

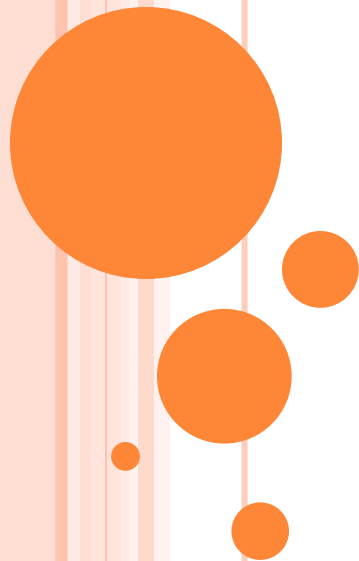
# **BACTERIAL PHYSIOLOGY**

**۲ Year**

**Dr. Hiyam Adil Altaii**

**Lec. ۱**

**BACTERIAL GROWTH**



# What does physiology means ?

It's the growth, nutrition, and metabolism OF BACTERIA.

## 1 - BACTERIAL GROWTH

It is an increase in all the cellular components, which end in multiplication of the cell leading to an increase in population.

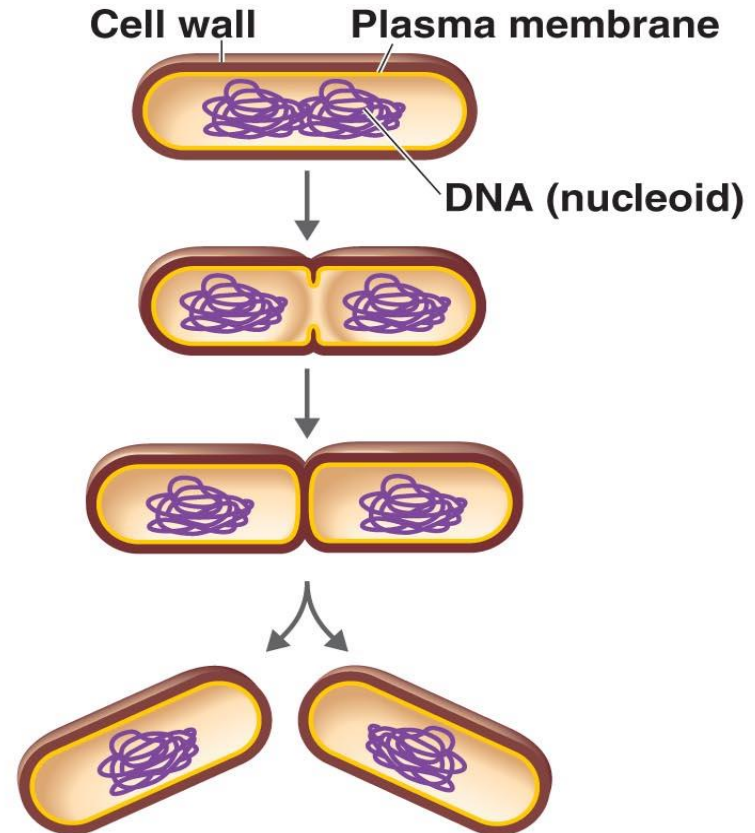
It involves an increase in the number of individual cells.

Bacteria divide by binary fission.

