RESURCH

BACTERIAL GROWTH CURVE

Subtitle: Microbiology Presentation

Section: 158

Instructor: Dr. Jenan Al-Otaibi

Introduction

This presentation covers the principles of bacterial growth, a key concept in microbiology and biotechnology. Bacteria multiply through binary fission, resulting in exponential population increases under favorable conditions. The bacterial growth curve, consisting of four phases—lag, log, stationary, and death—reflects critical biological and environmental transitions. We will explore how factors like temperature, pH, oxygen, and nutrients impact microbial development, linking theory to real-world applications in medical, industrial, and ecological fields.

The Bacterial Growth Curve

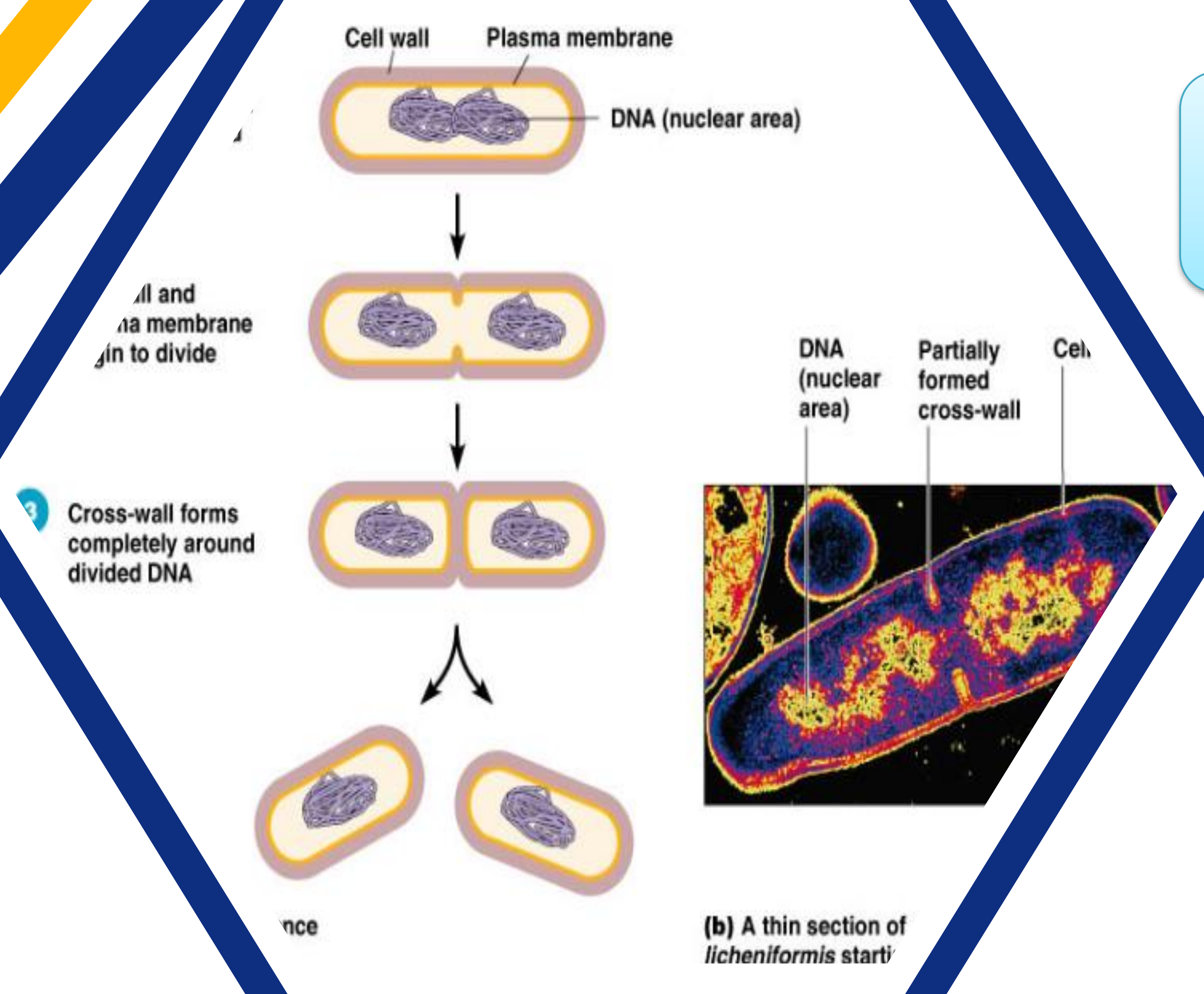
Diagram

Graph of cell number vs. time

4 distinct phases:

- ❑ Lag phase
- ❑ Exponential (log) phase
- ❑ Stationary phase
- ❑ Death phase

Lag Phase



No immediate cell division

Cells prepare for reproduction

Duration varies (minutes to hours)

Cellular activity without growth

Exponential Phase

01

Rapid cell division at constant rate

02

Generation time varies by species

03

Mathematical growth: 1→2→4→8→16 (2^n)

04

Example: E. coli doubles every 20 min

Stationary Phase

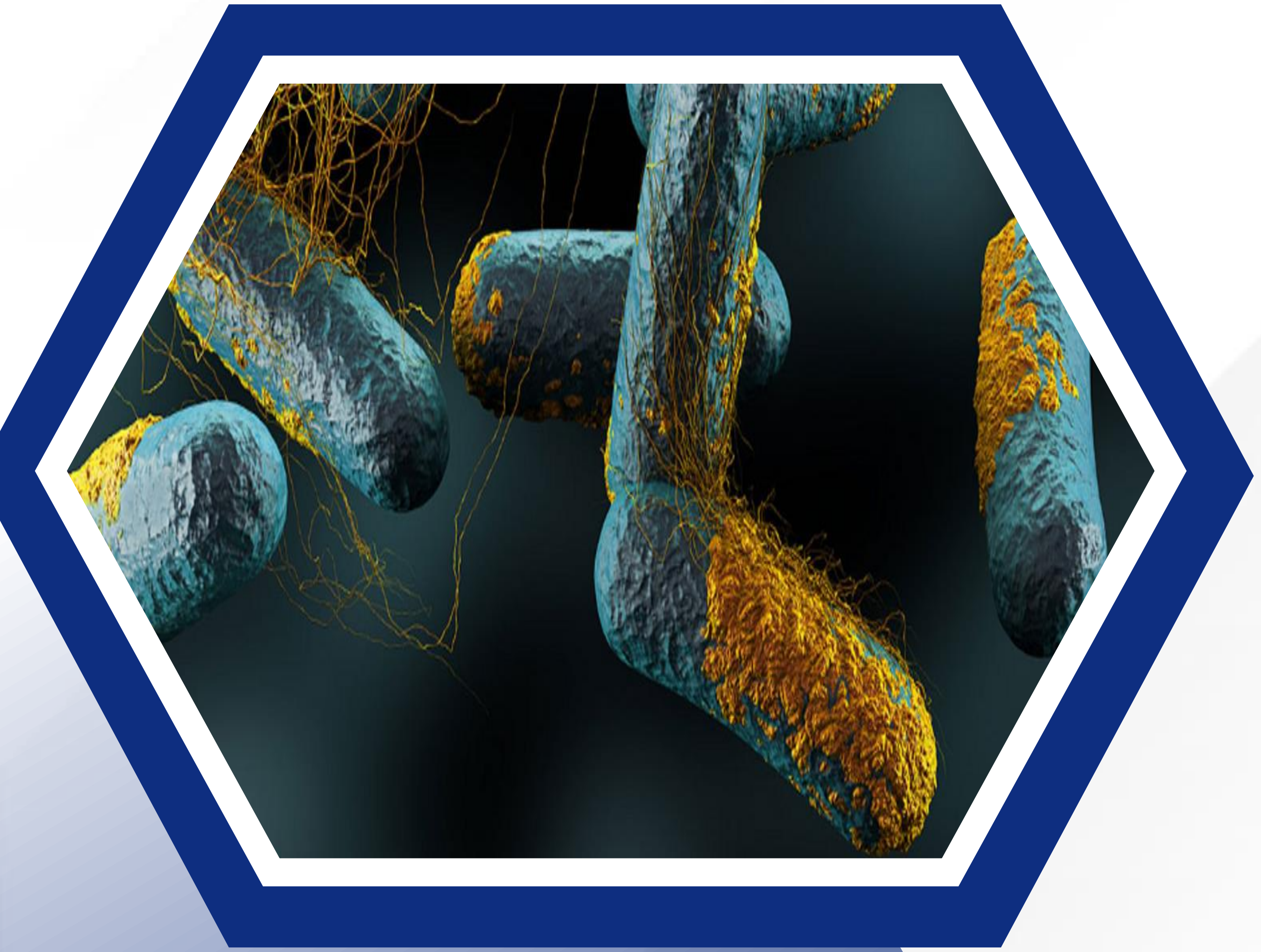
Growth slows/stops due to:

