Lecture-11

Microbial growth (Part-1)

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Cell Growth and Binary Fission

- Bacterial cell growth depends on a large number of cellular reactions :
  1. Reactions transform energy
  2. Synthesize small molecules (the blocks of macromolecules)
  3. Provide various cofactors and coenzymes needed for enzymatic reactions
  4. The key reactions of cell synthesis are polymerizations that make macromolecules from monomers.
- Macromolecules then assembled into news structures such as cell wall , cytoplasmic membrane , ribosomes and so on, leading to the process of cell division itself.

Cell Growth and Binary Fission

Growth: increase in the number of cells

Binary fission: cell division following enlargement of a cell to twice its minimum size

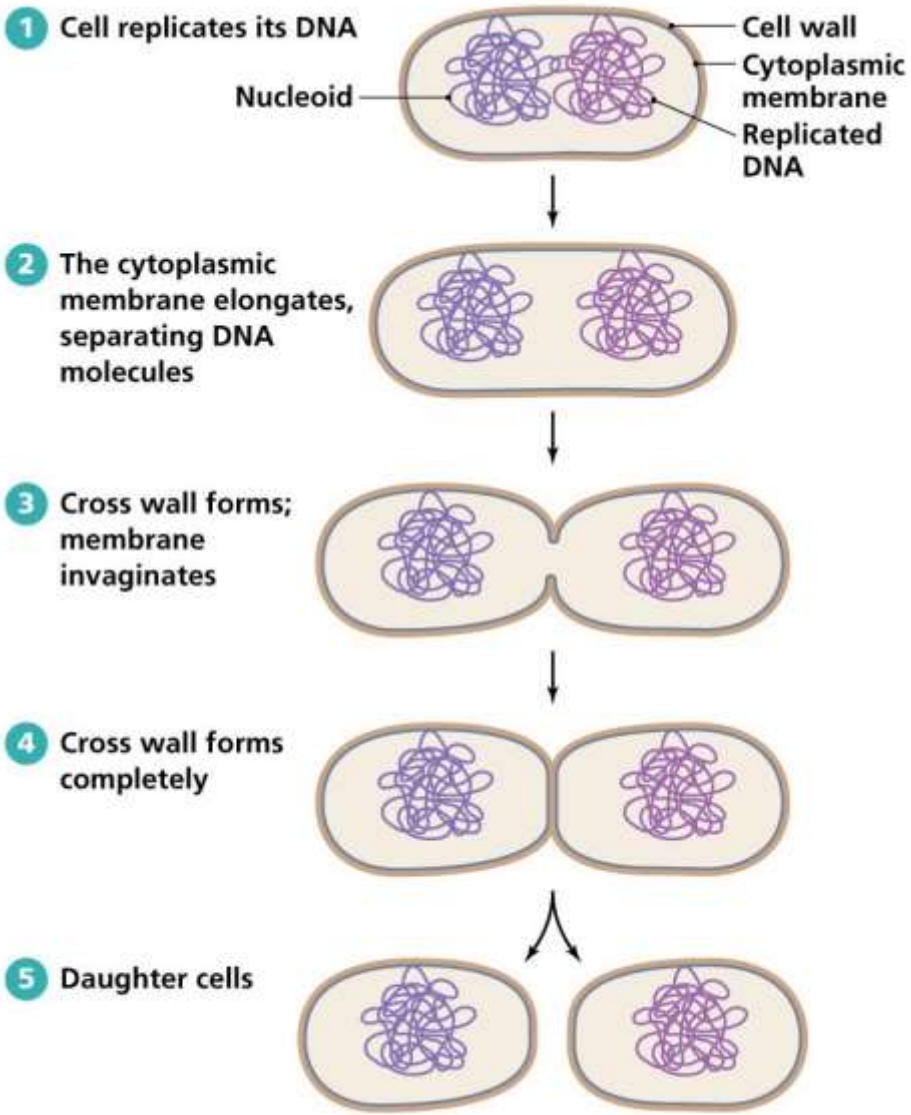
Generation time: time required for microbial cells to double in number

- When one cell eventually separates to form two cells ,we say that one generation has occurred and the time required for this process called generation time.
- **During cell division, each daughter cell receives a chromosome and sufficient copies of all other cell constituents to exist as an independent cell**
- .

Cell Growth and Binary Fission

- In a growing rod-shaped cell, cell elongate twice their original length and then form a partition that constricts the cell into two daughter cells .

- This partition called septum and results from the inward growth of the cytoplasmic membrane and cell wall from opposing directions ,septum formation continues until the two daughter cells are pinched off .



