Series No.2

Exercise 1:

1. Match the following terms with their correct definitions:
Terms: lacZ, lacY, lacA, Operator, Promoter, Repressor

Definitions:
a) Gene that codes for **β-galactosidase**.
b) **Binding site of RNA polymerase** where transcription begins.
c) Gene that codes for **permease**, a protein facilitating lactose entry into the cell.
d) Site where the **repressor binds** to block transcription of structural genes.
e) **Protein that binds to the operator** to prevent expression of the operon.
f) Gene that codes for **transacetylase**.

2. Draw a diagram of the lactose operon, indicating its key elements: structural genes, promoter, operator, and regulatory gene.

Exercise 2:

For each of the following statements, indicate whether it is **True or False**, and briefly explain your answer.

1. The lactose operon is an example of **positive regulation in the presence of glucose.**
2. **cAMP** binds directly to **RNA polymerase** to stimulate transcription.
3. In the **absence of lactose**, the **repressor blocks** expression of the lacZ, lacY, and lacA genes.
4. The lactose operon can only be activated if **lactose is present** *and* **glucose is absent.**

Exercise 3:

For each of the following situations, explain whether the **lactose operon** will be active or not, and why.

1. **Lactose present**, **no glucose** in the environment.
2. **No lactose** and **no glucose** in the environment.
3. **Glucose present**, **no lactose.**
4. **Both lactose and glucose present.**

Exercise 4:

A mutant strain of *E. coli* exhibits two mutations in the lactose operon:

- **Mutation A:** The **lacI gene** produces a repressor that **cannot bind** to the operator.
- **Mutation B:** A mutation in the **promoter region** prevents the **CAP–cAMP complex** from binding.

Questions:

1. Explain the effect of each mutation individually on the expression of the **lacZ**, **lacY**, and **lacA** genes.
2. Describe the **combined effect** of both mutations on operon expression in the **presence and absence of lactose**, as well as in the **presence and absence of glucose.**

Exercise 5:

For each statement, indicate whether it is **True or False**, and justify your answer.

1. The **trp operon** is an example of an **inducible operon.**
2. **Tryptophan** acts as a **corepressor** in the regulation of the trp operon.
3. In the case of **tryptophan shortage**, transcription of the structural genes is **inhibited.**
4. **Attenuation** is a mechanism that occurs **only in the absence of tryptophan.**

Exercise 6:

A mutant strain is created in which the **leader region (trpL)** is deleted.

1. What happens to the **attenuation mechanism**?
2. How does this affect the **transcription** of the structural genes?
3. Can the **repressor** still regulate the operon?

Exercise 7:

Consider several mutant *E. coli* strains. Determine whether transcription of the **structural genes** of the **trp operon** will occur under the following conditions. Justify your answers.

Mutant	Presence of tryptophan	Absence of tryptophan
Mutation in **trpR** (nonfunctional repressor)	?	?
Mutation in **operator** (cannot bind repressor)	?	?
Mutation in **leader region trpL**	?	?
Mutation in **promoter** (nonfunctional RNA polymerase)	?	?