01 Nutrient depletion

02 Waste accumulation

03 Limited space

Death Phase



- Exponential cell death
- Loss of division capability
- Some may survive as endospores

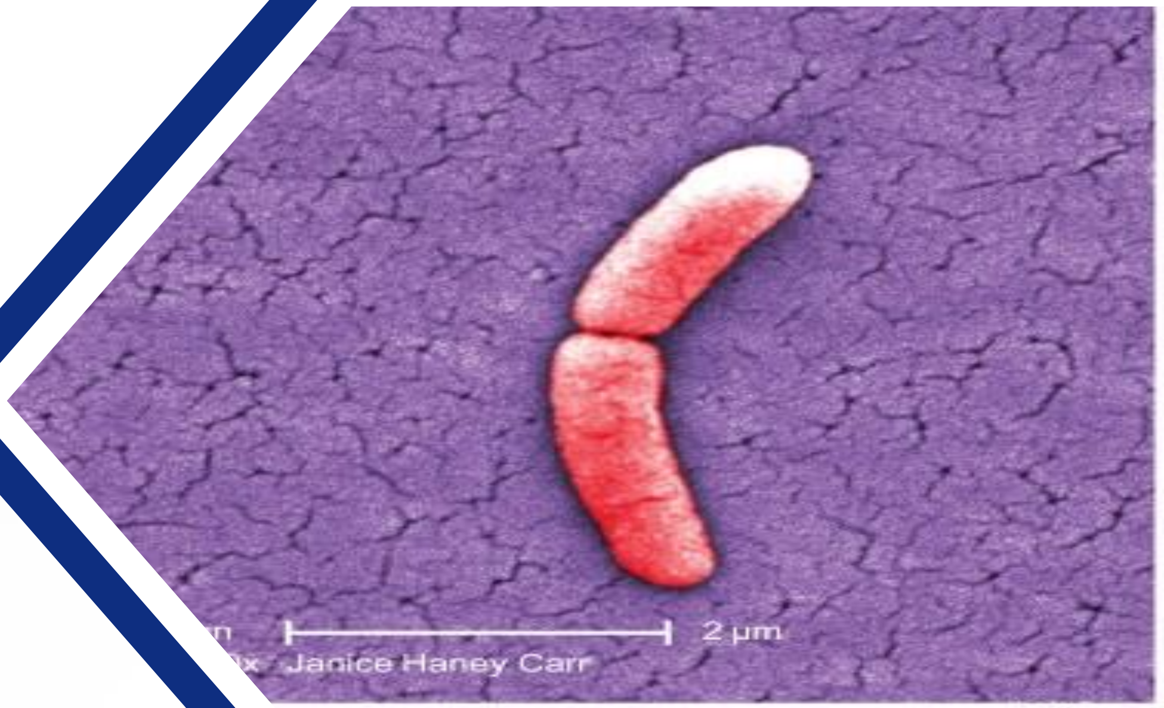
Generation Time Calculation

Formula: G = t/n

(G=generation time, t=time, n=number of generations)

