

The logo of Galgotias University is a stylized 'G' composed of several curved, overlapping bands in shades of yellow, orange, and blue, set against a light pink circular background.

# **Bacterial Growth Curve**

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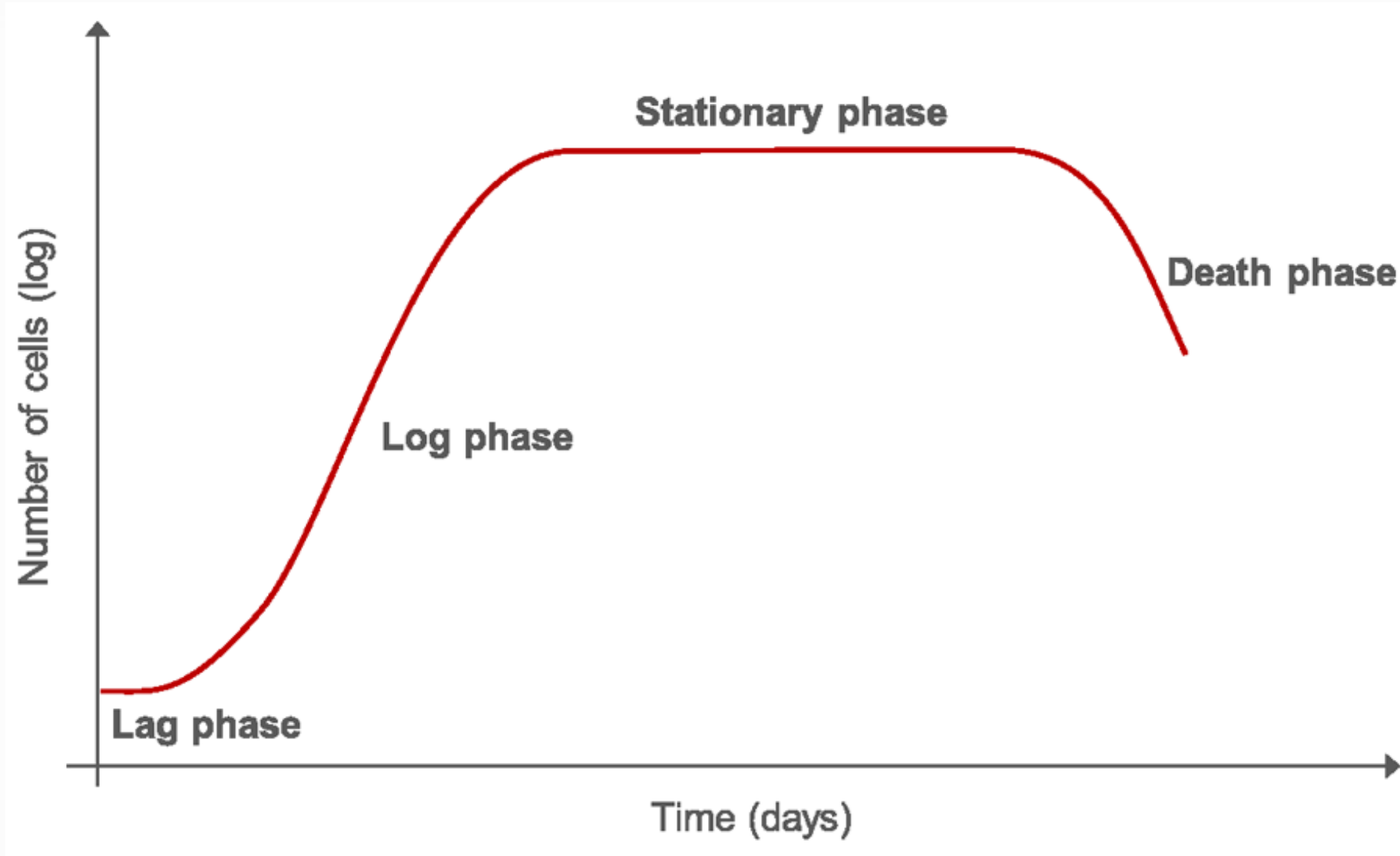
# Microbial growth physiology

- Microbial population growth can be studied by analyzing the growth curve of a microbial culture.
- In a batch culture system or closed system of growth— cells are incubated in a closed culture vessel with a single batch of medium and no fresh medium is provided .
- Bacterial cells undergo cell division by binary fission, When a bacterial culture is inoculated in a suitable liquid medium and incubated in a batch culture system, it follows a definitive growth course which can be plotted as the logarithm of the number of viable cells versus the incubation time.

# Stages of bacterial population growth

- This will yield a characteristic growth curve with four distinct phases:
  1. Lag Phase
  2. Exponential or Log (Logarithmic) Phase
  3. Stationary Phase
  4. Death/ Decline Phase.
- These phases reflect the physiologic state of the organisms in the culture at that particular time.

# Bacterial Growth Curve showing different phases of growth



# Lag phase

- The inoculated bacteria become accustomed and adjust to their new environment (fresh growth medium).
- As the cells are not dividing, the population remains at the same number and there is no net increase in cell mass.
- Metabolic activity is taking place, during which the necessary enzymes and metabolic intermediates are built up in adequate quantities for preparing cell to undergo division

# Logarithmic phase, or log phase

- Following the lag phase, bacterial cells start to actively grow and divide at optimal level and the population size doubles rapidly at the maximal rate.
- Numbers increase exponentially or by geometric progression with time.
- If the logarithm of the viable count is plotted against time, a straight line will be obtained.
- The log phase is preferred phase of growth for experimental studies and industrial metabolite productions.
- However, microorganisms are also particularly sensitive to adverse conditions, during their log phase of growth.

# The stationary phase

- In a closed growth system, active exponential growth leads to the nutrient exhaustion, accumulation of waste, and unfavorable environmental conditions (change in pH, decrease in oxygen tension, toxic substance)
- This eventually lead to cessation of growth and bacterial death.
- The reproduction of bacterial cells is offset by their death, and the population reaches a plateau.
- Bacteria in a batch culture may enter stationary phase in response to starvation and produce a variety of starvation proteins, which make the cell much more resistant to damage .
- They increase cell wall cross-linking and strength. The DNA-binding protein protein protects DNA. Chaperones prevent protein denaturation and renature damaged proteins. Hence the starved cells become more resistant and difficult to kill.

# Death phase

- If the conditions are not altered, the population will enter its **decline**, or **death phase**
- The bacteria die off rapidly, the curve turns downward, and the last cell in the population soon dies.
- Like bacterial growth, death is exponential cell death may also be caused by autolysis besides nutrient deprivation and buildup of toxic wastes.



# References

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