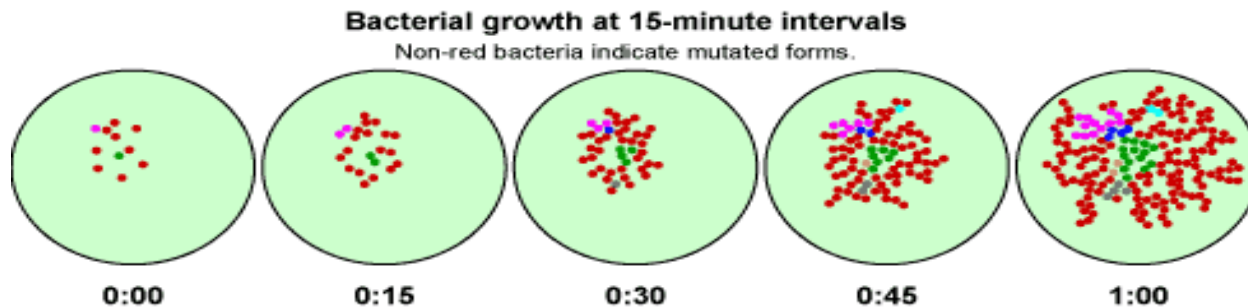


# BINARY FISSION

- 1** Cell elongates and DNA is replicated.
- 2** Cell wall and plasma membrane begin to constrict.
- 3** Cross-wall forms, completely separating the two DNA copies.
- 4** Cells separate.



**(a)** A diagram of the sequence of cell division



# Generation time:

Interval of time between two cell divisions

**OR**

The time required for a bacterium to give rise to 2 daughter cells under optimum conditions

Generation time of *E.coli* & other medically important bacteria is 20 mins.

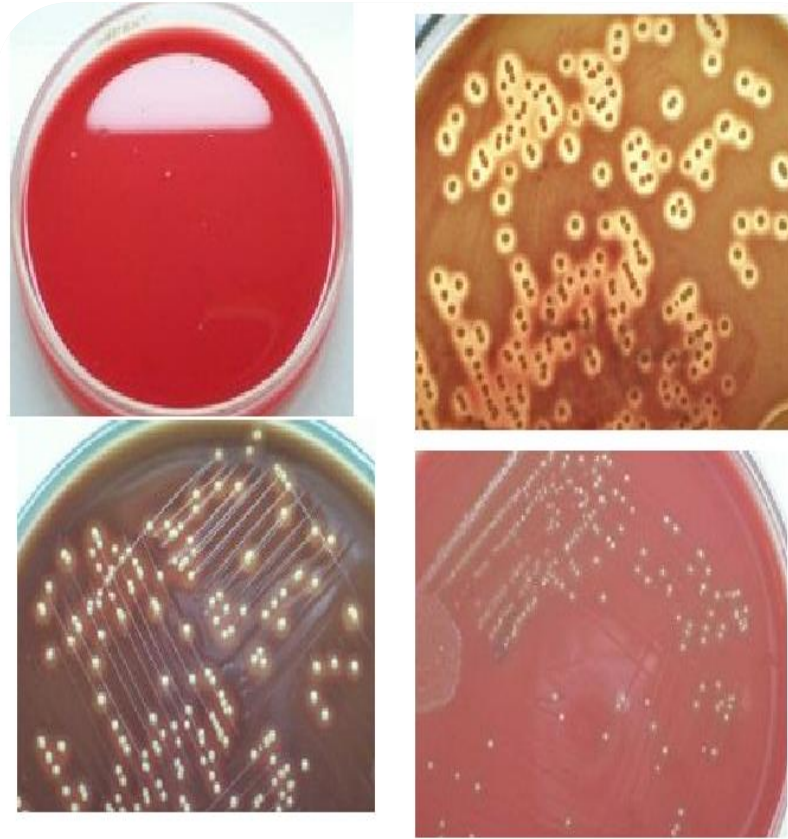
For tubercle bacilli is 24 hrs.

For lepra bacilli is 20 days.

Initial bacterial count: 100/g or ml



- **Colony** – formed by bacteria growing on solid media. Each bacterial colony represents a clone of cells derived from a single parent cell.



