AS91159 Demonstrate understanding of gene expression

Effect of Environment on Gene Expression

(2016, 2) Environmental Factors and Gene Expression

The honey bee (*Apis mellifera)* has two female phenotypes.

Female type	Larvae Diet	Adult phenotype	Genotype
Queen bee 	Royal jelly	• Increases ovary size • Large body mass • Live for 2 years	the same
Worker bee 	Royal jelly for 3 days, then only pollen and honey	• Infertile ovaries • Smaller body mass • Live for 3 – 6 weeks	

(a) Describe the term gene expression

(b) Explain why comparing worker and queen honey bee females is ideal for experiments on environmental factors and gene expression.

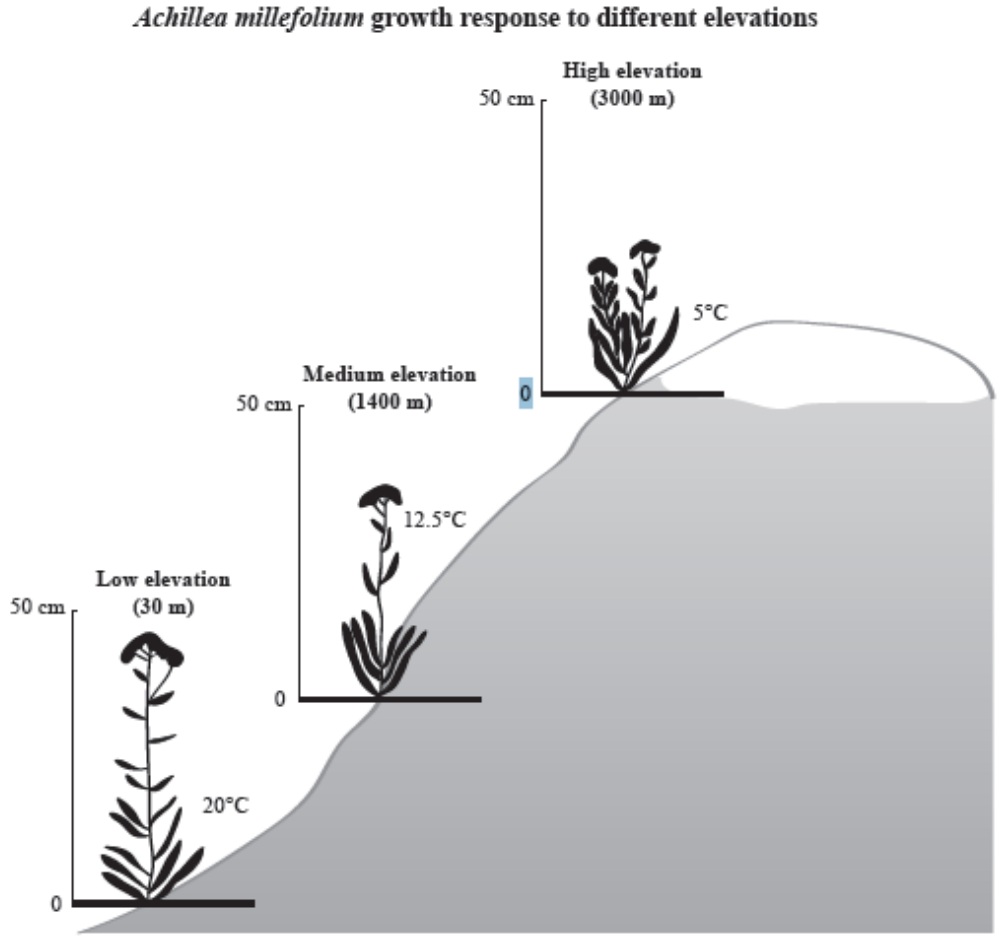
(c) Experiments have confirmed that royal jelly is not a mutagen.
Discuss the effect the environment has on the expression of the phenotype in honey bee females.
In your answer include:

- a description of the environmental factor that affects honey bee phenotype
- using an example, an explanation of the difference between environmental factor and mutagen
- a discussion of how honey bee phenotype can change without changing the genotype
- a discussion of why the queen bee's phenotype is fully expressed, but the worker bee's phenotype is not.

