

# فسيولوجيا الأحياء الدقيقة Microbial Physiology

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مكتب ٢ ب ٤٥

**Bacterial Growth**  
**L7**

# Factors affecting bacterial growth

- ❖ Temperature .
  - ❖ pH .
  - ❖ Nutrients availability.
  - ❖ Salt concentration.
  - ❖ Water availability.
  - ❖ Pressure.
- ❖ Bacteria are able to withstand a range of each of these factors (called a tolerance range or tolerance factor).

# How do bacterial cells grow?

## ❖ The bacterial cell grows by binary fission:

- A process where one cell becomes two, resulting in a large number of cells, in a relatively low number of generations.

## ❖ It includes the stages:

- **Cell Elongation:** Biosynthesis of new cell wall and membrane and intracellular proteins occurs.
- **DNA replication:** A new copy of the cell's chromosome is made.
- **Septum formation:** Partitioning of the chromosomes and the formation of a cross wall between the two cells.

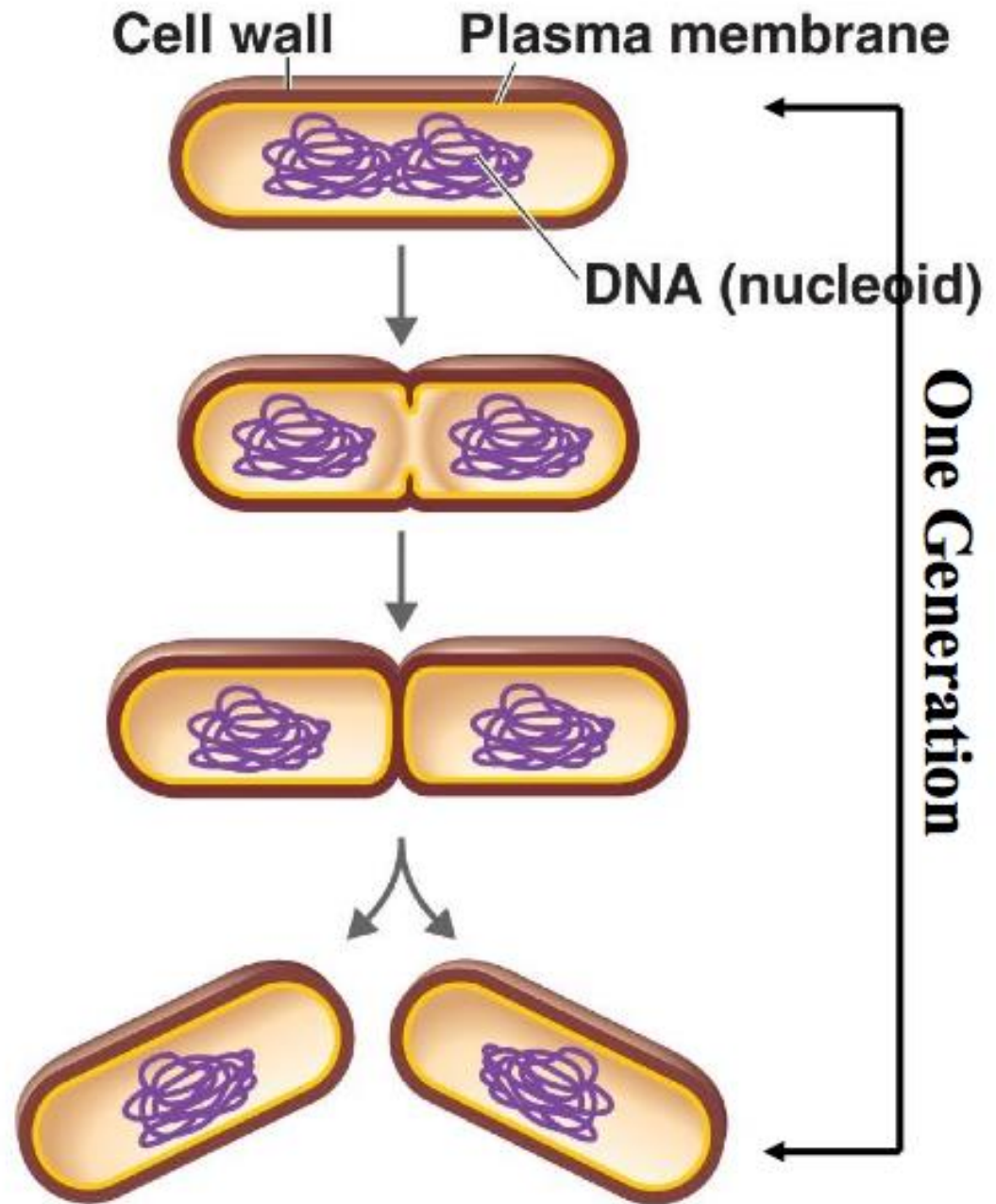
**1** Cell elongates and DNA is replicated.

