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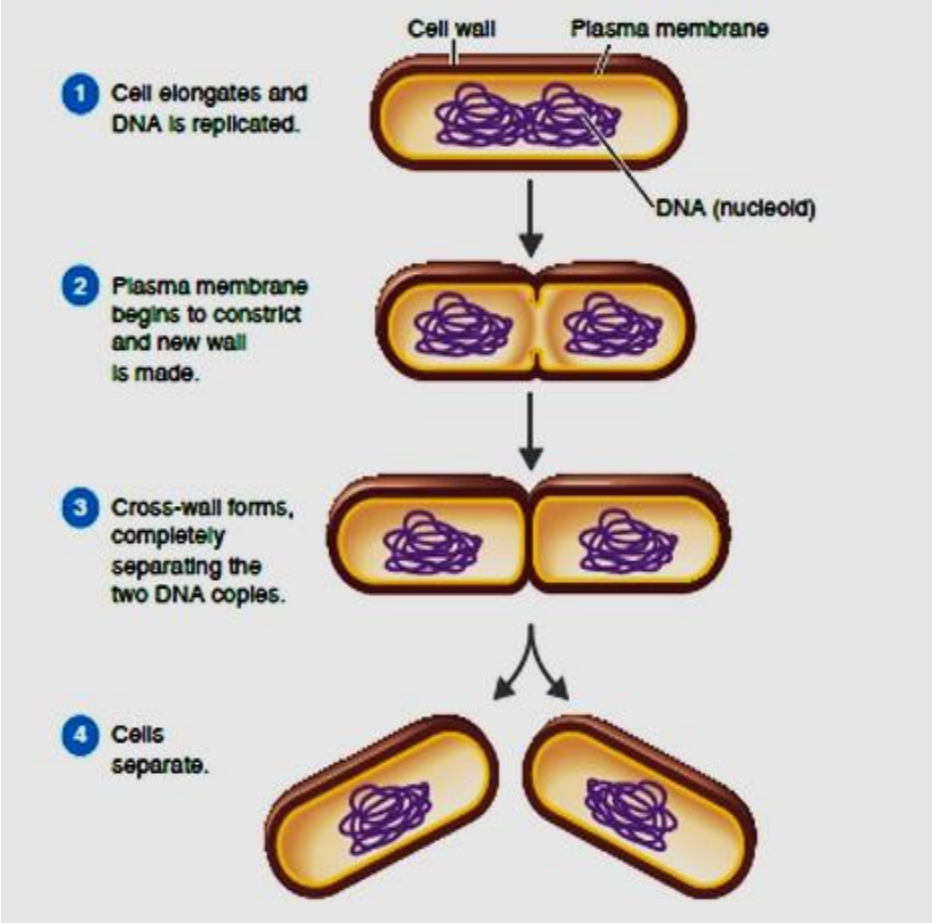
Lecture. 2
Two stage

College of Technology & Health Sciences
Department of Medical Laboratory Technique

GROWTH AND DEATH OF BACTERIA

Growth of bacterial

Is defined as an increase in the number of bacteria in a population rather than in the size of individual cells. The time required for the formation of a parental cell into two daughter cells known as **generation time** or **doubling time** or **replication time**.



A diagram of the sequence of cell division

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Bacterial growth curve In the presence of fresh growth medium bacteria show following four phases during their growth:

• The lag phase

• The log phase

• The stationary phase

• The decline phase

The Lag Phase: Lag phase is short duration in which bacteria adapt themselves to new environment. This phase represents a period of active growth during which bacteria prepare for reproduction, synthesizing DNA, enzymes, and other macromolecules needed for cell division.

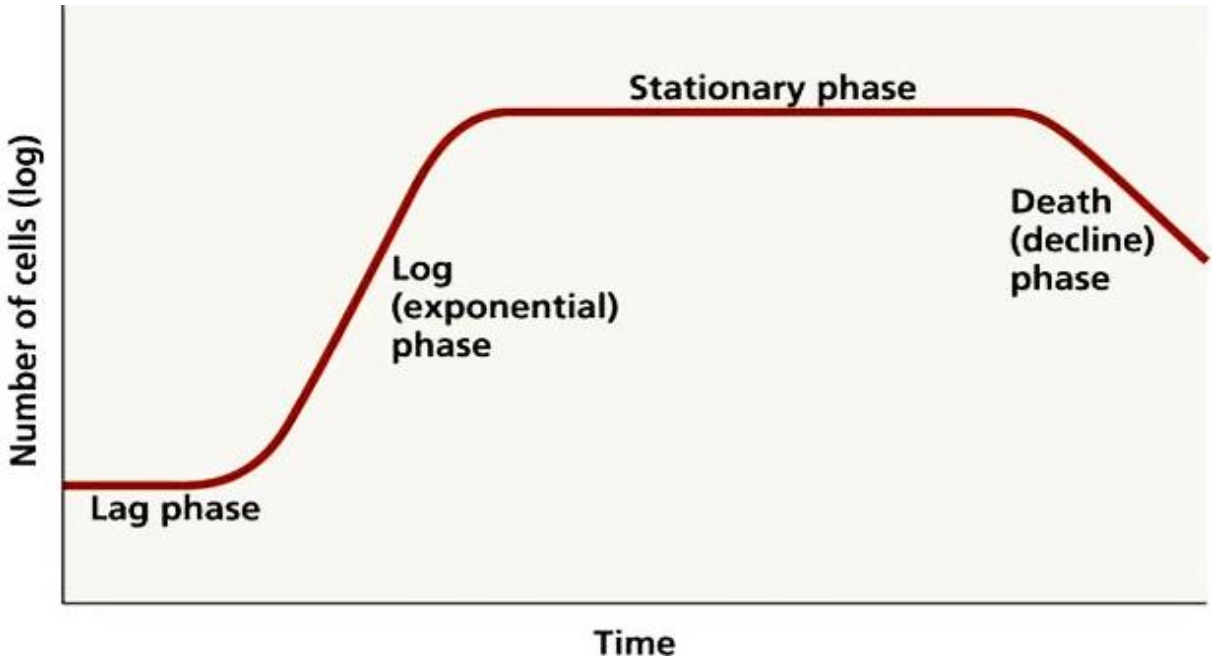
The Log Phase (Exponential Phase): Regular growth of bacteria occurs and undergo division and their population (number) increase exponentially at a logarithmic rate in this phase. The nutrients present in the medium are utilized by the bacteria and daughter cells. Once exhaustion of nutrients occurs, slowing down of growth also takes place and bacterium passes onto stationary phase.