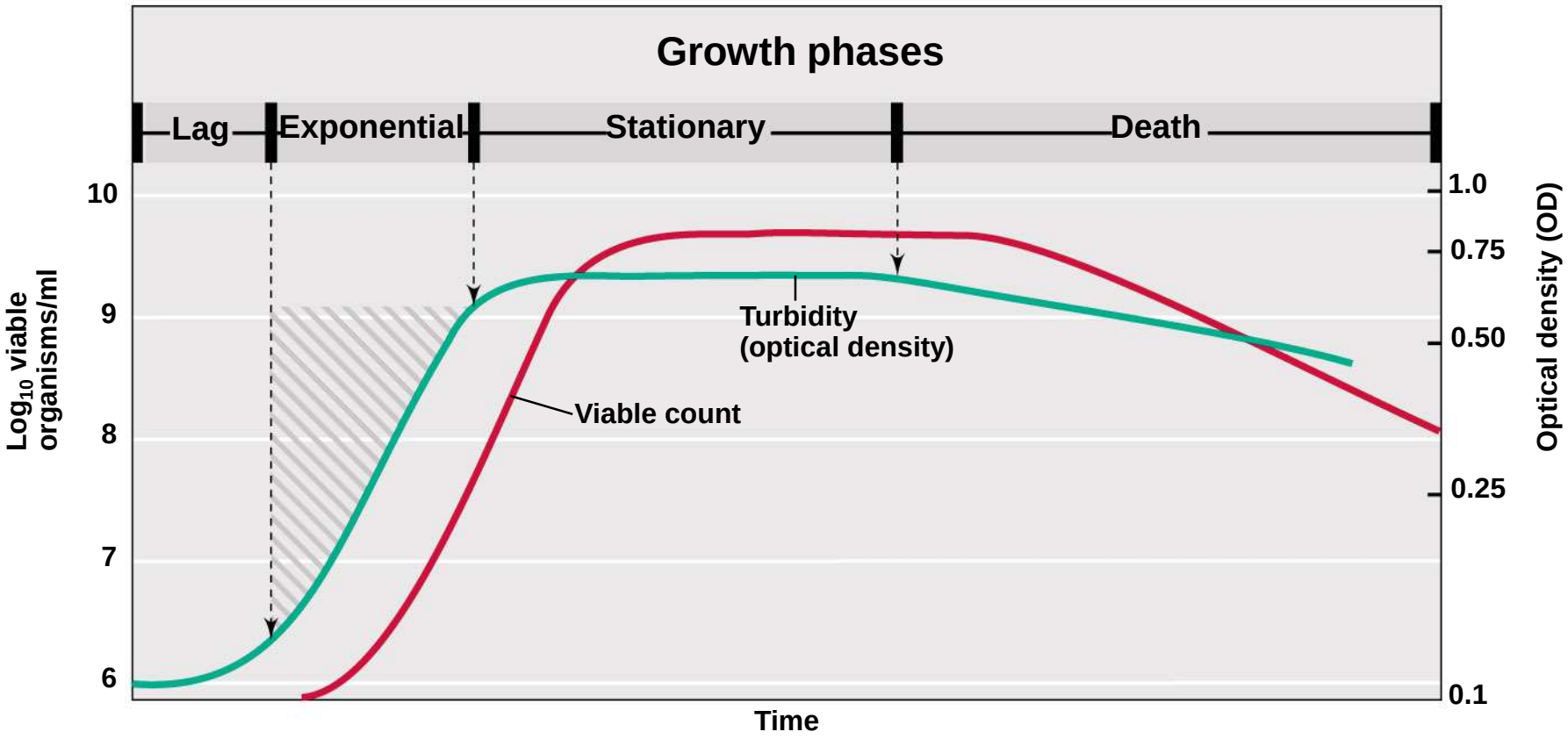
The Concept of Exponential Growth

- Most bacteria have shorter generation times than eukaryotic microbes
- Generation time is dependent on growth medium and incubation conditions
- *Exponential growth*: growth of a microbial population in which cell numbers double within a specific time interval

During exponential growth, the increase in cell number is initially slow but increases at a faster rate.

