Assessment Schedule – 2013

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	Phenotype definition: eg, it is the observable physical / (biochemical) characteristics of an organism Mutagens cause mutations / change in DNA sequence Environmental factors vary widely, but can include high / low / change in temperature, wind, salinity, available nutrients (food) etc. (Any reasonable / appropriate environmental factors can be accepted.) Mutagens cause changes to the genetic material / genotype / genetic information usually DNA, of an organism and increase the frequency of mutations. Mutagens cause a deletion in the DNA sequence which causes a characteristics / phenotype not to be expressed. The phenotype can be affected by the environmental conditions that exist internally or externally for an organism without the genotype itself being altered in any way, eg low nutrients causes the armadillos not to grow as well / big as those with high nutrients / limit potential genotype expression Not all environmental factors are mutagens, eg wind is not a mutagen because it doesn't change the DNA sequence but does change phenotype. Genotype is not the only factor influencing gene expression however, as the phenotype of an organism results from the interaction between the genotype and the environment. The genotype provides the instruction set for a particular structure or function, but this may not be able to be fully expressed if the environmental conditions work against it. Because the armadillos have identical genotypes, then changes that they exhibit in their phenotype must be due to non-mutagenic environmental factors. Experiments on identical quadruplets could vary factors such as food or water availability, temperature exposed to etc (accept any reasonable sugges-	• Defines phenotype. • Defines mutagen. • Describes the interaction between environment / mutagens and genotype. • Provides appropriate example of environmental factor that doesn't change genotype and linked to phenotype change.	• Gives reasons how / why the phenotype is affected by the mutagens. • Give reasons how / why the phenotype is affected by the environment. OR Explains why not all environmental factors are mutagens. • Explains an appropriate study to show the effect of non-mutagenic environmental factors on the armadillos. • Explains the interaction between environmental / mutagens and genotype.	• Evaluates how / why studies on the armadillos show environmental factors can change phenotype without changing genotype, showing understanding that the identical genetic nature of the armadillos excludes genotypic differences. • Links the factors that result in the phenotype by clearly comparing AND contrasting the effects of the environment on genotype and on the expression of that genotype.

		tions) and if there are resultant changes to phenotype, then this cannot be due to variations in genotype.			

	NØ	No response; no relevant evidence.
Not Achieved	N1	Provides any ONE statement from Achievement column.
	N2	Provides any TWO statements from Achievement column.
Achievement	A3	Provides any THREE statements from Achievement column.
	A4	Provides FOUR statements from Achievement column.
Merit	M5	Provides any TWO statements from Merit column.
	M6	Provides any THREE statements from Merit column.
Excellence	E7	Provides BOTH the criteria for Excellence.
	E8	Provides the criteria for Excellence AND the answer is supported with clear examples.

Q	Expected Coverage	Achievement	Merit	Excellence

TWO (a)	The genetic code has redundancy due to the fact that two or more codons can specify the same amino acid. (This is known as degeneracy.)
	
	For example, codons GAA and GAG both specify glutamic acid (GLU). (Any example can be given.)
	
	This means that there are more codons than amino acids in any given translation.
		• In (a) correctly completes the table, *see appendix*.
		• In (a) describes degeneracy (may call it redundancy) / example.
		• In (b) gives a description of at least THREE of the following:
		  - DNA template
		  - coding strands
		  - mRNA structure / function
		  - tRNA structure / function
		  - codons AND anticodons
		  - start AND stop codons
		  - the ribosome
		  - RNA and DNA.
			• In (a) gives reasons how / why more than one codon can code for the same amino acid (with an example from the table).
			• In (b) explains the role of the DNA template.
			• In (b) explains the relationship between mRNA, and tRNA.
			• In (b) gives a reason for the complementary nature of the relationship between codons and anticodons and how this relationship works.
			• In (b) explains the need for start and stop codons.
			• In (b) explains the purpose of the ribosome.
			• Explain the complementary nature of codon & anticodon.
				• In (b) relates (most / all) the functions and their associated functions to comprehensively show understanding of the process of translation and transcription.
				
