AP BIOLOGY • EXERCISE SHEET

6.5 Regulation of Gene Expression

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

Objective

Build the skills to answer exam questions on the **regulation of gene expression**.

You must be able to:

- explain that cells control **which genes** are expressed and when
- describe regulation by **promoters** 启动子 and regulatory proteins
- give the example of an inducible/repressible operon idea

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

■ Genes are switched on and off

A cell does not express all its genes at once. **Gene regulation** controls **which** genes are turned on, **when**, and **how much** —saving energy and allowing different cell types.

■ Promoters and regulatory proteins

RNA polymerase binds a gene's **promoter** to start transcription. **Regulatory proteins** can block or help this binding —acting as switches.

■ Turning genes on or off

- A **repressor** protein can bind and **block** transcription (off).
- An **activator** can **help** transcription (on).

Signals from the environment can control these proteins, so gene expression responds to conditions.

■ A worked idea

A bacterium turns on genes for digesting lactose only **when lactose is present**, saving resources when it is absent —efficient, controlled expression.

2 Practice

Now apply the methods above.

2.1 Does a cell express all its genes at once? [1]

2.2 Where does RNA polymerase bind to begin transcription? [1]

2.3 What does a repressor protein do? [1]

3 Exam-style questions

3.1 A protein that blocks transcription of a gene is a(n) [1]

- **A** activator
- **B** repressor
- **C** ribosome
- **D** polymerase

3.2 A bacterium expresses lactose-digesting genes only when lactose is present.

(a) Explain the advantage of this control. [2]

(b) State the general role of regulatory proteins in this. [1]

3.3 Explain why gene regulation is essential for a multicellular organism to have different cell types. [2]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **6.5 Regulation of Gene Expression** lesson on the **Learn** page;
- read the **Regulation of Gene Expression** section of the AP Biology handout on the **Know** page.

Solutions

2.1 No.

2.2 At the gene's promoter.

2.3 Blocks transcription of a gene.

3.1 B —a repressor.

3.2 (a) The cell makes the digesting enzymes only when they are useful, saving energy and resources when lactose is absent. (b) Regulatory proteins switch the genes on or off in response to the lactose signal.

3.3 Different cell types express different sets of genes; regulation turns the right genes on in each cell, so the same genome can produce specialized cells.