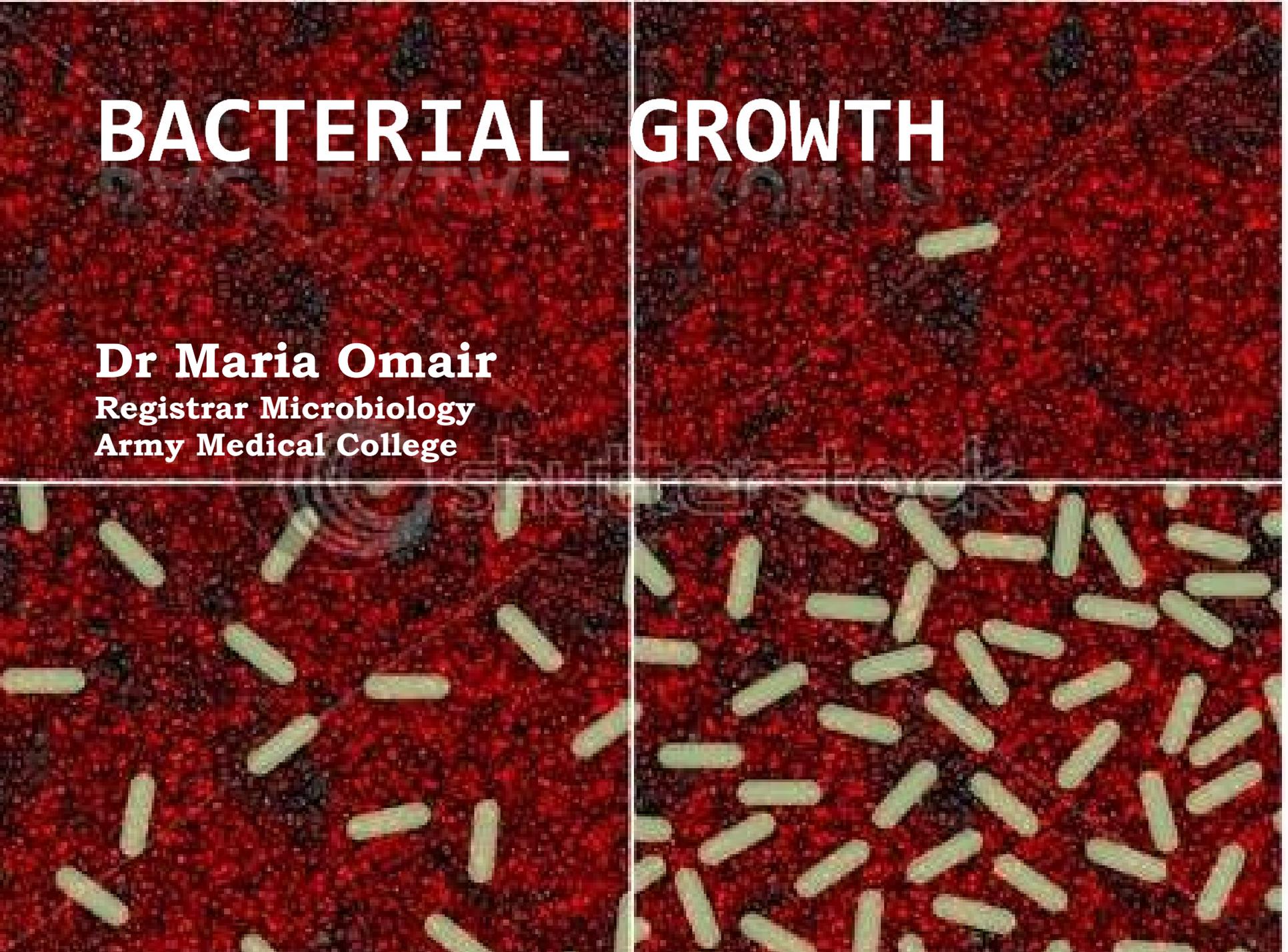


BACTERIAL GROWTH

The image is a composite of four panels showing bacterial growth on a red agar surface. The top-left panel shows a single rod-shaped bacterium. The top-right panel shows a few scattered rod-shaped bacteria. The bottom-left panel shows a moderate number of rod-shaped bacteria. The bottom-right panel shows a dense population of rod-shaped bacteria, illustrating exponential growth.