Example calculation

Comparison table of different bacteria



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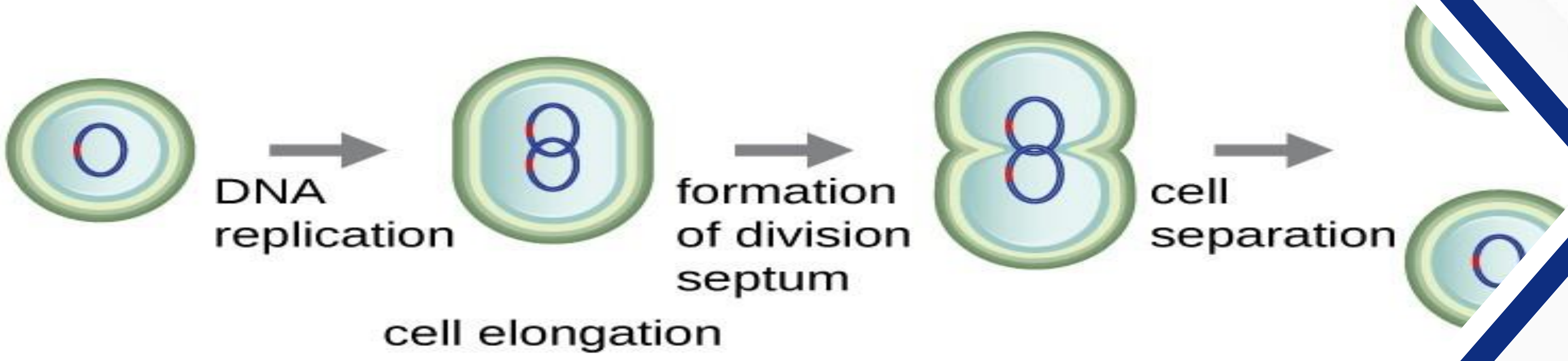

