

Study Outline Chapter 06

The Requirements for Growth (pp. 154- 162)

- The growth of a population is an increase in the number of cells or in mass.
- The requirements for microbial growth are both physical and chemical.

Physical Requirements (pp. 154- 158)

- On the basis of growth range of temperature, microbes are classified as psychrophiles (cold-loving), mesophiles (moderate-temperature- loving), and thermophiles (heat-loving).
- The minimum growth temperature is the lowest temperature at which a species will grow, the optimum growth temperature is the temperature at which it grows best, and the maximum growth temperature is the highest temperature at which growth is possible.
- Most bacteria grow best at a pH value between 6.5 and 7.5.
- In a hypertonic solution, most microbes undergo plasmolysis; halophiles can tolerate high salt concentrations.

Chemical Requirements (pp. 158- 162)

- All organisms require a carbon source; chemoheterotrophs use an organic molecule, and autotrophs typically use carbon dioxide.
- Nitrogen is needed for protein and nucleic acid synthesis. Nitrogen can be obtained from the decomposition of proteins or from NH_4^+ or NO_3^- ; a few bacteria are capable of nitrogen (N_2) fixation.
- On the basis of oxygen requirements, organisms are classified as obligate aerobes, facultative anaerobes, obligate anaerobes, aerotolerant anaerobes, and microaerophiles.
- Aerobes, facultative anaerobes, and aerotolerant anaerobes must have the enzymes superoxide dismutase ($2 \text{O}_2 + 2 \text{H}^+ + 2 \text{H}_2\text{O}_2$) and either catalase ($2 \text{H}_2\text{O}_2 \rightarrow 2 \text{H}_2\text{O} + \text{O}_2$) or peroxidase ($\text{H}_2\text{O}_2 + 2 \text{H}^+ + 2 \text{H}_2\text{O}$).
- Other chemicals required for microbial growth include sulfur, phosphorus, trace elements, and, for some micro-organisms, organic growth factors.

Culture Media (pp. 162- 168)

- A culture medium is any material prepared for the growth of bacteria in a laboratory.
- Microbes that grow and multiply in or on a culture medium are known as a culture.
- Agar is a common solidifying agent for a culture medium.

Chemically Defined Media (p. 162)

- A chemically defined medium is one in which the exact chemical composition is known.

Complex Media (pp. 163- 164)

- A complex medium is one in which the exact chemical composition is not known.

Anaerobic Growth Media and Methods (p. 164)

- Reducing media chemically remove molecular oxygen (O₂) that might interfere with the growth of anaerobes.
- Petri plates can be incubated in an anaerobic jar or anaerobic chamber.

Special Culture Techniques (pp. 164- 166)

- Some parasitic and fastidious bacteria must be cultured in living animals or in cell cultures.
- CO₂ incubators or candle jars are used to grow bacteria requiring an increased CO₂ concentration.

Selective and Differential Media (p. 166)

- By inhibiting unwanted organisms with salts, dyes, or other chemicals, selective media allow growth of only the desired microbes.
- Differential media are used to distinguish among different organisms.

Enrichment Culture (pp. 166- 167)

- An enrichment culture is used to encourage the growth of a particular microorganism in a mixed culture.

Obtaining Pure Cultures (pp. 167- 168)

- Colonies are visible clones that have grown on solid media.
- Pure cultures are usually obtained by the streak plate method.

Preserving Bacterial Cultures (p. 168)

- Microbes can be preserved for long periods of time by deep-freezing or lyophilization (freeze-drying).

The Growth of Bacterial Cultures (pp. 169- 177)

Bacterial Division (p. 169)

- The normal reproductive method of bacteria is binary fission, in which a single cell divides into two identical cells.
- Each time a substance is oxidized, another is simultaneously reduced.
- Some bacteria reproduce by budding, aerial spore formation, or fragmentation.

Generation Time (pp. 169- 170)

- The time required for a cell to divide or a population to double is known as the generation time.

Logarithmic Representation of Bacterial Populations (p. 170)

- Bacterial division occurs according to a logarithmic progression (2 cells, 4 cells, 8 cells, etc.).

Phases of Growth (pp. 170- 171)

- During the lag phase, there is little or no change in the number of cells, but metabolic activity is high.
- During the log phase, the bacteria multiply at the fastest rate possible under the conditions provided.
- During the stationary phase, there is an equilibrium between cell division and death.
- During the death phase, the number of deaths exceeds the number of new cells formed.

Direct Measurement of Microbial Growth (pp. 171- 176)

- A standard plate count reflects the number of viable microbes and assumes that each bacterium grows into a single colony.
- A plate count may be done by either the pour plate method or the spread plate method.
- In filtration, bacteria are retained on the surface of a membrane filter and then transferred to a culture medium to grow and subsequently be counted.
- The most probable number (MPN) method can be used for microbes that will grow in a liquid medium; it is a statistical estimation.
- In a direct microscopic count, the microbes in a measured volume of a bacterial suspension are counted with the use of a specially designed slide.