Dr Maria Omair
Registrar Microbiology
Army Medical College

Training objectives

- Introduction to the topic
- Understand exam scenarios
- Prepare for viva voce



Bacterial Growth

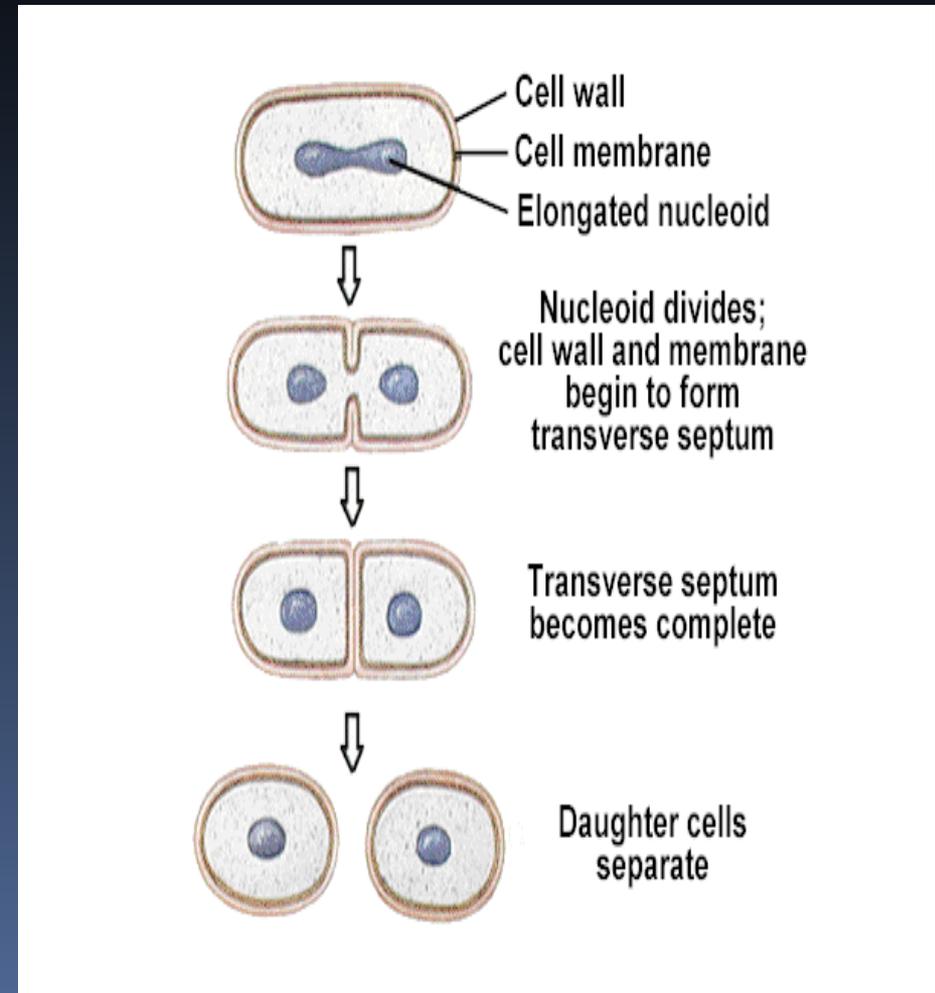
Bacteria divide by a Process called Binary Fission



"We should never have committed binary fission!"

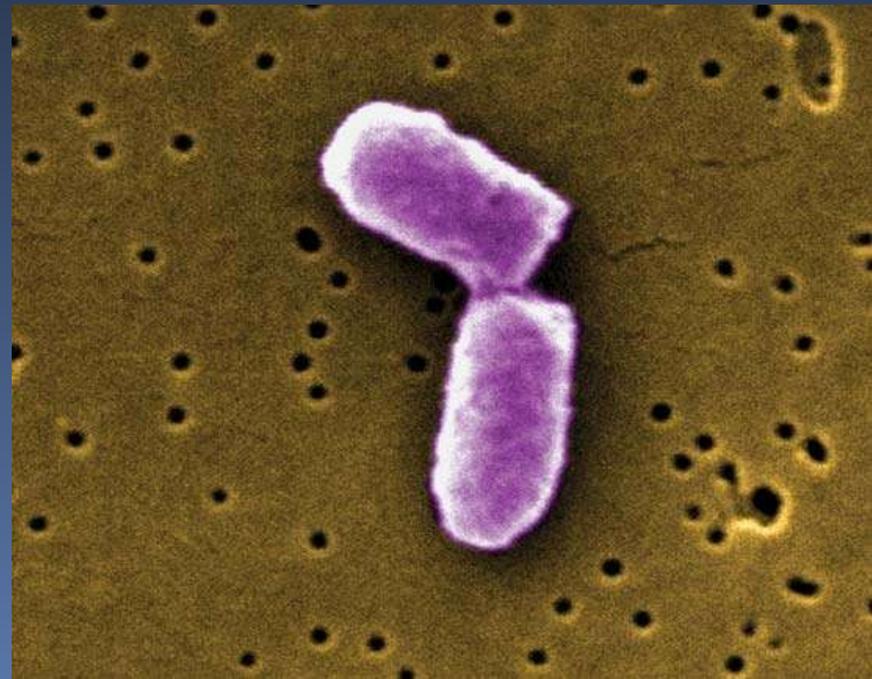
Binary Fission

- Binary Fission is a type of Asexual reproduction in single celled organisms
- Each cell divides into 2 equal sized offspring



