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Level 2 Biology, 2015

91159 Demonstrate understanding of gene expression

9.30 a.m. Monday 16 November 2015
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of gene expression.	Demonstrate in-depth understanding of gene expression.	Demonstrate comprehensive understanding of gene expression.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL

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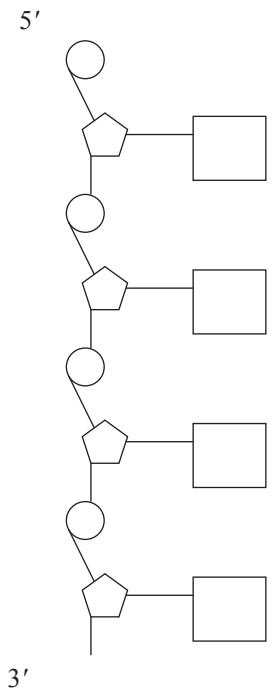
QUESTION ONE: MAKING PROTEINS

(a) The structure of DNA is made up of nitrogen bases, deoxyribose sugars, and phosphates.

Draw the corresponding **anti-parallel** complementary strand in the box below.

In your answer:

- fill in the template strand containing the bases adenine (A), thymine (T), guanine (G), cytosine (C)
- draw the corresponding **anti-parallel** complementary strand
- draw and label the sugars
- draw and label the phosphates.



(b) Protein synthesis is the process of making proteins. Triplets, codons, and anti-codons are important components in the process.

Discuss the relationship between triplets, codons, and anti-codons, and how they interact to form a protein.

In your answer include:

- a description of a triplet, codon, and anti-codon
- an explanation of what a start codon and a stop codon are
- a discussion of how triplets, codons, and anti-codons interact during transcription and translation to form a protein.

You may use diagrams in your answer.

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There is more space for your answer to this question on the following page.

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QUESTION TWO: METABOLIC PATHWAYS

In 1941 biologists George Beadle and Edward Tatum exposed the bread mould *Neurospora crassa* to radiation. The mutated moulds lost their ability to produce an amino acid (arginine), and this slowed or stopped their growth. However, they found when they provided the mould with the amino acid arginine, growth was restored. They concluded that a gene mutation inactivates an enzyme needed to synthesise the amino acid in a metabolic pathway.

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www.dnaftb.org/16/

(a) Describe what a gene mutation is.

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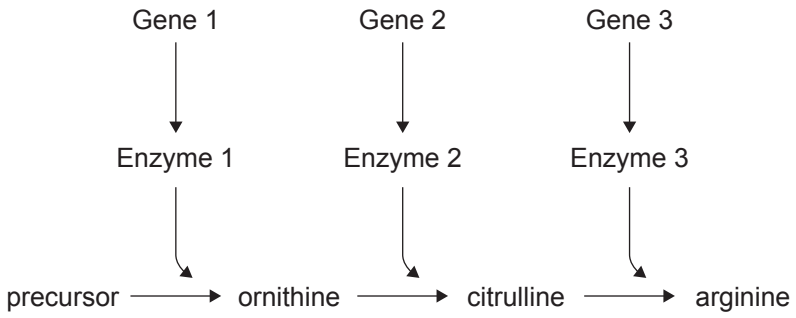
(b) The biologists carried out further experiments and found three mutations prevented the amino acid arginine from being made.

Using the *Neurospora crassa* metabolic pathway below, discuss why there are three mutations that can occur for the amino acid arginine not to be produced.

In your answer:

- explain what a metabolic pathway is
- discuss why a mutation to any one of the genes can result in arginine not being produced
- discuss why the biologists concluded 'One Gene Codes for One Protein'.