(2015, 3) Environment, genotype interactions

The common yarrow plant, *Achillea millefolium*, can be cut into several sections, and each section will grow asexually (reproduces without fertilisation or exchanging gametes) when put into soil. In an experiment, biologists cut one yarrow plant into three sections and planted each section at a different elevation to determine how phenotype is affected by the environment.

See figure below.



(a) Describe the difference between genotype and phenotype.

(b) Explain why the biologists used genetically identical cuttings, at the different elevations.

(c) Analyse the results shown in the figure on the previous page.

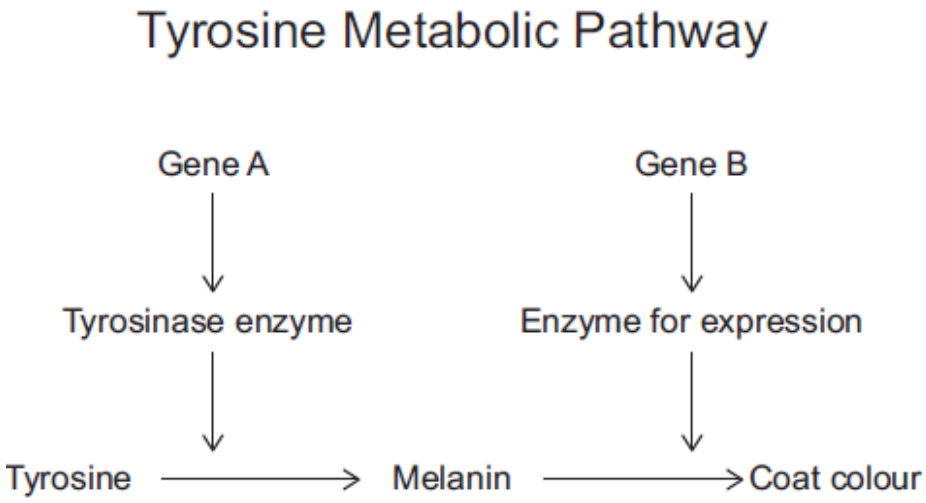
In your answer include:

- an explanation of why plants may grow differently at different elevations
- a discussion of the interaction between temperature, genotype, and phenotype expression
- a discussion of environmental factors that would influence the yarrow plants' genetic expression.

(2014, 2)

Skin and hair colouring are influenced by the pigment melanin. Melanin is a protein that is made via the tyrosine pathway, and there are two genes involved in the pathway, which lead to its expression.

Albino animals lack the pigment melanin, and so have no colouring of their skin, hair, and eyes. Siamese cats, like the one in the picture above, show a form of albinism. However, Siamese cats possess a mutated gene that codes for the enzyme tyrosinase, which is an enzyme in the melanin expression pathway. This enzyme is temperature sensitive, and so Siamese cats can produce the pigment melanin in body extremities, such as the feet, tail, and face, which gives them darker colouring.



Discuss how the metabolic pathway for melanin and the environment interact to influence the coat colour in Siamese cats.

In your answer:

- describe what a metabolic pathway is
- explain why Siamese cats have darker colouration around their body extremities such as the nose, feet and tail, and **not** around their chest area
- using the diagram above, discuss how genes and enzymes control the metabolic pathway for melanin, and how this causes Siamese cats to be albino.

(2013,1)

One way to examine the role of the environment in variation among organisms is to compare the phenotypes of various traits in genetically identical organisms. Armadillos are ideal animals to use in such research, because they are born as quadruplets derived from a single fertilised egg. This means that all four armadillo pups share the same genetic sequence. In a number of experiments carried out by scientists in the 1960s, genetically identical armadillos were found to show significant phenotypic differences when exposed to a range of environmental factors.

Discuss how genetically identical armadillos could be used to show the relationship between environmental factors and phenotype.

In your answer:

- describe what is meant by 'phenotype'
- describe what is meant by 'mutagen', and explain, using appropriate examples, why not all environmental factors are mutagens
- evaluate how studies on the armadillos could show that 'non-mutagenic' environmental factors may change phenotype without changing genotype.

(2012, 1) Effect of environment

The environment can affect the phenotype of an organism through direct changes to the genotype, and/or by the way in which the genotype is expressed.

Discuss this statement, with reference to mutagens, gene mutations and environmental factors.

In your answer you should give at least one example of each of these key terms.