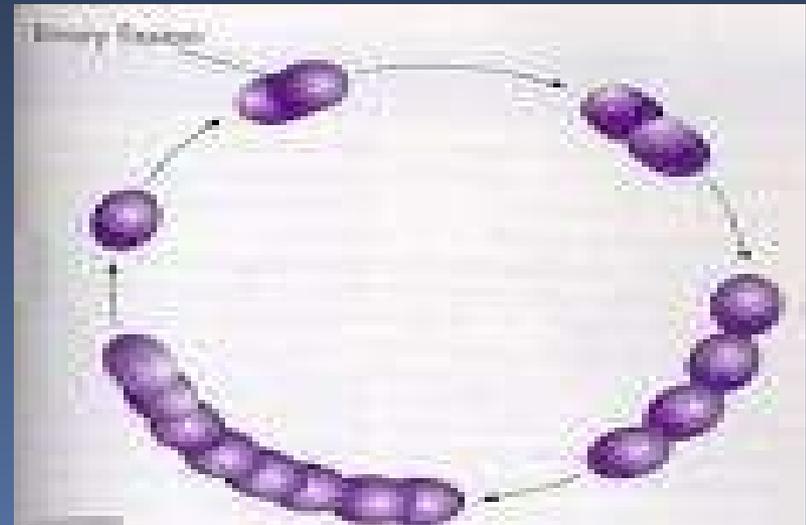
Bacterial Doubling Time

- *Escherichia coli* 20 minutes
- *Mycobacterium tuberculosis* 18 hours
- *Mycobacterium leprae* 14 days

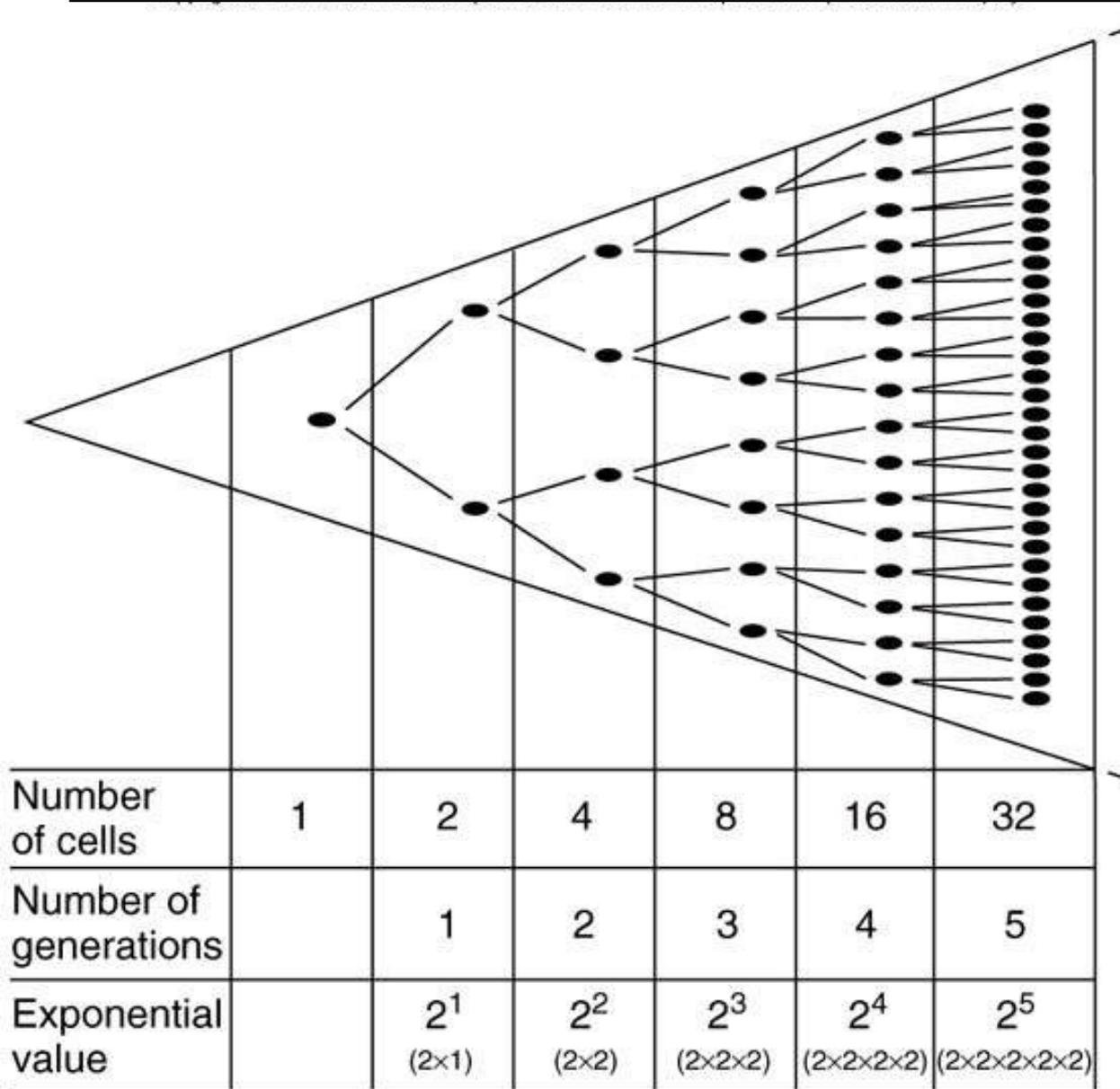


Logarithmic or Exponential Growth

The population of bacterial cells divide at a constant rate so that the total number of cells doubles with each division

