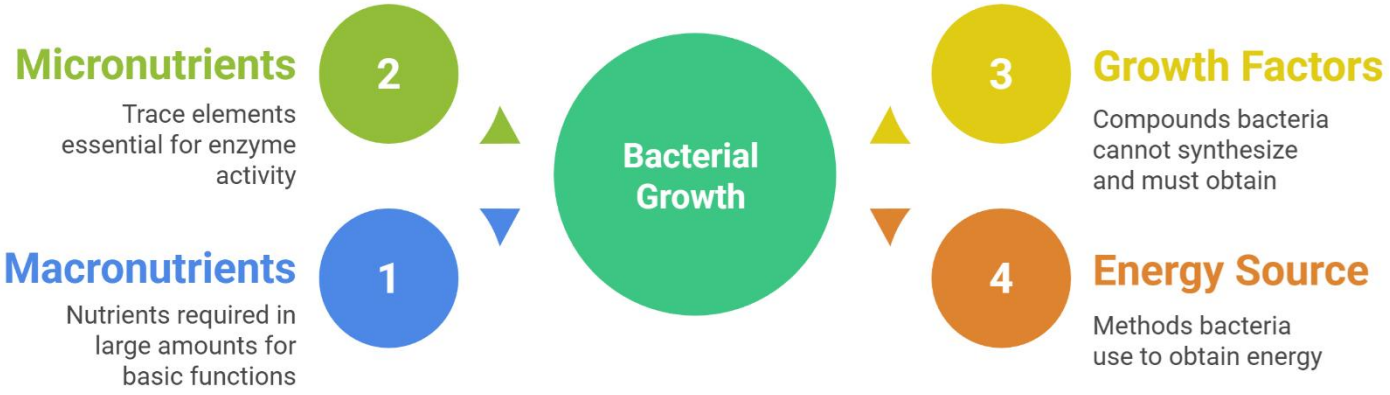
Bacteria

Nutritional Requirements of Bacteria

- Bacteria require a variety of nutrients for growth and reproduction.

These nutrients can be broadly classified into:



A. Macronutrients:

These are required in large amounts.

1. **Carbon (C):**
   - Most essential element.
   - Needed for cellular structures and energy.
   - Can be derived from organic compounds (heterotrophs) or carbon dioxide (autotrophs).
2. **Nitrogen (N):**
   - Important for proteins, nucleic acids, and other cellular components.
   - Sources include ammonia (NH_3), nitrates (NO_3^-), or nitrogen gas (N_2 in nitrogen-fixing bacteria).
3. **Hydrogen (H):**
   - Found in water and organic compounds.
   - Necessary for redox reactions and organic compound formation.
4. **Oxygen (O):**
   - Present in water and organic compounds.
   - Acts as a terminal electron acceptor in aerobic respiration.
5. **Phosphorus (P):**
   - Essential for ATP, nucleic acids, and phospholipids.
   - Supplied as phosphate ions (PO_4^{3-}).

6. **Sulfur (S):**
    - Found in amino acids like cysteine and methionine.
    - Available as sulfate (SO_4^{2-}) or in organic sulfur sources.
7. **Potassium (K), Magnesium (Mg), Calcium (Ca), and Iron (Fe):**
    - Required for enzyme function, membrane stability, and electron transport.

B. Micronutrients (Trace Elements):

- Required in minute amounts for enzyme activity.
- **Examples:** Zinc (Zn), Manganese (Mn), Cobalt (Co), Molybdenum (Mo), Copper (Cu), Nickel (Ni).

C. Growth Factors:

- Some bacteria cannot synthesize all compounds they need, so they must obtain these from the environment.
- **Examples:**
    - Vitamins (e.g., niacin, biotin)
    - Amino acids
    - Purines and pyrimidines

D. Energy Source:

- Bacteria can be classified based on how they obtain energy.
    - **Phototrophs:** Use light (e.g., Cyanobacteria).
    - **Chemotrophs:** Use chemical compounds.
        - **Chemoorganotrophs:** Use organic molecules.
        - **Chemolithotrophs:** Use inorganic substances (e.g., H_2S, NH_3).

Growth of Bacteria

Bacterial growth refers to **an increase in the number of cells**, not the size of individual cells.

