Assessment Schedule – 2014
Biology: Demonstrate understanding of gene expression (91159)

Assessment Criteria

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding involves defining, using annotated diagrams or models to explain, and giving characteristics of, or an account of, gene expression.	*Demonstrate in-depth understanding* involves providing a reason as to how or why biological ideas and processes affect gene expression.	*Demonstrate comprehensive understanding* involves linking biological ideas and processes about gene expression. The explanation may involve justifying, relating, evaluating, comparing and contrasting, or analysing.

Evidence Statement

Q	Expected Coverage	Achievement	Merit	Excellence
ONE (a)	CUAGUA	• Correctly transcribes the mRNA strand.	• Explains the purpose of transcription.	• Discusses the process of transcription and translation, with links to the purposes of protein synthesis.
(b)	The purpose of transcription is described: mRNA transcribes the code for a polypeptide from the DNA. The purpose of transcription is explained: mRNA transcribes the code for a polypeptide from the DNA in the nucleus and carries it to the ribosomes / cytoplasm. So that the original DNA does not get damaged leaving the nucleus. The purpose of translation is described: to use mRNA to make a polypeptide / protein. The purpose of translation is explained: to use mRNA to make a polypeptide / protein. So that the protein can be used for cellular functions (or named example given e.g. to make an enzyme). The process of transcription is described: e.g. DNA unwinds and a single mRNA strand is made using U instead of T. The mRNA strand leaves the nucleus through a nuclear pore. The process of transcription is explained by giving a substantially correct sequence of steps: an enzyme (RNA polymerase) separates / unzips the DNA strand, exposing the gene / bases / nucleotides. Free nucleotides are match to the exposed bases on the template strand using the base pairing rule, A-U and G-C. Transcription forms a single mRNA strand, with groups of 3 bases (codons) that code for the amino acids. Transcription is complete when (RNA polymerase reaches the terminator sequence) mRNA detaches and moves out of the nucleus into the cytoplasm and attaches to a ribosome in preparation for translation. The process of translation is described: eg. a 'triplet' of 3	• Describes the purpose of transcription. • Describes the process of transcription • Describes the purpose of translation • Describes the process of translation • Describes one similarity. • Describes one difference.	• Explains the purpose of translation. • Explains the process of transcription by giving a substantially correct sequence of steps. • Explains the process of translation by giving a substantially correct sequence of steps.	• Compares and contrasts similarities and differences between transcription and translation

	bases on the mRNA codes for an amino acid . tRNA carries the amino acid to the ribosome and drops it off. The process of translation is explained by giving a substantially correct sequence of steps: ribosomes move along the mRNA from the start codon until the stop codons is reached. Each sequence of 3 bases (codon) on the mRNA is read by the ribosome and matched to the complementary unpaired three base sequence (anticodon) on the tRNA. The specific amino acid attached to the tRNA is then added (peptide bond forms) to the polypeptide chain being made. Similarities between transcription and translation include: • both use complementary base pairing • both have mRNA involved in the process • both have a start and stop sequence • both are controlled by enzymes • code on both read in sets off three bases Differences between transcription and translation include: • transcription occurs in the nucleus and requires DNA. Translation occurs in the cytoplasm on a ribosome and involves tRNA and amino acids (*explanation for compare and contrast differences*) • transcription makes mRNA, translation reads mRNA / makes proteins • transcription uses DNA as a template, translation uses mRNA as a template • transcription involves the pairing of DNA and free RNA nucleotides, whereas translation involves pairing anticodon bases of tRNA and codon mRNA (*explanation for compare and contrast differences)*. Compares and contrasts similarities and differences between transcription and translation. Eg both transcription and translation involve the use of templates but they are different. Transcription uses a DNA template whereas translation a mRNA template. • Transcription takes place in the nucleus and involves DNA and free nucleotides to make mRNA whereas translation occurs in the cytoplasm using ribosomes, tRNA and amino acids to read mRNA. So both processes involve mRNA.			

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Describes any ONE statement from Achievement.	Describes any TWO statements from Achievement.	Describes any THREE statements from Achievement.	Describes any FOUR statements from Achievement.	Explains any TWO statements from Merit.	Explains any THREE statements from Merit.	Discusses EITHER criterion for Excellence.	Discusses BOTH criteria for Excellence.