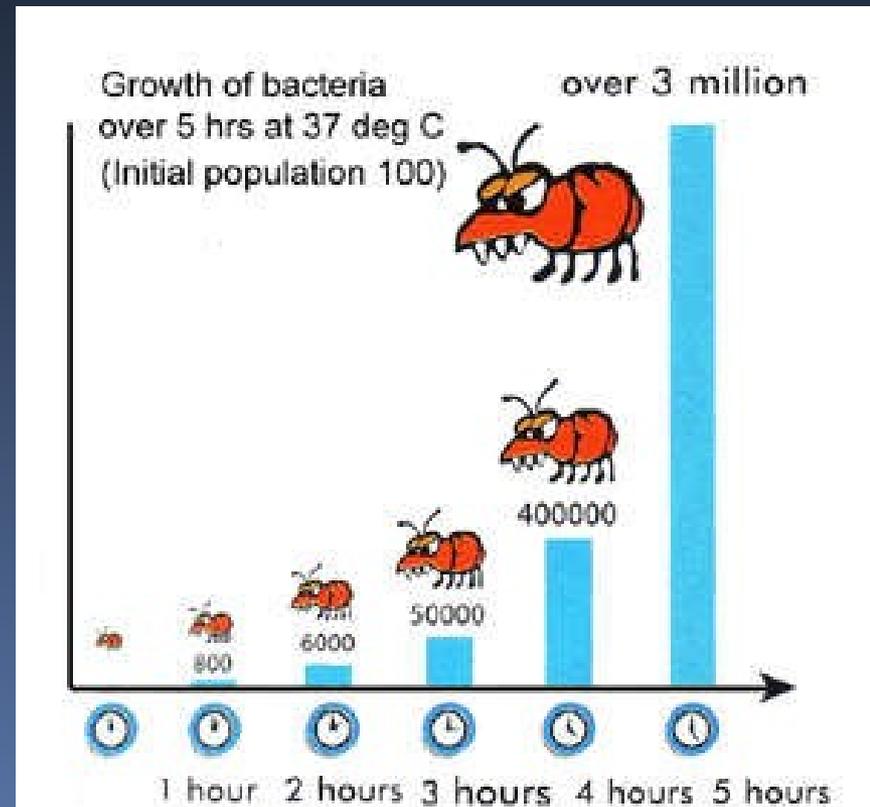


Bacteria Undergo Exponential Growth



Stages of Bacterial Growth

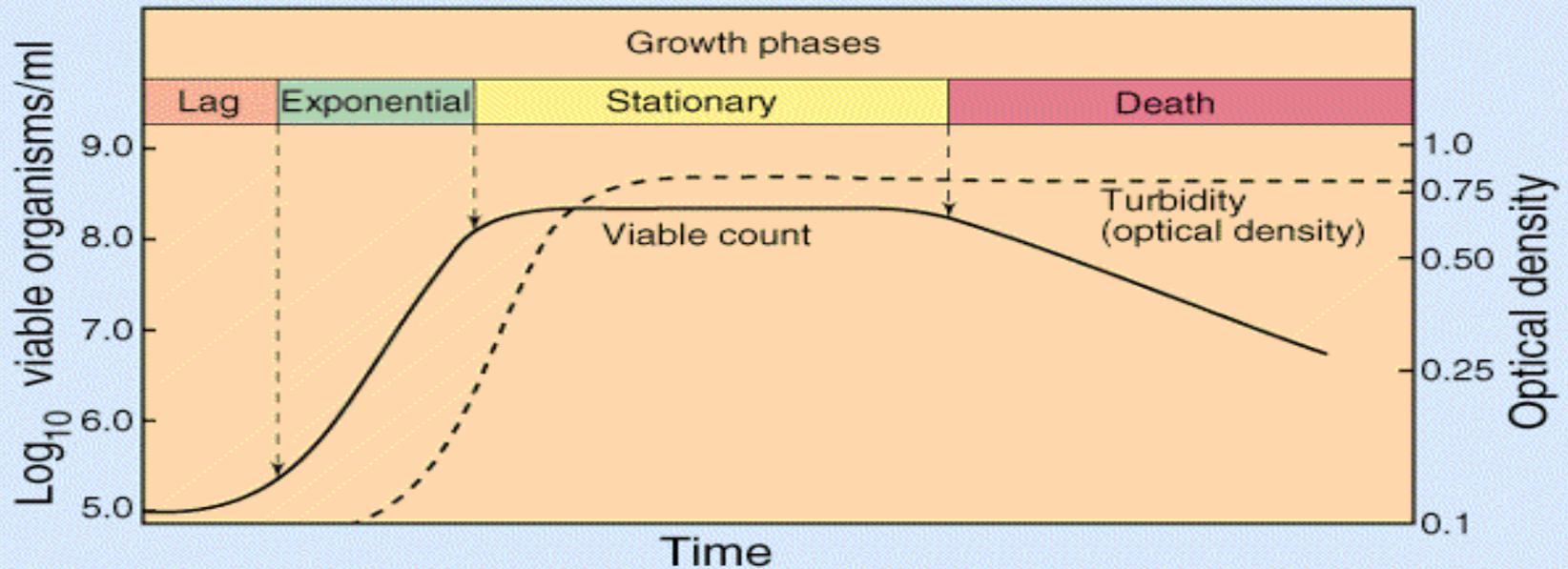
- Lag
- Log (logarithmic)
- Stationary
- Death