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Physical Growth Factors

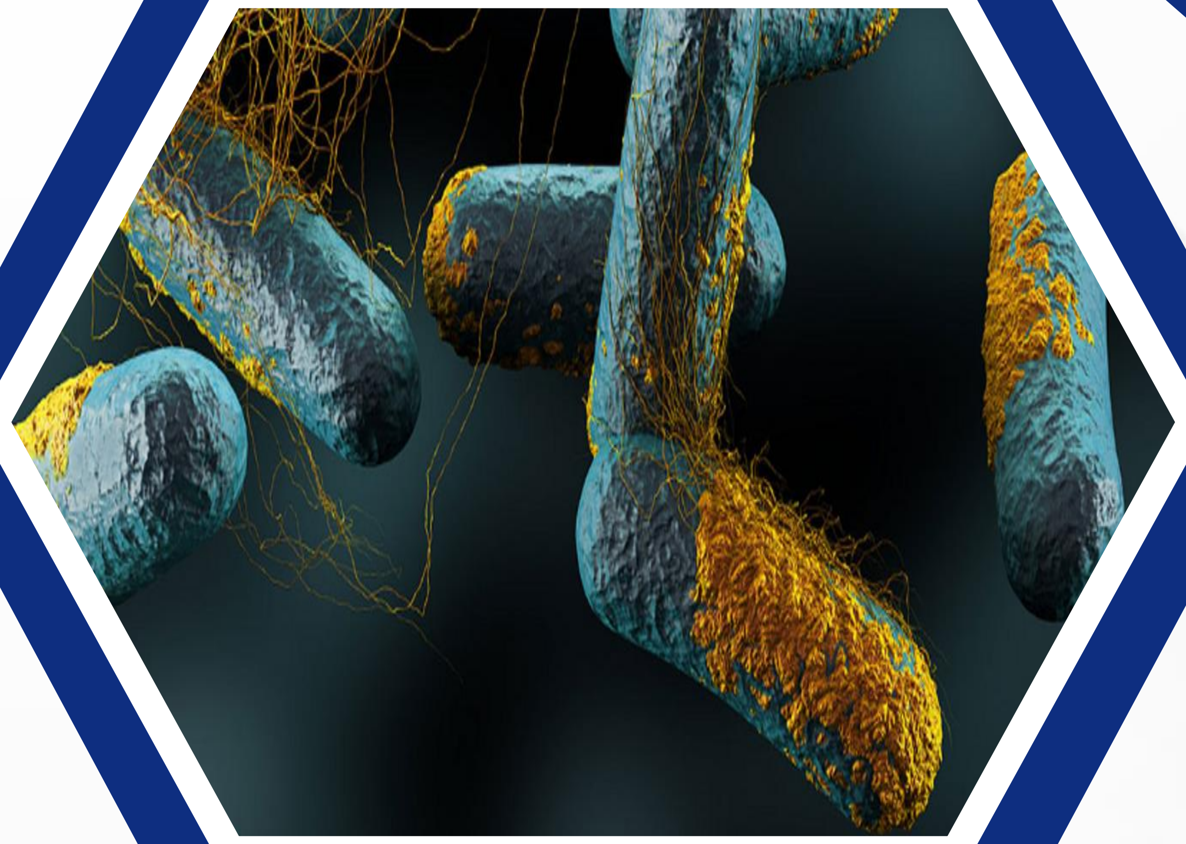
1.Temperature

2.pH

3.Osmotic pressure

4.Radiation

5.Hydrostatic pressure



Temperature

Requirements

Minimum/Optimum/Maximum temps

Psychrophiles (-20°C to +10°C)

Mesophiles (20°C to 45°C) - most pathogens

Thermophiles (45°C to 80°C)

pH Requirements

- Acidophiles (pH 0.1-5.4)
- Neutrophiles (pH 5.4-8.5)
- Alkaliphiles (pH 7-12)
- Most prefer neutral pH (6.5-7.5)

Osmotic Pressure

Hypertonic solutions cause plasmolysis

Hypotonic solutions may lyse cells

Halophiles (salt-loving bacteria)

Chemical Requirements

Carbon sources

Oxygen requirements

Nitrogen, phosphorus, sulfur

Oxygen Requirements

Obligate aerobes (require O_2)

Facultative anaerobes (prefer O_2 but can live without)

Facultative anaerobes (prefer O_2 but can live without)

Obligate anaerobes (harmed by O_2)

Applications
Medicine

Understanding bacterial growth helps:

- Develop antibiotics
- Create sterilization methods
- Design infection control protocols

Applications
Food Industry

Pasteurization based on temp. sensitivity

Food preservation methods:

- Salting (hypertonic)
- Pickling (acidic pH)
- Refrigeration (low temp)