The Concept of Exponential Growth

- ***Batch culture***: a closed-system microbial culture of fixed volume
- Typical growth curve for population of cells grown in a closed system is characterized by four phases:
  - Lag phase: Interval between when a culture is inoculated and when growth begins
  - Log or Exponential phase: Cells in this phase are typically in the healthiest state
  - Stationary phase: Growth rate of population is zero, either an essential nutrient is used up or waste product of the organism accumulates in the medium
  - Death phase: If incubation continues after cells reach stationary phase, the cells will eventually die



Continuous Culture: The Chemostat

***Continuous culture*:** an open-system microbial culture of fixed volume

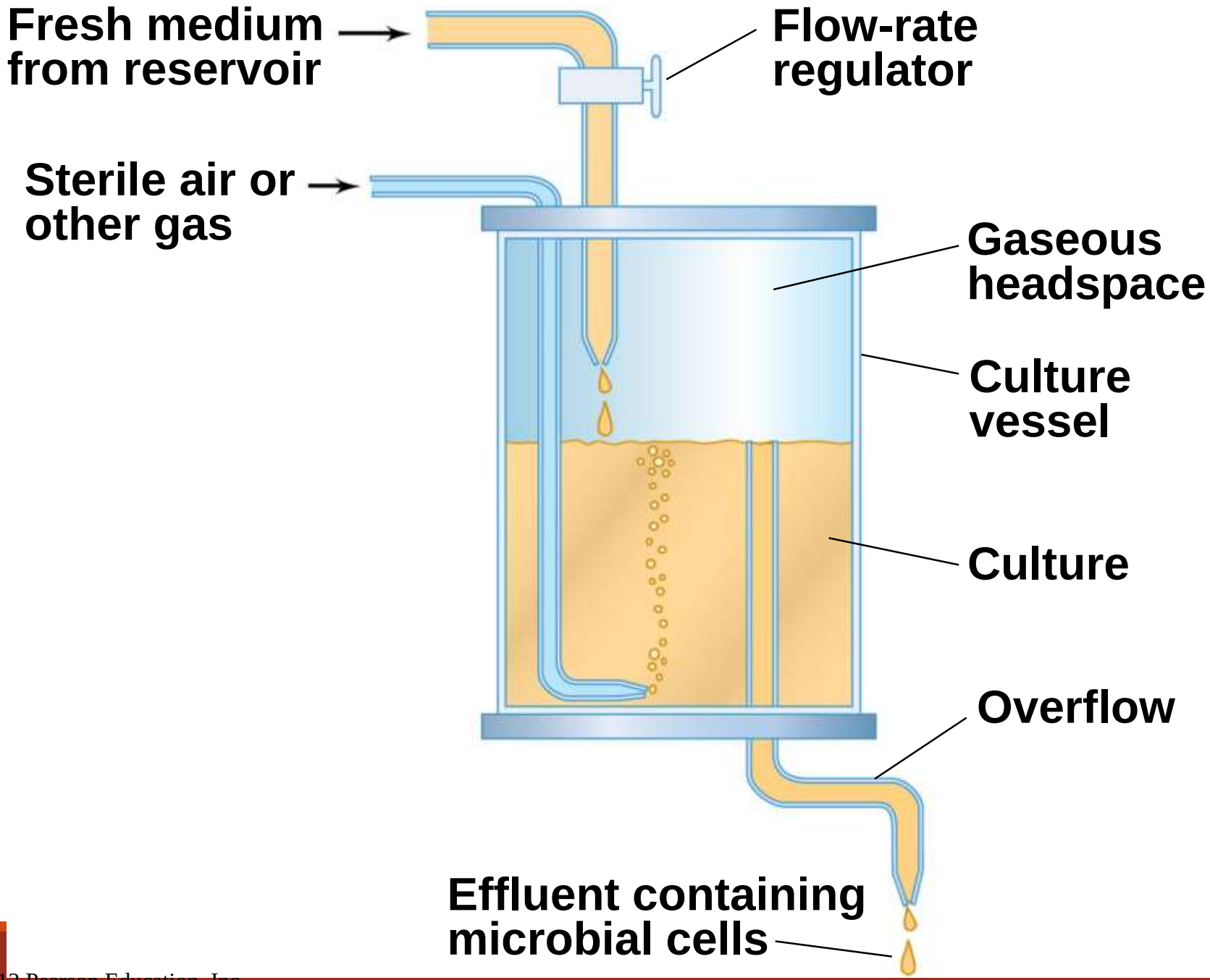
Chemostat: most common type of continuous culture device

Both growth rate and population density of culture can be controlled independently and simultaneously

- ***Dilution rate***: rate at which fresh medium is pumped in and spent medium is pumped out
- ***Concentration*** of a limiting nutrient

In a batch culture, growth conditions are constantly changing; it is impossible to independently control both growth parameters.

Figure 5.11

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QUESTIONS
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