

# 3<sup>rd</sup> Tutorial session's correction

## Exercise I

### 1. Main functions of the bacterial cytoplasmic membrane

1. Selective barrier
2. Transport (passive and active)
3. Respiratory function
4. Excretion of hydrolytic enzymes
5. Platform for enzymes and molecule transporters involved in the biosynthesis of DNA, cell wall polymers, and membrane lipids
6. Attachment site for flagella and initiation point for their movement

### 2. Differences between bacterial and eukaryotic ribosomes

- Prokaryotic ribosomes: **70S**
  - Subunits: 30S and 50S
  - 30S contains 16S rRNA
  - 50S contains 23S rRNA and 5S rRNA

### 3. What is a polysome?

Polysomes are chains of ribosomes bound to a single messenger RNA (mRNA) molecule when cells are metabolically active.

### 4. Advantage of gas vacuoles

Gas vacuoles allow aquatic microorganisms to float and ascend to the water surface for optimal light exposure.

## Exercise II

### 1. General morphology

- Double-stranded circular DNA helix
- Supercoiled DNA
- Forms the nucleoid

### 2. Fundamental differences from eukaryotic chromosomes

- Bacterial DNA is not enclosed within a nuclear membrane
- Not associated with histones

- Circular DNA

### 3. Base pairing rule

A = T

C ≡ G

(Base complementarity via hydrogen bonds.)

### 4. Define an operon

An operon is a cluster of functionally related genes controlled by a single promoter.

### 5. Replication model used by most bacteria

Theta ( $\theta$ ) replication model.

Replication is semi-conservative and bidirectional.

### 6. Okazaki fragments

Okazaki fragments are short DNA fragments synthesized on the lagging strand during discontinuous replication.

They appear on the lagging strand.

### 7. Order of replication steps and enzymes

1. Unwinding of the double helix → Helicase
2. Primer synthesis → DNA Primase
3. Strand elongation → DNA polymerase III
4. Fragment ligation → DNA ligase  
(DNA polymerase I removes RNA primers)
5. Separation of daughter chromosomes → Topoisomerase IV

## Excercise III

### 1. What is a plasmid?

Plasmids are small, circular, double-stranded DNA molecules independent of the bacterial genome.

They are not essential for survival but may confer a selective advantage.

They differ from the chromosome because

- They are extra-chromosomal

- Smaller size
- Independent replication
- Carry relatively few genes

## 2. Episome

An episome is a plasmid capable of integrating into the chromosome.

## 3. Two plasmid replication models

- Theta ( $\theta$ ) replication
- Rolling circle replication

## 4. Matching plasmid types

F plasmid → C. Transfer by conjugation

R plasmid → A. Antibiotic resistance

Metabolic plasmid → E. Utilization of new carbon sources

Virulence plasmid → D. Pathogenicity factors

Bacteriocin plasmid → B. Production of bacteriocins

## 5. Vertical vs Horizontal transfer

Vertical transfer:

- Occurs during cell division
- Plasmids passed from parent to daughter cells

Horizontal transfer:

- Exchange of genetic material between bacteria
- Can occur through transformation, transduction, and conjugation

## 6. Mechanisms of horizontal transfer

1. Transformation  
Uptake of free DNA from the environment
2. Transduction  
Transfer via bacteriophages
3. Conjugation  
Direct contact via pilus