Q	Expected Coverage	Achievement	Merit	Excellence
TWO	A metabolic pathway is a series of enzyme controlled chemical reactions . Gene A codes for the tyrosinase enzyme. This enzyme converts tyrosine into melanin. Gene B codes for an enzyme that expresses the melanin in the coat colour. Explains the metabolic pathway for the expression of coat colour in Siamese cats as a series of enzyme controlled chemical reactions. As enzymes are specific, a different enzyme is needed for each step in a metabolic pathway. In the first step of the metabolic pathway, the enzyme tryosinase produces melanin from the substrate tyrosin. A different enzyme, for the expression of the melanin, is needed in the second step of the metabolic pathway. Explains the tyrosinase mutation: Each step in the metabolic pathway is indirectly controlled by a gene on the DNA as that gene has the code for the enzyme needed to catalyse that step. If gene A on the DNA mutates so that the enzyme tyrosinase is temperature sensitive, that step in the pathway may not always occur. Explains the darker colour of the Sianese cats extremities:if gene A mutates so that the enzyme tryrosinase is temperature sensitive, melanin will only be produced at the cooler temperatures of the Siamese cats extremities. Explains the white colour of the Siamese cats chest area:if gene A mutates so that the enzyme tyrosinase is heat sensitive / inactive / non-functional at the warmer chest area then melanin is not produced and the chest is white. • Discusses how the temperature sensitive tyrosinase enzyme produces the coat colour in Siamese cats: The abnormal form of tyrosinase does not work as a catalyst at warm core cat body temperatures. This is because the enzyme denatures (loses shape) and as a result pigment is not produced. The enzyme maintains its shape and its active site only at the cooler extremities so is able to catalyse the breakdown of tyrosine with subsequent production of melanin- these parts of the body are coloured.	• Describes a metabolic pathway. • Describes gene A. • Describes gene B. • Describes that cooler temperatures produce pigment. • Describes that warmer temperatures do not produce pigment.	• Explains the metabolic pathway for the expression of coat colour in Siamese cats. • Explains the effect of the tyrosinase mutation in the metabolic pathway for the expression of coat colour in Siamese cats. • Explains the darker colour of Siamese cat's extremities. • Explains the white colour of Siamese cat's chest area.	• Discusses how genes and enzymes control the metabolic pathway for melanin and the how the environment interacts to influence the coat colour in Siamese cats. • Discusses how the temperature sensitive tyrosinase enzyme produces the coat colour in Siamese cats in the metabolic pathway.

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Q	Expected Coverage	Achievement	Merit	Excellence
THREE (a)	Normal DNA TAC CAC GTG GAC TGA GGA CTC AAC Normal amino acids Met Val His Leu Thr Pro Glu Leu	• Correct DNA sequence. • 6 / 8 correct amino acid sequence.	• All correct normal amino acid sequence. **AND** mutated amino acid sequence produces Val instead of Glu.	• Discusses how the insertion mutation affects the bases sequence and final protein compared to a substitution mutation.
(b)	Mutated DNA TAC CAC GTG GAC TGA GGA C**A**C AAC Mutated mRNA AUG GUG CAC CUG ACU CCU G**U**G UUG Mutated Amino Acid Met Val His Leu Thr Pro **Val** Leu	• Correct mutated DNA sequence. • Correct mutated mRNA sequence. • Correct mutated amino acid sequence.	• Explains how a substitution mutation affects the sequence of bases.	• Degeneracy of the code is unable to buffer the effect of the mutation as every codon and thus every amino acid from the insertion point changes. Therefore having a more profound effect on the organism. OR • Relates degeneracy to the sickle cell example
(c)	When A is substituted into the DNA sequence instead of T, it causes a totally new amino acid to be made and changes the function of the final protein. When A is substituted into the DNA sequence instead of T, it still has the right number of bases to produce a final protein. However, a new amino acid is included, and this will affect final protein shape and functioning. **Substitution** mutation involves the exchange of one base for another, hence a different codon may code for a different amino acid; final protein is still made, but may function incorrectly. If an insertion occurred, this would cause all bases to move along one during translation, causing totally new amino acids to be formed from the mutation onwards. This is called a frame shift and because the degeneracy of the code is unable to buffer this mutation, because more than one codon has changed, this will significantly affect the functioning of the protein. Because the final amino acid chain would not be able to fold into a shape required for functioning.	• Required protein will not be made.	• Explains how a substitution mutation affects the final protein. • Explains how an insertion mutation into sequence affects bases. • Explains how an insertion mutation affects final protein. • Explains degeneracy of the genetic code.	

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Describes any ONE statement from Achievement.	Describes any TWO statements from Achievement.	Describes any THREE statements from Achievement.	Describes any FOUR statements from Achievement.	Explains any THREE statements from Merit.	Explains any FOUR statements from Merit.	Discusses FIRST statement for Excellence.	Discusses FIRST and ONE OTHER statement for Excellence.

Cut Scores

	Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
Score range	0 – 7	8 – 13	14 – 18	19 – 24