Growth of Microbial Population

Microbial growth refers to increase the number of Microbial cells by binary fission, leading to increasing of a bacterial population. This phenomenon occurs by a series of events interspersed with time periods that depend on the environmental conditions known as the **bacterial cell cycle**, and (the time required for the cell to complete cycle from its beginning to its end) is known as the generation time. The generation time varies with different species and ranges from 20 to 25 minutes in *E.coli* and two hours to several days in eukaryotic cells. The generation time highly depends on environmental conditions such as the nature and concentration of nutrients in the growth medium, temperature, and pH.

After culturing number of cells in a liquid medium and incubating under optimal environmental conditions in the laboratory, the culture will undergo the following sequential stages which known as **Growth Phases**

1- **Lag or adaptation phase**
2- Log or exponential phase
3- Stationary phase
4- death phase

1- Lag or adaptation phase : the cells do not divide after culturing in the medium, But the cells begin with synthesis of the proteins, enzymes, and other large molecules that they need to build their structures and synthesis of (RNA), while the amount of (DNA) remains constant because cells do not divide during this phase, the mass of cells increases without their numbers

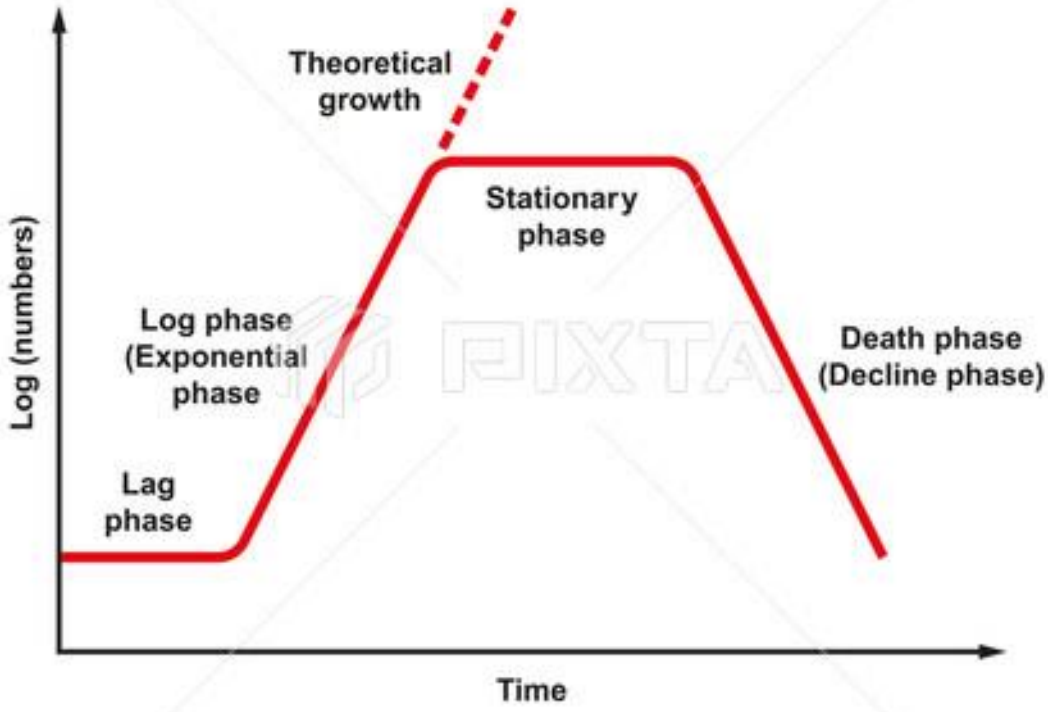
2- Log or exponential phase:DNA duplicates and RNA, after that the cells divide And increase exponentially in numbers, as follows: 2^0, 2^1, 2^2, 2^3, 2^4, ... Therefore, it is also called the exponential phase. Bacteria in this phase are very sensitive to environmental influences as temperature, toxins, antibiotics.

3- Stationary phase : It is a phase in which the number of cells produced by division approximately equals the number of dead cells (growth stabilization),

In this phase, the concentration of nutrients decreases, and the amount of metabolic waste increases, which causes cell death and lysis . This phase is not devoid of constructive life activities; for example, the spore-forming bacteria *Bacillus subtilis* begin to synthesize many essential enzymes for spore formation.

4- death phase: in this phase, the rate of cell death is higher than the rate of division, and cells begin to autolysis, where **autolysins enzymes** are produced to lyse the cell wall,.

above growth phases occur in bacteria in **batch cultures**, which are cultures that do not add to it new nutrients and do not remove the metabolic substances excreted by the microorganisms. **contineoues cultures** is reverse batch culture, remaine in expotential phase only and don't pass with stationary phase because adding nutrient coexist pull of waste or toxic matters .



(Diagram explain Bacterial Growth Curve)