## **FACTORS AFFECTING BACTERIAL GROWTH INCLUDE:**

Temperature

Atmosphere –  $O_2$  &  $CO_2$

H-ion concentration

Moisture & drying

Osmotic effects

Radiation

Mechanical & sonic stress



## ○ 1. **Temperature**

- Bacteria vary in their temperature requirements.
- **Temperature range** – growth does not occur above the maximum or below the minimum.
- **Optimum Temperature** – It is the temperature at which growth occurs best, it is  $37^{\circ}\text{C}$  for most pathogenic

## ○ **CLASSIFICATION BASED ON TEMP.**

1. **Mesophilic** – grows best between  $20^{\circ}\text{C}$  and  $45^{\circ}\text{C}$ . e.g. most pathogenic bacteria
2. **Psychrophilic** (cold loving) – grows best below  $20^{\circ}\text{C}$  e.g. *Flavobacterium* spp
3. **Thermophilic** – grows best at high temp,  $50-80^{\circ}\text{C}$  e.g. *Bacillus sterothermophilus*



## γ-OXYGEN

Depending on the  $O_2$  requirement, bacteria are divided into :

**Strict (Obligate) Aerobes** – require  $O_2$  for growth e.g. *Pseudomonas aeruginosa*

**Strict (Obligate) Anaerobes** – grow in the absence of  $O_2$  & may even die on exposure to  $O_2$  e.g. *Bacteroides fragilis*

**Microaerophilic** – grow best in the presence of low oxygen levels

e.g. *Campylobacter* spp, *Helicobacter* spp.

ξ. **Facultative anaerobe** – aerobic but can also grow in the absence of  $O_2$

e.g. *Staphylococcus* spp

ο. **Aerotolerant anaerobe** – anaerobic, but tolerates exposure to  $O_2$

e.g. *Clostridium perfringens*

γ. **Capnophilic organism** – requires high  $C O_2$  levels eg *Neisseria*





# THE EFFECT OF OXYGEN (O<sub>2</sub>) ON GROWTH

a. Obligate Aerobes



Needs oxygen

b. Facultative Anaerobes



Grows best in oxygen, but can grow without it

c. Obligate Anaerobes



Only grows without oxygen

d. Aerotolerant Anaerobes



Grows with or without oxygen

e. Microaerophiles



Grows in low concentrations of oxygen

## ३ - H-ion Concentration

pH range, optimum pH

Majority of pathogenic bacteria grow best at neutral or slightly alkaline pH (७.२ – ७.६) .

Lactobacilli require acidic pH

*Vibrio cholerae* require alkaline pH



## ॔ - Moisture and drying

Water is an essential ingredient of bacteria. Hence drying is lethal to cells.

Effect of drying varies :

*Trepanoma pallidum* are highly sensitive to drying

*Staphylococcus* spp. withstand drying for months

**Spores** are resistant to drying and may survive for several decades



## ◦ - **Osmotic effects**

More tolerant to osmotic variation due to mechanical strength of their cell walls.

## ∩ - **Radiation**

X rays & gamma rays exposure – lethal

## ∪ - **Mechanical & Sonic Stress**

May be ruptured by mechanical stress.



## **BACTERIAL GROWTH CURVE:**

When a bacterium is added to a suitable medium & incubated, its growth follows a definite course.

If bacterial counts are made at intervals after inoculation & plotted in relation to time, a growth curve is obtained.

Growth curve shows 4 phases : Lag, Log or Exponential, Stationary & phase of Decline.