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(b)	The term **template strand** refers to the sequence of DNA that is used during the synthesis of mRNA. The opposite strand (that is, the strand with a base sequence directly corresponding to the mRNA sequence) is called the **coding strand**. mRNA is single stranded (with base Uracil instead of Thymine) and carries the copied genetic sequence from the nucleus to the ribosome. tRNA brings in amino acids / the basic structure looks similar and is sometimes described as a cloverleaf. Codon – mRNA bases are in a code of three bases at a time. Anti-codon – Three unpaired bases on the tRNA are known as an anticodon. A start codon initiates the translation / protein synthesis and a stop codon ends translation / protein synthesis. RNA is a ribose sugar whereas DNA is a deoxyribose sugar. The Ribosome is the cell organelle which is involved in the translation of messenger-RNA into a polypeptide chain 3 bases on mRNA / codon correspond to 3 bases on tRNA / anti-codon which carries an (specific) amino acid. Codon-anticodon 'matches' combine with base pairing, thus bringing the (correct / specific) amino acid to the next part of the sequence. The start codon and stop codons indicate the start and end of a protein. They are important for ensuring correct protein length / structure.			

Not Achieved	NØ	No response; no relevant evidence.
	N1	Provides any ONE statement from BP Achievement column.
	N2	Provides any TWO statements from BP 3 Achievement column.
Achievement	A3	Provides any TWO BPs from Achievement column.
	A4	Provides all THREE BPs from Achievement column.
Merit	M5	Provides any THREE statements from Merit column.
	M6	Provides FOUR statements from Merit column.
Excellence	E7	Provides the criteria for Excellence for mRNA, tRNA and ribosome functions + 1 of template strand / start stop / codons anticodons.
	E8	Provides the criteria for Excellence for ALL structures.

Q	Expected Coverage	Achievement	Merit	Excellence
THREE (a)	Defines mutation: Eg, a mutation is a change in the base sequence / genetic code of a gene. (However Do NOT accept change in genetic code which results in a new allele).	• In (a) gives an appropriate definition of a mutation. • In (b) describes substitution. • In (b) describes insertion and / or deletion. • In (c) describes inherited mutations. • Describes mutations that occur in an organism's lifespan. • In (c) describes a non-inheritable condition.	• In (b) explains a substitution mutation and why it is likely to be less significant on organisms phenotype. • In (b) explains frame shift and why it is likely to be more significant on organisms phenotype. • In (c) explains why somatic mutations cannot be passed on and example of non inherited condition. • In (c) explains why gamete mutations can be passed on (meiosis / by the next generation). • In (c) explains why cystic fibrosis can be passed from generation to generation without all individuals having the condition.	• Compares and contrasts the two types of mutation clearly and supports discussion with appropriate example of non-heritable condition. • Clearly identifies the nature of cystic fibrosis inheritance.
(b)	Gene mutations can be of three different kinds: **Base substitution:** In this case, one base in the DNA is substituted for another. Eg, instead of CAT there could be CGT. Only one triplet code is affected, so the likely outcome of the mutation will usually be less significant. **Base insertion:** These occur when a base is inserted, changing the reading frame of each triplet code. **Base deletion:** These occur when a base is deleted, changing the reading frame of each triplet code. **Insertion and deletion mutations lead to Frame Shifts:** thus changing the reading frame of each triplet code and altering the amino acid sequence / final protein.			
(c)	Inherited mutations are able to be passed on to the next generation and occur in gametes (sperm or egg). Mutations that occur during the organism's lifetime occur in body cells (may say somatic) and affect that individual only / gametes and affect the next generation. Named diseases which occur in an organism's lifespan, such as most colon cancers or melanomas. Cystic fibrosis is an inheritable recessive condition (stated in question), so it can be passed on from generation to generation. Most individuals will receive a 'normal' dominant gene from the other parent so will not actually get cystic fibrosis but will be carriers. Only an individual who gets two recessive alleles will get the condition. Conditions caused by somatic mutations are often due to environmental factors such as diet, exposure to sunlight, toxins etc and impact on an individual but not on the genetics of their offspring. However, environmental factors such as chemicals and toxins can mutate gametes and effect the next generation.			

Not Achieved	NØ	No response; no relevant evidence.
	N1	Provides any ONE statement from Achievement column.
	N2	Provides any TWO statements from Achievement column.
Achievement	A3	Provides any THREE statements from Achievement column.
	A4	Provides any FOUR statements from Achievement column.
Merit	M5	Provides any THREE statements from Merit column.
	M6	Provides any FOUR statements from Merit column.
Excellence	E7	Provides the first criteria for Excellence.
	E8	Provides BOTH criteria for Excellence.

APPENDIX – Q2a Table

DNA Coding	ATG	CAA CAG GAA GAG	TAT TAC	TAA TAG TGA
DNA template	TAC	GTT GTC CTT CTC	ATA ATG	ATT ATC ACT
mRNA	AUG	CAA CAG GAA GAG	UAU UAC	UAA UAG UGA
Amino Acids	MET	GLU	TYR	STOP

Judgement Statement

	Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
Score range	0 – 7	8 – 12	13 – 18	19 – 24