Exercise walk-through

Gene control ▪ 16.3

eXercise

You must be able to

- distinguish structural and regulatory genes, and inducible and repressible enzymes
- explain the control of protein production by the lac operon
- state the role of transcription factors and explain gibberellin's action via DELLA proteins

Method — Genes and enzymes

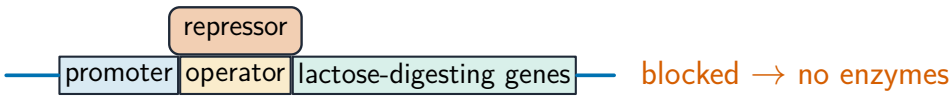
A **structural gene** codes for a useful protein (e.g. an enzyme); a **regulatory gene** controls whether other genes are switched on. An **inducible enzyme** is made only when needed; a **repressible enzyme** is normally made but can be switched off.

Method — The lac operon

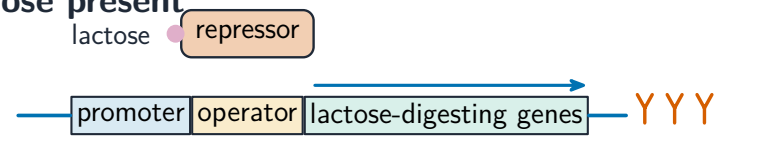
- **no lactose**: a **repressor** 阻遏物 protein binds the operator and blocks **transcription** 转录 — no enzymes made.
- **lactose present**: lactose binds the repressor and pulls it off; transcription occurs and the lactose-digesting enzymes are made (they are **inducible**).

Method — The lac operon

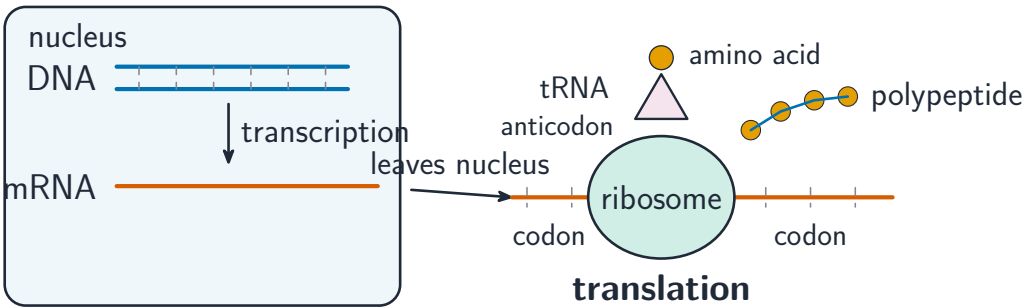
no lactose



lactose present



Method — The lac operon



Gene control acts on transcription and translation

Method — Transcription factors and gibberellin

In eukaryotes, **transcription factors** are proteins that bind DNA and raise or lower the rate of transcription. **Gibberellin** 赤霉素 switches genes on by causing the breakdown of **DELLA** protein repressors, which normally block the factors that promote transcription.

Practice 2.1 ▪ 2 marks

State the difference between a structural gene and a regulatory gene.

Solution 2.1

Method: Genes and enzymes

Worked steps

a structural gene codes for a (useful) protein such as an enzyme B1; a regulatory gene controls whether other genes are switched on B1.

Practice 2.2 ▪ 1 mark

State what is meant by an inducible enzyme.

Solution 2.2

Method: Genes and enzymes

Worked steps

an enzyme that is made only when it is needed (e.g. when its substrate is present) B1.

Exam-style 3.1 ▪ 1 mark

In the lac operon, when **no** lactose is present, the repressor protein:

A is broken down

B binds the operator and blocks transcription

C is transcribed into mRNA

D binds the lactose-digesting enzymes

Solution 3.1

Method: The lac operon

A is broken down

B binds the operator and blocks transcription ✓

C is transcribed into mRNA

D binds the lactose-digesting enzymes

Worked steps

B. With no lactose, the repressor binds the operator and blocks transcription.

Exam-style 3.2 ▪ 1 mark

What is the role of a transcription factor in a eukaryotic cell?

A to replicate DNA

B to bind DNA and control the rate of transcription

C to translate mRNA

D to break down glucose

Solution 3.2

A to replicate DNA

B to bind DNA and control the rate of transcription ✓

C to translate mRNA

D to break down glucose

Worked steps

B. A transcription factor binds DNA and increases or decreases the rate of transcription.

Exam-style 3.3 ▪ 4 marks

Explain how the lac operon allows a bacterium to make lactose-digesting enzymes only when lactose is present.

Solution 3.3

Method: The lac operon

Worked steps

when no lactose is present, the repressor binds the operator and blocks transcription, so no enzymes are made B1 B1; when lactose is present, it binds the repressor and removes it from the operator B1; transcription can now occur, so the lactose-digesting enzymes are made B1.

Exam-style 3.4 ▪ 2 marks

Explain how gibberellin switches on genes by acting on DELLA proteins.

Solution 3.4

Method: Transcription factors and gibberellin

Worked steps

gibberellin causes the breakdown of DELLA protein repressors **M1**; these normally block the transcription factors, so removing them lets the genes be transcribed/expressed **A1**.