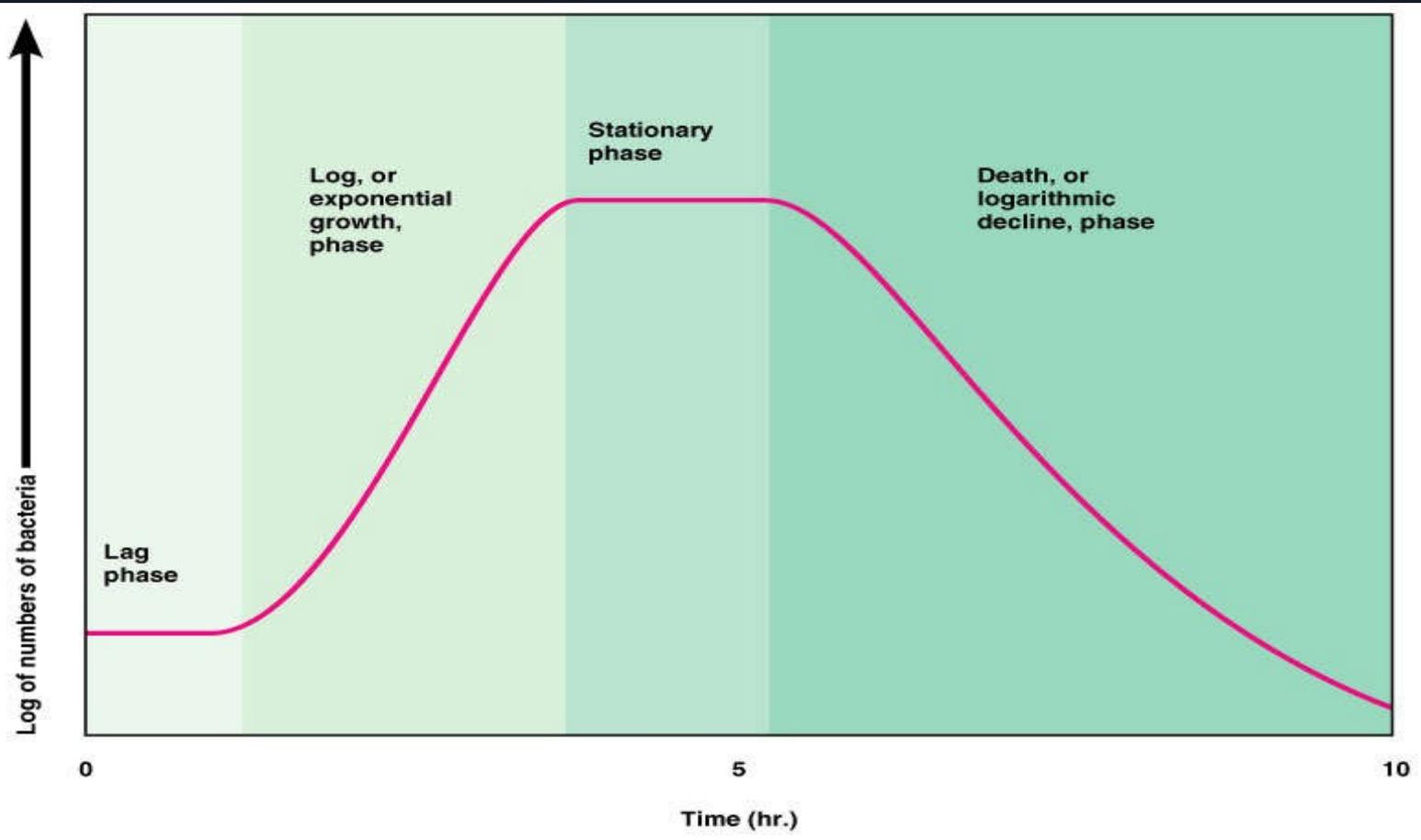


Stages of Bacterial Growth

- Lag Adapt to nutrients
- Log Active Growth
- Stationary Growth equals death
- Death Nutrients Consumed