The Stationary Phase: In this phase, the growth i.e., cell division, almost ceases due to exhaustion of nutrients and also the accumulation of toxic products. At this stage the cell death starts at a slow rate and is compensated by the formation of new cell through cell division. The duration of this phase is variable which ranges from few days to few

GROWTH AND DEATH OF BACTERIA

hours. The bacterial cells start dying and the number of such cells balances the number of new born cells, and the bacterial population stabilizes.

The Decline Phase: The phase of decline is also called as death phase. Due to depletion of nutrients and accumulation of toxic end products the number of bacteria dying is much more than those dividing and hence there is a gradual decline in the total number of organisms. The growth curve now dips downwards. For a microbial cell, death means the irreversible loss of the ability to reproduce (growth and divide).



Requirements for microbial growth:

The requirements for microbial growth can be divided into two main categories:

(i) chemical

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(ii) physical.

I. Chemical requirements: Chemical requirements include sources of carbon, nitrogen, sulfur, phosphorus, trace elements, oxygen, and organic growth factors.

Growth factors some bacteria require certain organic compounds in minute quantities known as growth factors or bacterial vitamins. A growth factor is an organic compound which a cell must contain in order to grow, but which it is unable to synthesize. Growth factors are called 'essential' when growth does not occur in their absence, or 'accessory' when they enhance growth without being absolutely necessary for it.

II. Physical requirements: Certain physical conditions affect the type and amount of microbial growth. There are physical actors influencing microbial growth such as:

• **Temperature:** Organisms can be grouped as psychrophiles, psychrotrophs, mesophiles, thermophiles, or hyperthermophiles based on their optimum growth temperatures.

• **Oxygen (O2) Requirements:** Organisms can be grouped as obligate aerobes, obligate anaerobes, facultative anaerobes, microaerophiles based on their oxygen (O2) requirements.

• **CO2:** Microbes that grow better at high CO2 concentrations are called capnophiles.

• PH • Light • Osmotic effect

Table: Comparative characteristics of Gram positive and Gram negative bacteria

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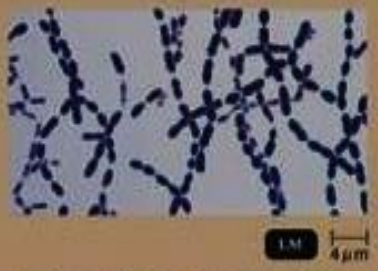
Characteristic	Gram-Positive	Gram-Negative
		
Gram Reaction	Retain crystal violet dye and stain blue or purple	Can be decolorized to accept counterstain (safranin) and stain pink or red
Peptidoglycan Layer	Thick (multilayered)	Thin (single-layered)
Teichoic Acids	Present in many	Absent
Periplasmic Space	Absent	Present
Outer Membrane	Absent	Present
Lipopolysaccharide (LPS) Content	Virtually none	High
Lipid and Lipoprotein Content	Low (acid-fast bacteria have lipids linked to peptidoglycan)	High (because of presence of outer membrane)
Flagellar Structure	2 rings in basal body	4 rings in basal body
Toxins Produced	Exotoxins	Endotoxins and exotoxins
Resistance to Physical Disruption	High	Low
Cell Wall Disruption by Lysozyme	High	Low (requires pretreatment to destabilize outer membrane)
Susceptibility to Penicillin and Sulfonamide	High	Low
Susceptibility to Streptomycin, Chloramphenicol, and Tetracycline	Low	High
Inhibition by Basic Dyes	High	Low
Susceptibility to Anionic Detergents	High	Low
Resistance to Sodium Azide	High	Low
Resistance to Drying	High	Low