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SUPERVISOR'S USE ONLY

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 2 Biology, 2013

91159 Demonstrate understanding of gene expression

9.30 am Friday 22 November 2013
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 2–9 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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You are advised to spend 60 minutes answering the questions in this booklet.

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QUESTION ONE: EFFECT OF ENVIRONMENT

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.

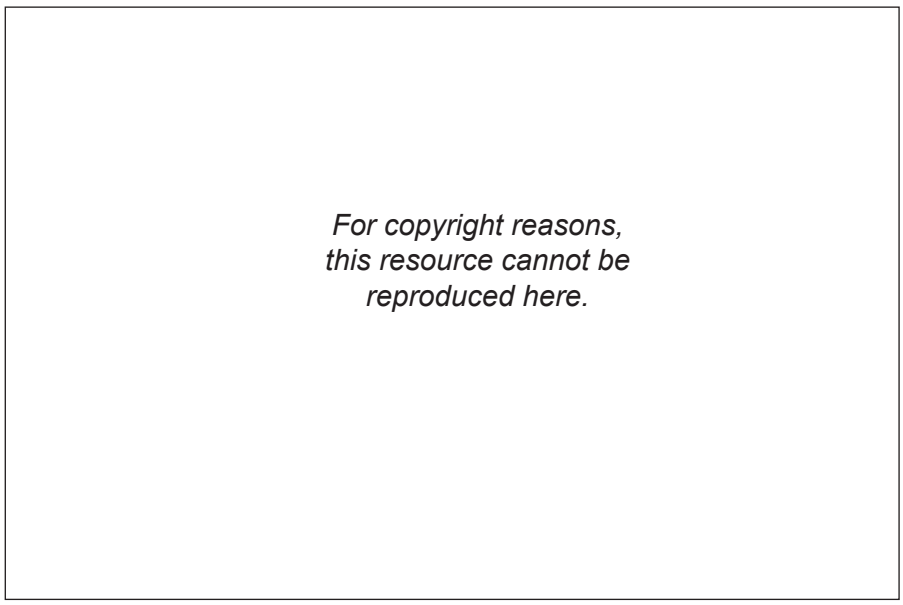

Image Source: http://www.nature.com/scitable/nated/content/5884/four_armadillos_83-72_mid_1.jpg

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.

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QUESTION TWO: PROTEIN SYNTHESIS

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The DNA sequence determines the structure of a protein and how that protein is produced.

(a)

Table of mRNA CODONS

FIRST CODON ELEMENT	SECOND CODON ELEMENT: U	SECOND CODON ELEMENT: C	SECOND CODON ELEMENT: A	SECOND CODON ELEMENT: G	THIRD CODON ELEMENT
U	PHE	SER	TYR	CYS	U
	PHE	SER	TYR	CYS	C
	LEU	SER	STOP	STOP	A
	LEU	SER	STOP	TRP	G
C	LEU	PRO	HIS	ARG	U
	LEU	PRO	HIS	ARG	C
	LEU	PRO	GLU	ARG	A
	LEU	PRO	GLU	ARG	G
A	ILE	THR	ASPN	SER	U
	ILE	THR	ASPN	SER	C
	ILE	THR	LYS	ARG	A
	MET	THR	LYS	ARG	G
G	VAL	ALA	ASP	GLY	U
	VAL	ALA	ASP	GLY	C
	VAL	ALA	GLU	GLY	A
	VAL	ALA	GLU	GLY	G

Using the information provided above, complete the table below.

Note: In the table below, you need only to give one possible codon for each mRNA.

DNA				
mRNA				
Amino Acids	MET	GLU	TYR	STOP

Explain with an example from the table why there is more than one possible codon for the same amino acid.

(b) Discuss the major stages of protein synthesis.

In your answer, include each of the following:

- the role of the DNA template and coding strands
- RNA structure and function
- the relationship between codons AND anticodons
- the role of start AND stop codons
- the purpose of the ribosome.

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There is more space for your answer to Question Two (b) on the following page.

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QUESTION THREE: MUTATIONS

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Cystic fibrosis is caused by a mutation in the gene CFTR (cystic fibrosis transmembrane conductance regulator). The most common mutation is a deletion of three nucleotides that results in a loss of an amino acid at the 508th position on the protein. This mutation accounts for approximately 66–70% of cystic fibrosis cases worldwide. **It is an inheritable recessive condition.**

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Image Source: https://www.boundless.com/physiology/the-respiratory-system/respiratory-system-disorders-and-clinical-cases/cystic-fibrosis/

(a) Define the term **mutation**.

(b) Identify the differences between substitution, insertion and deletion mutations, and explain which type of mutation has the most significant effect on an organism's phenotype.

Question Three continues on the following page.

(c) With reference to cystic fibrosis and another named disease, compare and contrast inherited mutations with mutations that occur during the organism's lifespan.

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In your answer include:

- a description of both types of mutation
- an explanation of possible causes of these mutations and why they are different in terms of their effect on the organism
- a discussion of each type of mutation, in relation to the two diseases, and whether the diseases are inherited.

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

QUESTION NUMBER

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