Stages of Bacterial growth







Factors affecting Bacterial Growth

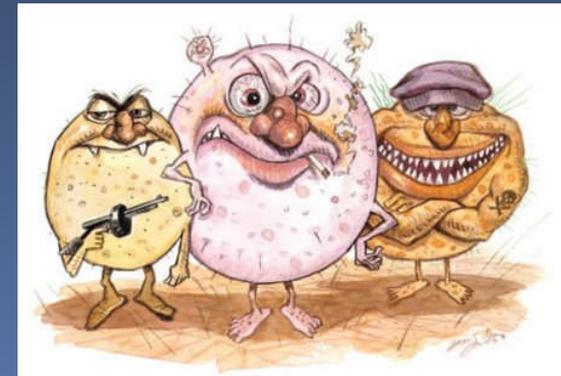
- Amount of nutrients
 - Temperature
 - pH
 - Other Environmental factors
- 

Classification based upon Nutrient requirements

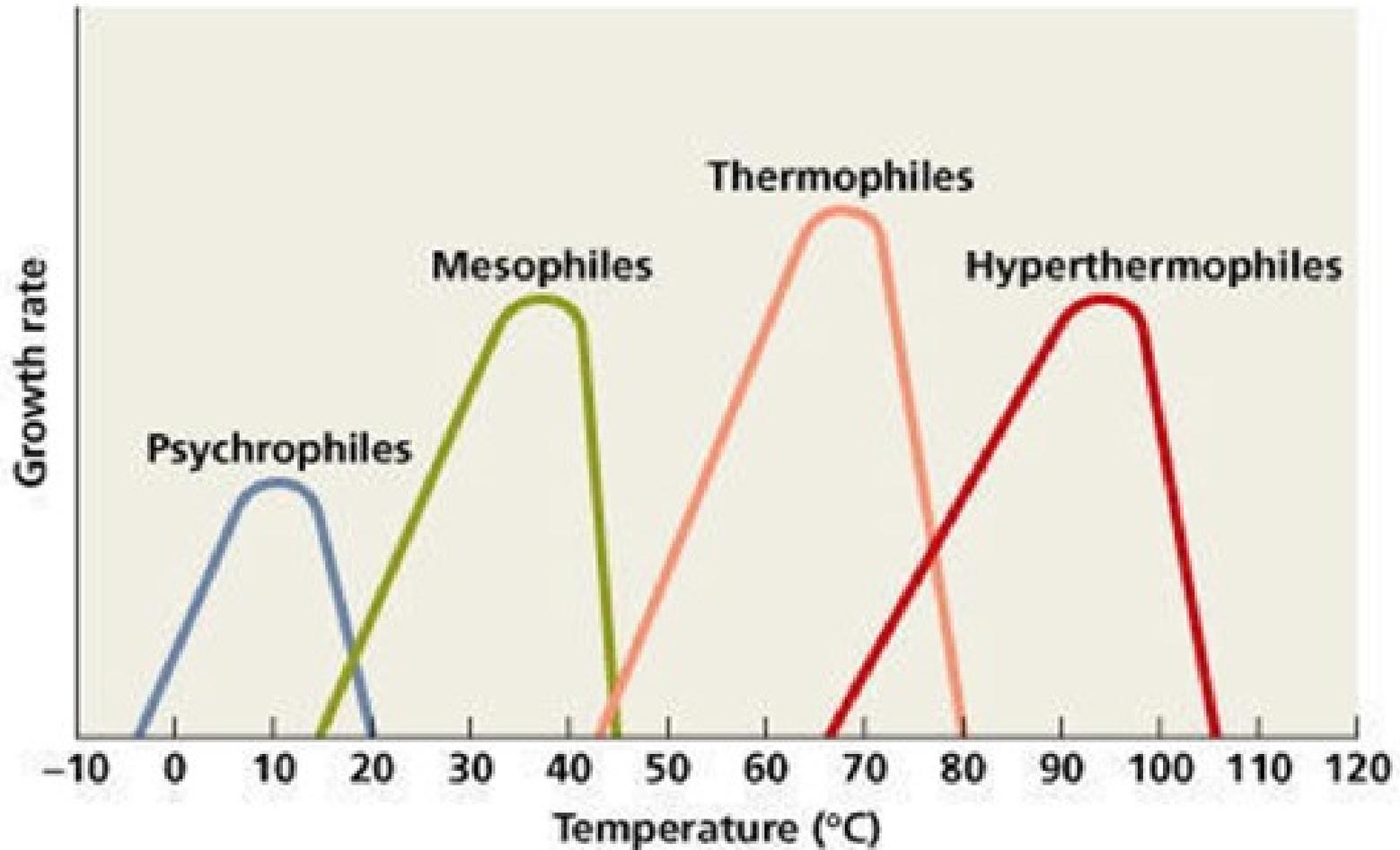
- Auxotrophs
 - Can live on simple compounds
 - NO_3^- , Glucose
 - Make all Amino Acids, Vitamins, etc.
- Prototrophs
 - Require complex compounds
 - Vitamins, Amino Acids
 - Fastidious
 - Most Pathogens