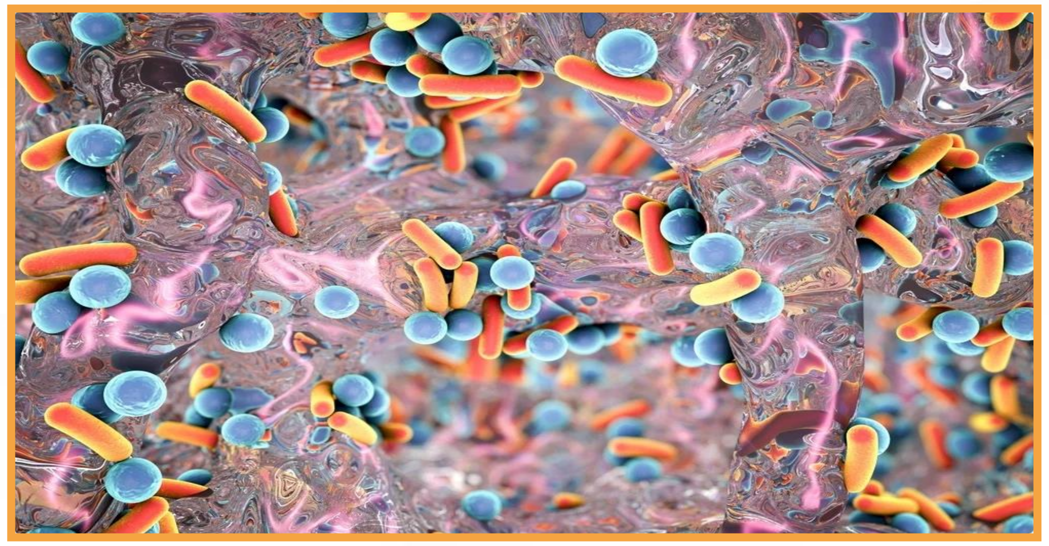
Bacterial Growth in Lab

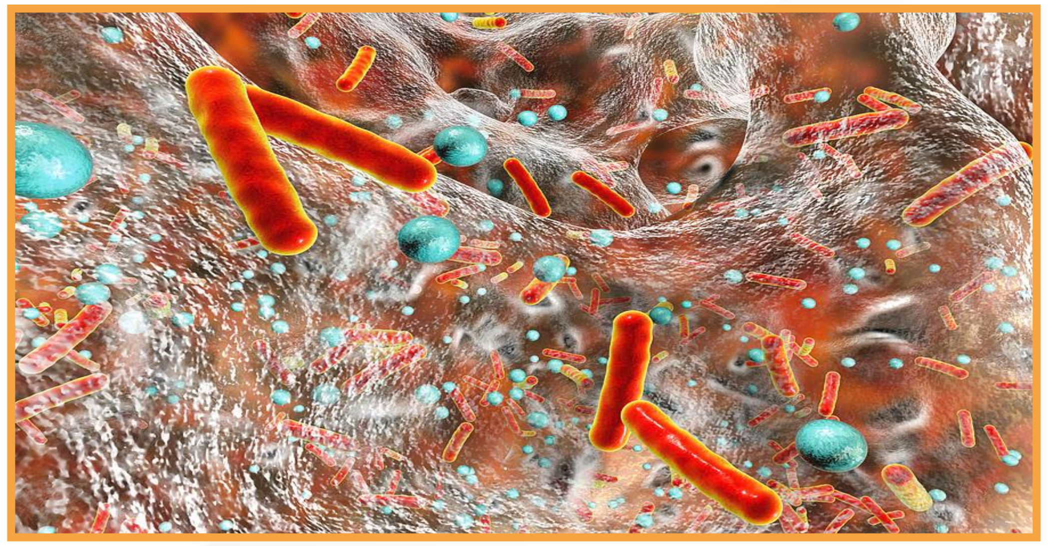
Culture media types:

Liquid (broth)

Solid (agar)

Biofilms





Complex bacterial communities

Protective extracellular matrix

Medical significance (catheters, implants)

Quorum Sensing

Cell-to-cell communication

Coordinates group behaviors

Regulates virulence factors

Spore Formation

- Survival mechanism
- Resistant to heat, chemicals
- Example: Clostridium, Bacillus

Antibiotic Resistance

- Fast reproduction → rapid evolution
- Horizontal gene transfer
- Importance of complete antibiotic courses

