Microbial Growth requirements
Microbial growth

- **Biomass**
- The importance
Microbial multiplication

- Binary Fission
- Budding

- Generation (doubling) time
Bacterial growth

• Forms of growth:
  1. Development of colonies
  2. Transformation of a clear broth to a turbid one
  3. Biofilm formation
Nutritional requirements

1. The energy source
   • Phototrophic
   • Chemotrophic

2. The hydrogen donors
   • Organotroph
   • Lithotroph

3. Carbon source
   • Autotrophs
   • Heterotrophs
Physical requirements

1. Growth atmosphere

• Oxygen

  Types of bacteria according to energy production
  
  – Strict or Obligate aerobe
  – Strict or Obligate anaerobe
  – Facultative anaerobes
  – Microaerophilic
  – Aerotolerant anaerobes
  – Capnophiles
Physical requirements

1. Growth atmosphere
   - Moisture

   • Osmotic pressure
     - Hypertonic
     - Hypotonic
     - Extremophiles
Physical requirements

2. Growth temperature
   - Psychrophiles
   - Mesophiles
   - Thermophiles
   - Hyperthermophiles (or extreme thermophiles)

3. Growth pH
   - Neutrophiles
   - Acidophiles
   - Alkaphiles
Chemical requirements

• Carbon

• Nitrogen, Sulfur, Phosphorus

• Trace Elements
Culturing Bacteria in the Laboratory

- **Bacterial Growth**
  - fastidious

- **Culture Media**
  - enriched medium, selective medium, differential medium

- **Inoculation of Culture Media**

- **Aseptic Technique**

- **Incubation**

- **Bacterial Population Growth Curve**

- **Bacterial Population Counts**
Growth phases in broth culture

1. Lag phase
2. Logarithmic phase
3. Stationary phase
4. Decline phase (Death phase)
Growth phases in broth culture

- Lag phase: Few or no cells
- Logarithmic growth phase: Viable cells increase rapidly
- Stationary phase: Growth rate decreases, population stable
- Death (decline) phase: Viable cells decrease, nonviable cells increase

Number of viable and nonviable cells in population: 
- Few or no cells
- Viable cells
- Nonviable cells
Growth phases in broth culture

Cell Density

- **LAG**
- **EXPONENTIAL**
- **STATIONARY**
- **DECLINE**

Time (Hours)

- **BIOMASS**
- **Viable Cells**
Bacterial growth

Synchronous growth
Measuring Bacterial Growth

Serial dilution

standard plate counts
Culturing Viruses and Other Obligate Intracellular Pathogens in the Laboratory

- embryonated chicken eggs
- Laboratory animals
- Cell cultures
Culturing Fungi in the Laboratory

- Solid culture media
- Liquid culture media

Culturing Protozoa in the Laboratory