Classification based upon temperature requirements

- Mesophiles
 - Organisms which are able to grow at 20-40°C
 - Most of the human pathogens
- Psychrophiles
 - Organisms which grow best at <10°C
 - Capable of growth in pharmaceuticals and foods stored in refrigerator
- Thermophiles
 - Organisms which grow best at >60°C



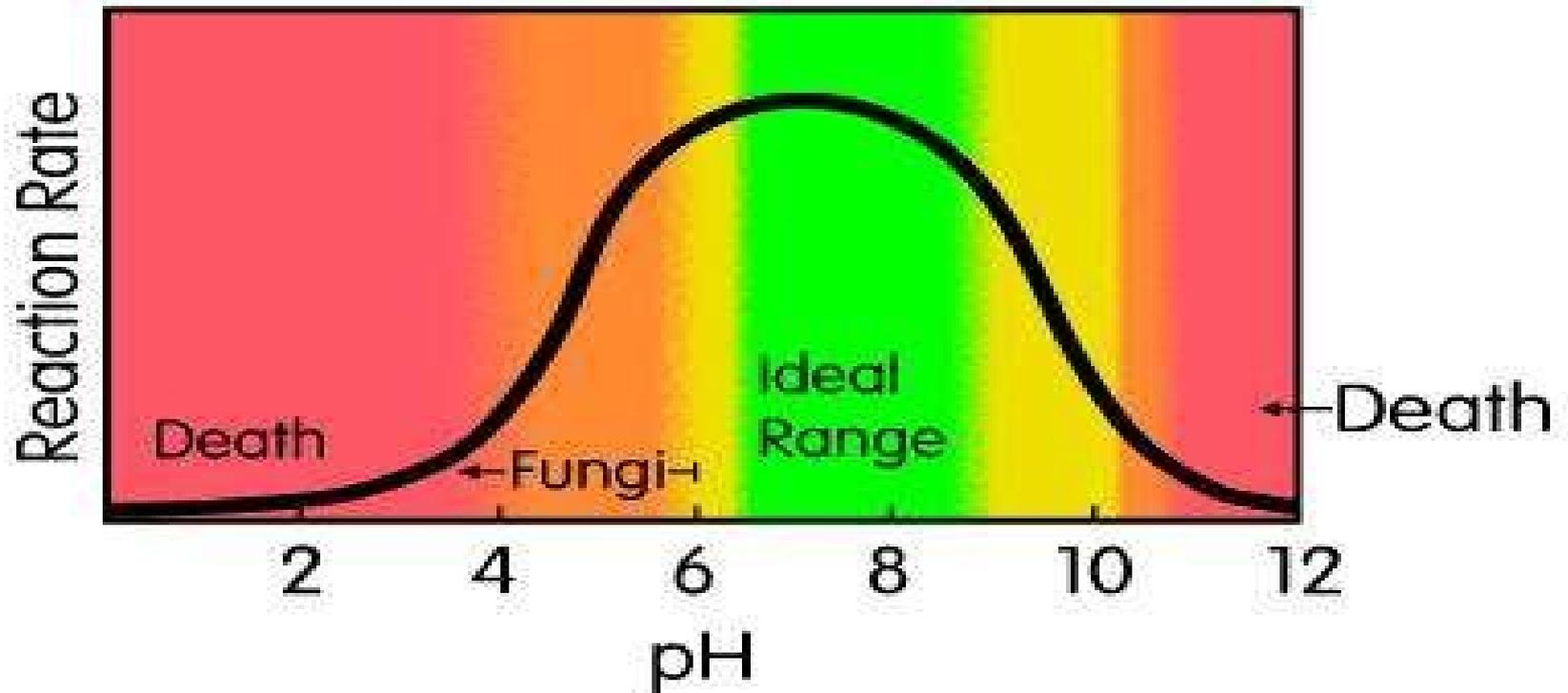
Effect of Temp on Growth



Classification based upon pH requirements

- Acidophiles (pH <5.0)
 - Organisms that grow at a low pH e.g. *Lactobacillus* spp., *Thiobacillus ferrooxidans*
- Neutrophiles (pH 6.0-8.0)
 - Organisms that grow at a neutral pH
 - Most of human pathogens
- Alkaliphiles (pH 8.5-10.5)
 - Organisms that grow at a high salt conc. or at high pH e.g. *Vibrio* spp., *Bacillus alcalophilus*