**2** Cell wall and plasma membrane begin to constrict.

**3** Cross-wall forms, completely separating the two DNA copies.

**4** Cells separate.

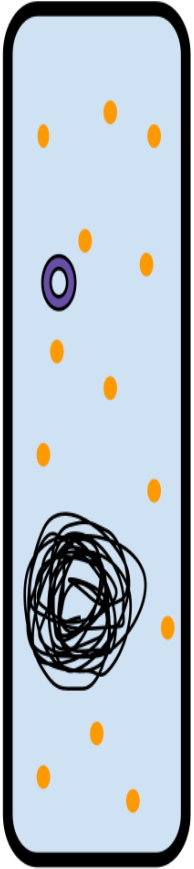
n of the cell division



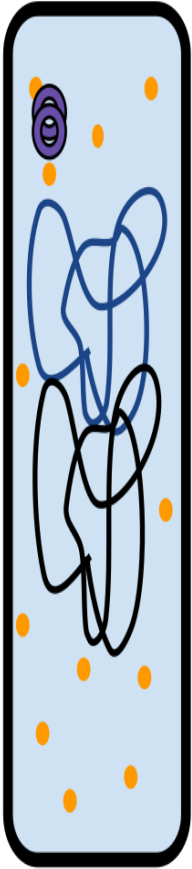
○ : Plasmid

● : Ribosome

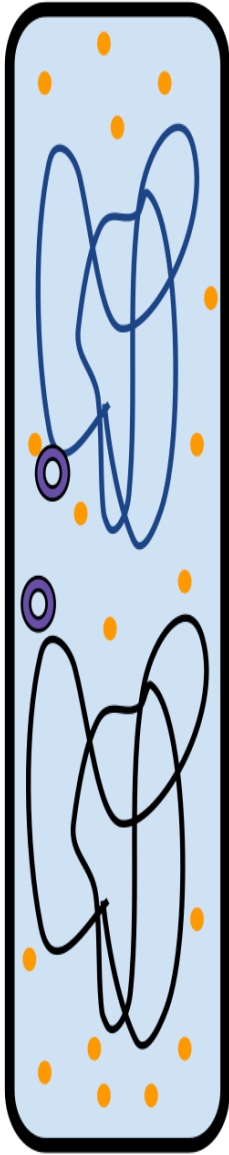
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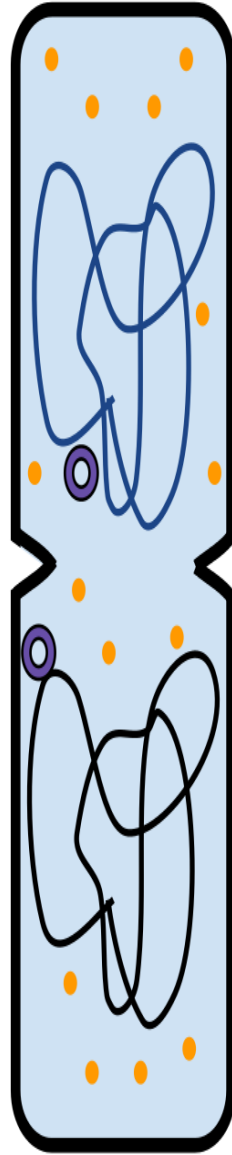
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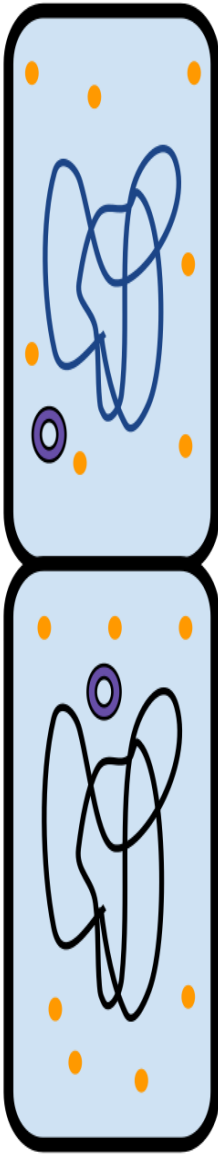
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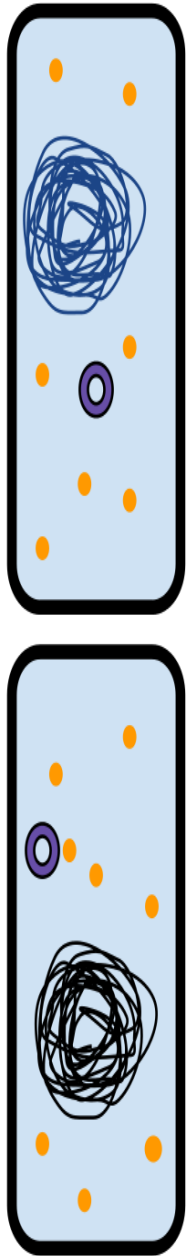
4



5



6





Streptococci

Escherichia coli

# Growth Rate (k)

- ❖ It can be defined as the average generation time; the time taken for one cell to divide into two.
- ❖ Due to binary fission, the number of cells can increase rapidly.  
(2 → 4 → 8 → 16 → 32 → 64 → → → )
- ❖ It is characteristic of bacterial species, and is defined by other factors:
  - Temperature.
  - Media conditions.
  - pH.

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Organism	Temp (°C)	Generation Time (min)
<i>Bacillus stearothermophilus</i>	60	11
<i>Escherichia coli</i>	37	20
<i>Pseudomonas putida</i>	30	45
<i>Vibrio marinus</i>	15	80
<i>Mycobacterium tuberculosis</i>	37	360
<i>Treponema pallidum</i>	37	1980

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# Measurement of growth in the Lab

## ❖ Direct Methods

- Cell Counts (total by microscopic, or electrically).

## ❖ Indirect Methods

- Colony counts (viable).
- Weight (wet vs dry).
- Spectrophotometer.
- ATP measurement.
- DNA.
- RNA.
- Protein.
- Metabolic activity.

# Population Growth Phases

- ❖ The growth of bacteria can be described in couple of ways:
  - **Unrestricted growth:** the growth that occurs when there are no limiting factors of the population.
    - Nutrients.
    - Waste products accumulation.
    - pH and etc.
  - **Balanced growth:** the synthesis of all cell constituents in a balanced manner.

# QUESTIONS??