Beneficial Bacteria

- Gut microbiome
- Food production (yogurt, cheese)
- Environmental cleanup

Current Research

Microbiome studies

Phage therapy

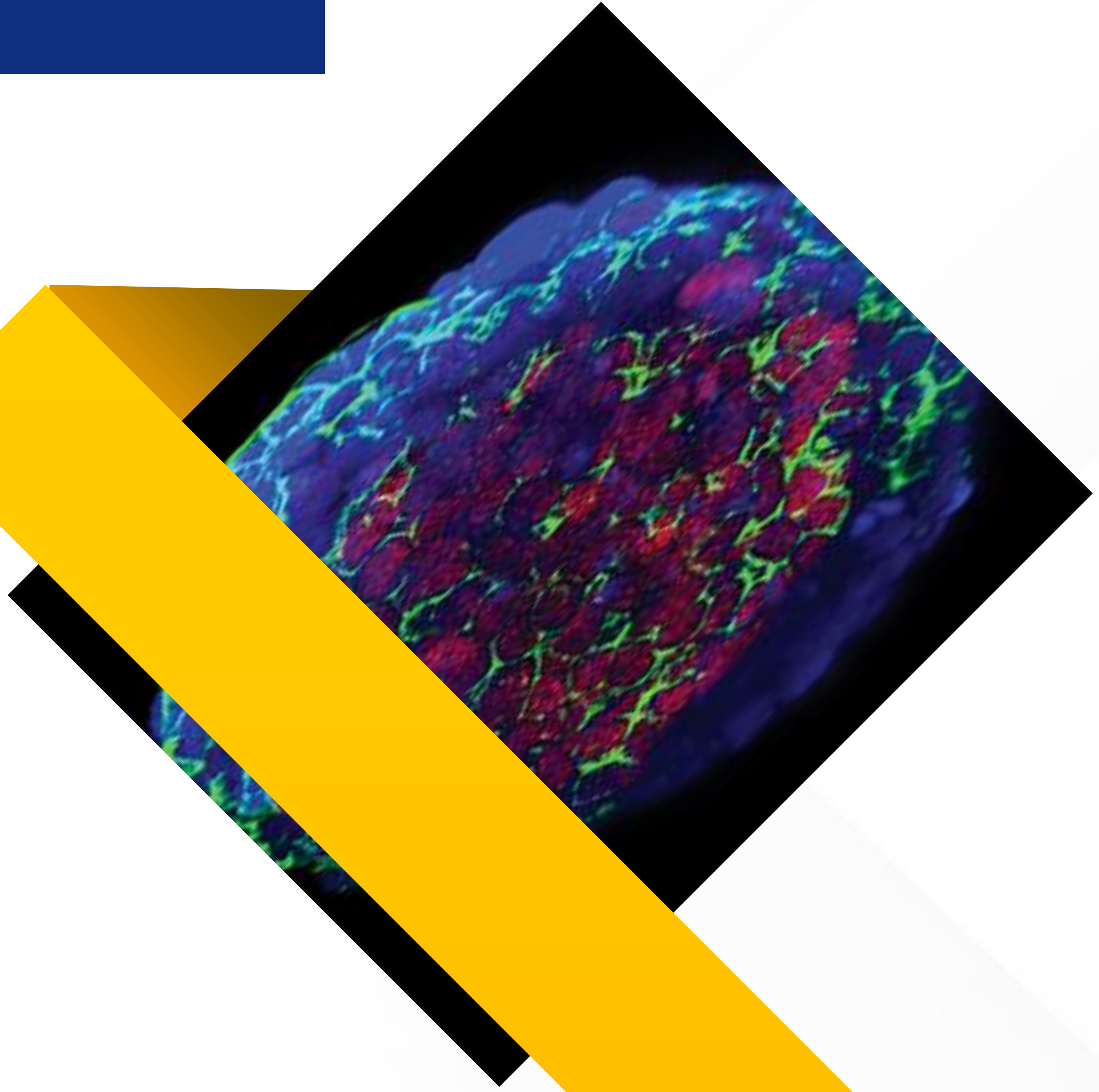
Synthetic biology

Summary

The bacterial growth curve demonstrates the dynamic nature of microbial populations under varying conditions. Understanding the four phases—lag, exponential, stationary, and death—helps predict bacterial behavior in labs, medicine, and industry. Physical factors (temperature, pH, osmotic pressure) and chemical requirements (oxygen, nutrients) dictate growth rates, enabling targeted control methods. This knowledge is vital for antibiotic development, food safety, and combating antibiotic resistance.

- Bacterial growth has 4 phases
- Many physical/chemical factors affect growth
- Knowledge applied in medicine, food safety

Quiz/Review Questions



- What happens during lag phase?
- How does pH affect bacteria?
- Why is exponential phase dangerous for infections?

Presented By

Microbiology Section: 158

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