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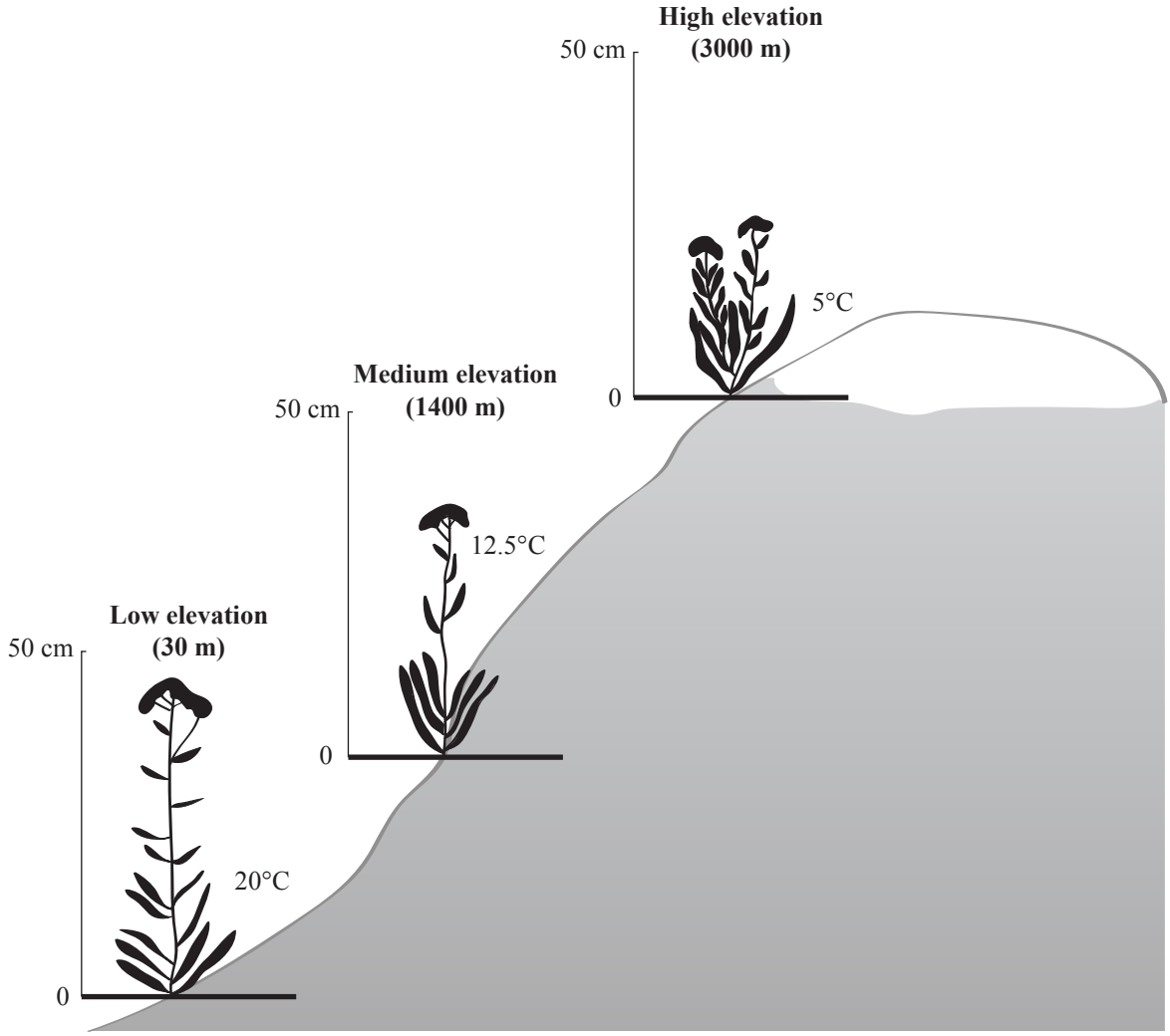
QUESTION THREE: ENVIRONMENT, GENOTYPE INTERACTIONS

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.

***Achillea millefolium* growth response to different elevations**



Adapted from http://www.flyfishingdevon.co.uk/salmon/year3/psyc364evolutionary_psychobiology/psy364_genotype_phenotype/psy364_genotype_phenotype.htm

(a) Describe the difference between genotype and phenotype.

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

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(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.

Extra paper if required.
Write the question number(s) if applicable.

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