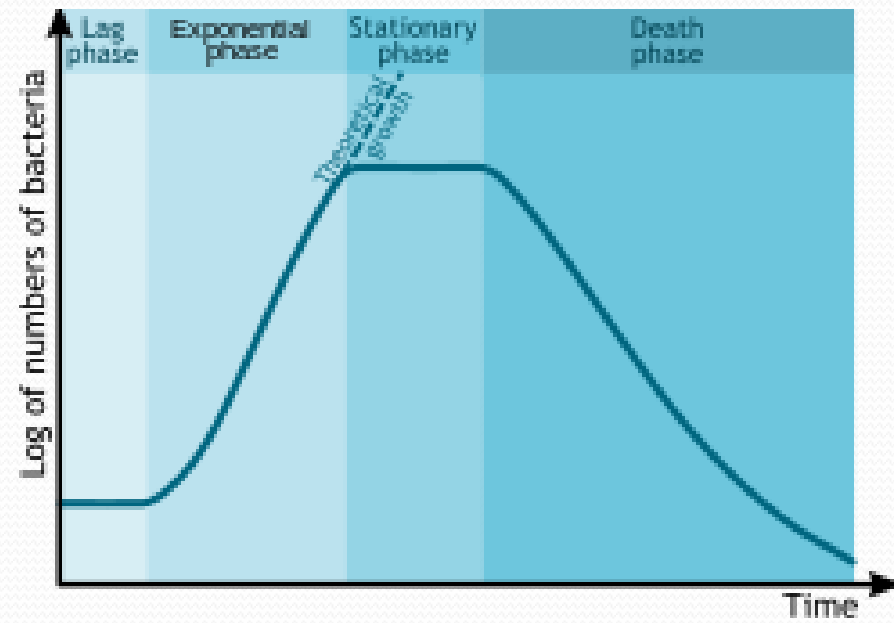
**Log phase : It is known also as Logarithmic or •  
exponential phase . Bacterial cells divide at a  
constant rate as a result of binary fission , there is  
linear relation between time and log.**

- 
- **Stationary phase :** During this stage the number of bacterial cells undergo division is equal to that are dying. Therefore there is no further increase in cell number and the population is maintained . Cessation of growth is achieved by the exhaustion of essential nutrients in the medium and accumulation of toxic waste products .
  - **In this phase bacteria may produce secondary metabolites like antibiotics , exotoxins.**





***Decline phase: Because of the continuing depletion of nutrients and the building up of metabolic wastes ,microorganisms die at a rapid and uniform rate . Some bacteria start to digest themselves and liberate cellular contents into the environment and this is known as autolysis.***



# Continuous culture :

- **Growth curve of a given organism can be kept at a certain phase, primarily Log phase to get mass production of microbial cells or its products.**