## **PHASES OF GROWTH:**

**Lag phase** – no increase in number but there may be an increase in the size of the cell.

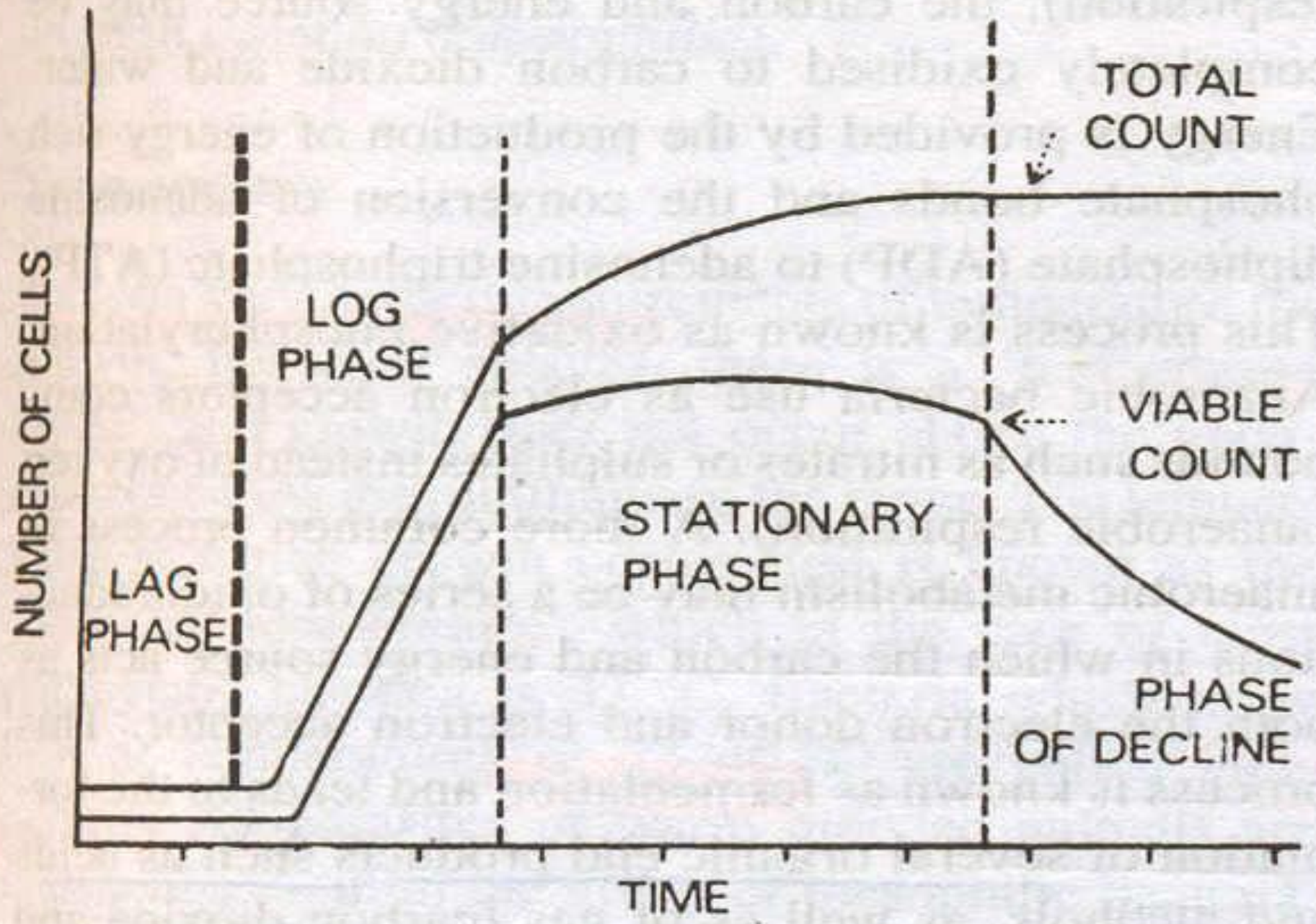
**Log or Exponential phase** – cells start dividing and their number increases exponentially.

**Stationary phase** – cell division stops due to depletion of nutrients & accumulation of toxic products.

- Equilibrium exists between dying cells and the newly formed cells, so viable count remains stationary

**Phase of decline** – Population decreases due to the death of cells – autolytic enzymes.





# BACTERIAL COUNTS

Growth in numbers can be studied by bacterial counts.

- ‡ **methods** – Total cell count
  - Viable cell count

## Viable Cell Count

Measures the number of living cells.

Methods – Surface colony count

Dilution method

Plating method

Number of colonies that develop after incubation gives an estimate of the viable count.

End

