

APOLLO

Gene expression HL

Biology

First assessment 2025

5 questions | questions

- 20.** Scientists measured methylation levels of amino acids in chromosome 2 in twin studies. The methylation levels of twin 1 were significantly and consistently higher than those of twin 2. What could be proposed to explain this data?
- A. Modification to the histone of twin 1
 - B. Removal of the histone from the chromosome in twin 2
 - C. The DNA base sequence of twin 1 was altered
 - D. Cytosines in promoters of twin 2 are more methylated than in twin 1

Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

1. Angora rabbits (*Oryctolagus cuniculus*) have soft and silky coats with fine hairs that grow about 30 mm per month. These hairs can be collected and used as wool. Hair growth in mammals depends on stem cells in the base of hair follicles called dermal papilla cells.



Research was carried out to investigate the role of the *WIF1* gene in hair growth. Wool was collected from 6-month-old angora rabbits. Expression of the *WIF1* gene was assessed by measuring the quantity of *WIF1* mRNA produced in cells taken from each rabbit. The rabbits were divided into groups according to their rate of wool production (low or high).

The table shows mean wool production per rabbit in the low and high wool production groups and relative expression of the *WIF1* gene.

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(Question 1 continued)

- (a) Calculate the difference in mean wool production between the high and low wool production groups. [1]

- (b) (i) Identify the relationship between wool production and relative expression of *WIF1*. [1]

- (ii) Discuss whether the data in the table shows a causal relationship between *WIF1* expression and wool production. [2]

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(Question 1 continued)

Proteins produced by expressing the *WIF1* gene bind to a group of glycoproteins used in chemical signalling. This signalling can promote or inhibit transcription of other genes.

Rabbit dermal papilla cells growing in liquid tissue culture were modified in two different ways by introducing a genetically engineered loop of DNA (plasmid) with or without a copy of the *WIF1* gene:

- pcDNA-*WIF1*: a plasmid carrying a copy of the *WIF1* gene
- pcDNA: the same plasmid without the *WIF1* gene

The expression of three genes, EGF, SFRP2 and CCND1, was measured in the modified rabbit dermal papilla cells. The bar chart shows the results.

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(c) Identify the control treatment.

[1]

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(d) Outline the effect of pcDNA-*WIF1* on the expression of each of the three genes.

[3]

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In other species, expression of *WIF1* has been found to affect rates of apoptosis (programmed cell death) and cell proliferation. These two processes were measured in the modified rabbit dermal papilla cells. The pie charts show apoptosis rates, and the graph shows cell proliferation rates.

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- (e) Explain how expression of the *WIF1* gene could affect the rate of wool production in angora rabbits, using evidence from the data in the question.

[4]

[illegible]

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Answers written on this page
will not be marked.



32. Scientists incubated larvae of the moth *Utetheisa ornatrix* at either 15 °C or 22 °C until they hatched. They found the hatched moths had different wing colour patterns due to phenotypic plasticity.

Moth from larvae
incubated at 15 °C



Moth from larvae
incubated at 22 °C



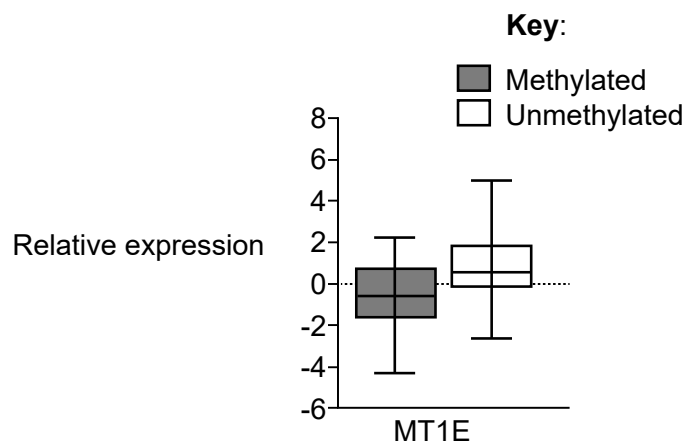
Which of the following explains the observed differences in wing colour?

- A. Colder temperatures induce mutations in genes for wing colour.
- B. The expression of genes for wing colour is affected by temperature.
- C. A mutation makes moths less visible to predators in cold climates.
- D. Wing colour is the result of polygenic inheritance.

10. Which are examples of non-coding DNA?

- A. Dominant and recessive alleles
- B. Promoters and telomeres
- C. Oncogenes and tumour suppressor genes
- D. Introns and exons

19. The graph shows the effect of methylation on the expression of MT1E, a gene involved in the control of prostate cancer development. Patients with a reduced expression of this gene are more likely to develop prostate cancer.



What are effects of MT1E methylation?

- A. It reduces transcription of MT1E, increasing the risk of prostate cancer.
- B. It increases translation of MT1E, reducing the risk of prostate cancer.
- C. It reduces replication of MT1E, reducing the risk of prostate cancer.
- D. It increases the chances of mutation in proto-oncogenes, increasing the risk of prostate cancer.