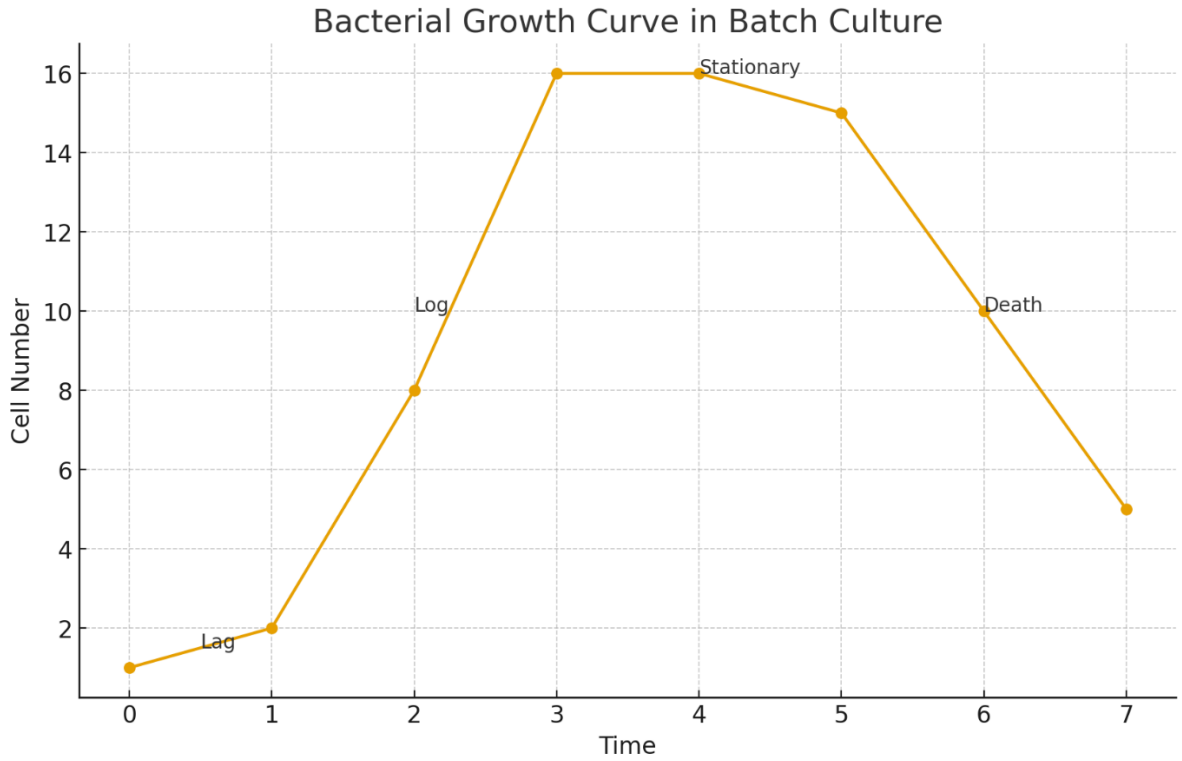
Binary Fission:

- Main mode of reproduction in bacteria.
- One cell divides into two identical daughter cells.
- **Steps:**
    1. DNA replication.
    2. Elongation of the cell.

3. Septum formation.
4. Cell separation.

Growth Curve (in Batch Culture):

Occurs in four phases when bacteria are cultured in a closed system:



A. Lag Phase:

- Adaptation period.
- Cells metabolically active but not dividing.
- Enzymes and proteins are synthesized.

B. Log (Exponential) Phase:

- Rapid cell division.
- Cells most metabolically active.
- Used for biochemical studies and antibiotic susceptibility tests.

C. Stationary Phase:

- Nutrient depletion and waste accumulation.
- Growth rate = death rate.
- Some cells form endospores (e.g., Bacillus, Clostridium).

D. Death (Decline) Phase:

- Cell death exceeds growth.
- Population declines.

Generation Time:

- Time taken for one cell to divide into two.
- Varies with species and conditions (e.g., *E. coli* ~20 minutes under optimal conditions).

Cultivation of Bacteria

Cultivating bacteria involves providing appropriate environmental conditions and nutrients for their growth.

Physical Conditions:

A. Temperature:

- Psychrophiles (0–20°C)
- Mesophiles (20–45°C)
- Thermophiles (45–80°C)
- Hyperthermophiles (>80°C)

B. pH:

- Most bacteria prefer pH 6.5–7.5.
- Acidophiles and alkaliphiles grow in extreme pH ranges.

C. Oxygen Requirements:

- **Obligate aerobes:** Need O_2.
- **Obligate anaerobes:** Killed by O_2.
- **Facultative anaerobes:** Grow with or without O_2.
- **Microaerophiles:** Require low O_2.
- **Aerotolerant anaerobes:** Do not use O_2 but can tolerate it.

D. Water and Osmotic Pressure:

- Bacteria need water.
- Halophiles grow in high salt concentrations.

Culture Media:

- Culture media are nutrient preparations used to grow bacteria in the lab.

Types of Media:

A. Based on consistency:

- Liquid (broth)

- Semi-solid
- Solid (with agar)

B. Based on purpose:

- **Basic (nutrient) media:** For general bacterial growth.
- **Enriched media:** Contains additional nutrients (e.g., blood agar).
- **Selective media:** Inhibits some organisms, allows others (e.g., MacConkey agar inhibits Gram-positives).
- **Differential media:** Shows visible differences (e.g., lactose fermenters on MacConkey agar).
- **Transport media:** Preserves specimens during transport.

Aseptic Techniques:

- Prevent contamination of cultures and environment.
- Includes sterilization, flame techniques, and use of sterile instruments.

First Hope

FREE PREVIEW

Click here to visit our website

PHARMACY PREMIUM NOTES

Complete subject and semesters are available on FirstHope app only.

Scan or click here

Click here to get the app >

Available on Google Play

JOIN THE FIRSTHOPE COMMUNITY

Join our Telegram channel

Click here to join Telegram >

Scan or click here

@FirstHopeNotes

Instagram

@firsthope.official

Click here to follow >

YouTube channel

FirstHope-Pharmacy / Live streams

Click here to watch >

WhatsApp channel

Follow FirstHope on WhatsApp

Click here to join >

FirstHope website

firsthope.co.in

Click here to visit >

B.Pharm / D.Pharm / M.Pharm / Pharm.D

Preview notes. Complete subjects and semesters in the FirstHope app.