Effect of pH on Bacterial Growth



Classification based upon Oxygen requirements

- Strict Aerobes
 - Grow only in the presence of ambient oxygen (21%)
 - e.g. *Mycobacterium tuberculosis*, *Pseudomonas aeruginosa*
- Strict Anaerobes
 - Grow only in the absence of oxygen
 - *Bacteroides fragilis*

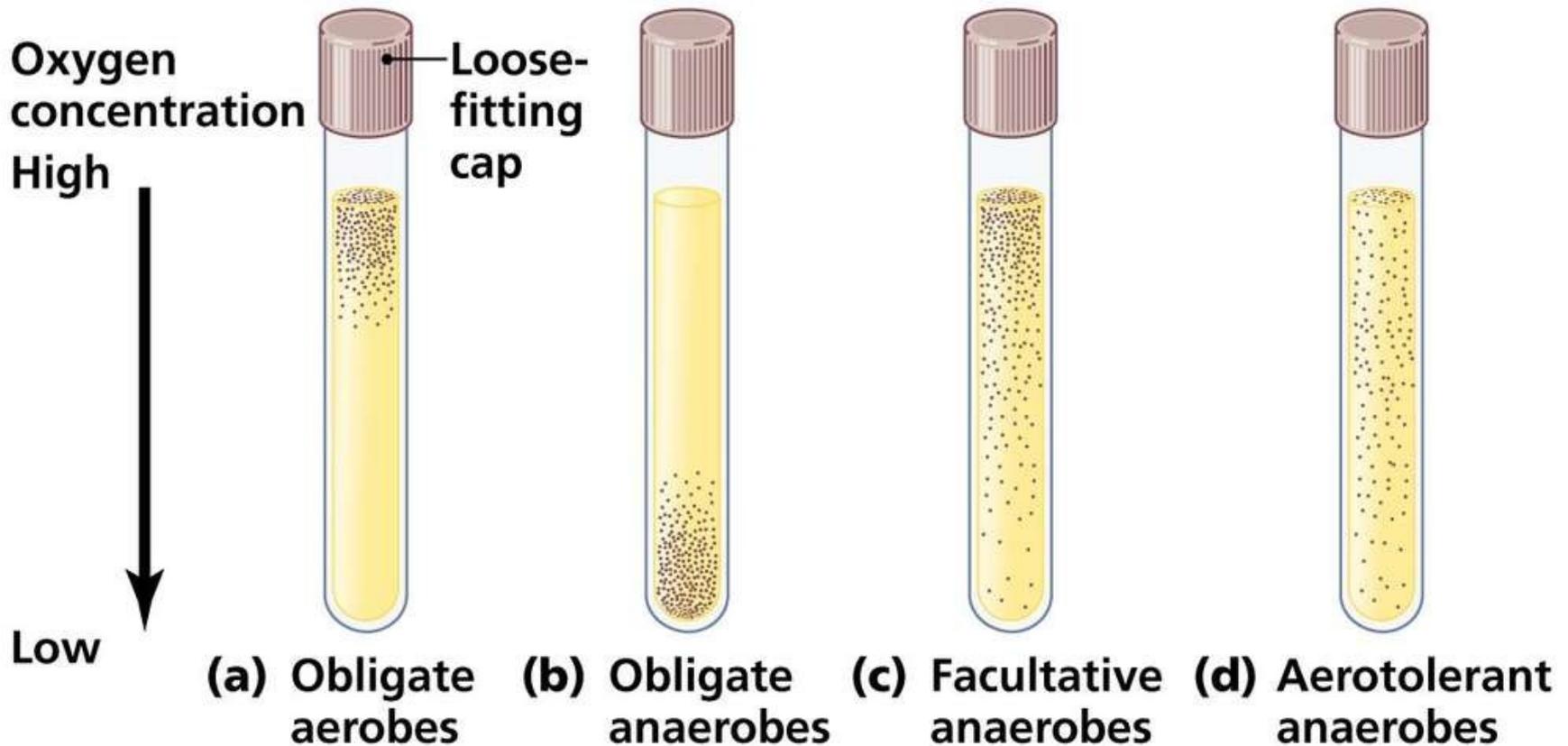
Classification based upon Oxygen requirements (Contd.)

- Facultative Anaerobes
 - Can grow in anaerobic environment but grow best in aerobic environment
 - e.g. *Staphylococcus aureus*, *Escherichia coli*
- Aerotolerant anaerobes
 - Are anaerobes but can tolerate exposure to oxygen
 - e.g. *Clostridium perfringens*

Classification based upon Oxygen requirements (Contd.)

- Microaerophilic
 - Require or prefer decreased oxygen environment (5%)
 - e.g. *Campylobacter jejuni*, *Helicobacter pylori*
- Capnophilic
 - Require or prefer increased CO₂ environment
 - e.g. *Neisseria meningitidis*

Effect of Oxygen Concentration on Bacterial Growth







Questions?

