Assessment Schedule – 2016

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)	DNA is a double-stranded molecule made up of a phosphate, deoxyribose sugar, and nitrogen base. The nitrogen bases are A, T, G and C. It is a long molecule (2 m long). RNA is a single-stranded short molecule made up of phosphate, ribose sugar, and nitrogen bases A, U, G and C.	• Describes the structure of DNA. *May use annotated diagrams.* • Describes the structure of RNA. *May use annotated diagrams.*		
(b)	DNA function is to hold (long term storage) the genetic information for the cell. The genetic information contains the instructions for development and function of living organisms. RNAs have many different functions e.g. mRNA function is to carry sections of this genetic information to the ribosome for protein synthesis. mRNA is produced when an enzyme unwinds the DNA double helix, exposing nucleotide bases. Free nucleotide bases that are complementary attach by RNA pol' binding to the promoter region, transcribing the template stand until the termination region using the base pairing rule A-U and G-C, to produce a single stranded mRNA molecule. mRNA moves out of the nucleus to a ribosome. The ribosome moves along the mRNA strand. tRNA has an anticodon, which is three consecutive bases, and codes for an amino acid. Anticodon / codon and amino acids are specific to one another. tRNA function is to carry a specific amino acid to the ribosome, and its anticodon complementary (H bonding) matches to the codon (3 consecutive bases) on the mRNA strand. The amino acid bonds with another amino acid to produce a polypeptide chain. The cell continually makes mRNA because it's a (relatively) short-lived molecule; DNA is long-lived. DNA is protected and not damaged when making proteins, because it stays in the nucleus and is tightly wound. More proteins can be made simultaneously when there are multiple mRNA molecules made, because the cell may have increased demands for a specific protein; therefore lots of mRNA made (note that mRNA can be read by multiple ribosomes).	• Describes the function of DNA. • Describes why DNA stays in the nucleus • Describes protein synthesis • Describes the function of mRNA. • Describes the function of tRNA. • Describes how mRNA is produced. • Defines transcription • Describes DNA has introns • Describes specific proteins in that fold into different shape	• Explains the function of DNA: to carry the code (in its order of bases) for the synthesis of proteins • Explains the function of mRNA: to carry the 'message' from the template strand (or of the coding strand) to the ribosome for translation. • Explains the function of tRNA: to be 'an adaptor molecule' to be the link between the message of the codon and the specific amino acid. Has complementary anticodon. • Explains how mRNA is produced by mentioning the stages attaches to promoter / or starts at initiative sequence, then copies gene / reads template strand, then reaches termination sequence / hops off the DNA. • Explains how mRNA / tRNA have specific amino acids by mentioning their complementary nature and the anticodon is part of a specific	• Discusses the significance of DNA (triplet)(this series of 3 nucleotides on the template strand is a code for a specific amino acid) mRNA (codon) carries this message to the ribosome and is complementary to the specific tRNA molecule and tRNA (anti-codon) specificity in forming proteins. Mentions functions of all 3 also well as the production of mRNA. And why the cell continually makes mRNA but not DNA during protein synthesis. • Discussion of why mRNA is made by mentioning DNA is only made prior to cell division and mRNA is made continuous whenever proteins are required. May include information such as there are signals when proteins are needed / are 64 triplets and 61 code for aa / mRNA carries no info from the introns / tRNA is attracted to the mRNA / mRNA is read

			tRNA that is specific only to ONE amino acid. • Explains the complementary nature of DNA and mRNA, mRNA and tRNA.: by mentioning the H bonding between the bases / chemical attraction. • Explains why the cell continually makes mRNA by mentioning that (while the gene is turned on) the cell needs more proteins / polypeptides so more mRNA is made. • Explains the use of enzyme) (RNA pol') in matching the complimentary base / (mentions U).	by a lot of ribosomes / mRNA is broken up once gene turned off / specific genes lead to specific proteins with the link of sequence of bases → order of amino acids / link to folding (form and function link) / also , May mention some of DNA when made is always the same, and only made prior to cell division whereas the mRNA made by a cell changes over the day / lifetime as different gene products are needed

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Provides any ONE statement from Achievement column.	Provides any TWO statements from Achievement column.	Provides any THREE statements from Achievement column.	Provides FOUR statements from Achievement column.	Provides any THREE statements from Merit column.	Provides any FOUR statements from Merit column.	Provides the criteria for Excellence for the first bullet point.	Provides the criteria for Excellence including the final bullet point.

Q	Expected Coverage	Achievement	Merit	Excellence
TWO (a)	Gene expression – information from one gene is used to synthesise a functional protein / the production of a gene product(protein) using the DNA template and the genetic code / the whole process of transcription and translation – including protein folding and any post-translational modifications.	• Describes gene expression.		
(b)	Honey bees are ideal to use for experiments on how environment effects gene expression because all the females share identical genotypes / alleles / base sequence. Therefore, any changes to gene expression would be due to environmental factors.	• Describes why honey bees are ideal to use for experiments: identical alleles / genotypes.	• Explains why honey bees are ideal to use for experiments: identical alleles so that observations must be linked to effect on environment.	
(c)	The environmental factor that affects honey bee phenotype is royal jelly / pollen or honey / nutrition / diet. Environmental factor can be an internal or external factor that affects the organism's phenotype. Such as nutrient availability affecting height expression in plants / humans. It does not change the organism's genotype. For example, royal jelly allows genes / turns on genes for functioning ovaries. Mutagen – is a substance or environmental factor (e.g. UV rays) that changes genotype / base sequence. For example UV rays cause mutations in skin cells DNA, resulting in melanoma / cancer. Royal jelly amount changes phenotype but not genotype, because it is not a mutagen and therefore doesn't change DNA sequence. Mutations are changes to the DNA sequence, and change the genotype. Royal jelly interacts with the honey bee's genotype to express different phenotypes. For example, the genes for fully developed ovaries are expressed with a diet of only royal jelly, and are not expressed with limited royal jelly. The genotype of an organism and environmental conditions interact to determine the phenotype. The genotype of the queen bee is fully expressed because it's provided with optimal / correct amount of nutrient / royal jelly conditions. However, the worker bee's genotype is not fully expressed because it is not provided with enough nutrients / royal jelly to express ovaries / extended life / size. Hence, its genes cannot be / are not fully expressed.	• Describes environmental factors. • Gives the bee example of the environmental factor. • Describes mutagen: may cause a mutation / increases the chance of mutations • Gives an example of a mutagen. • Describes genotype + environment →phenotype	• Explains environmental factor and gives example for the bee. • Explains mutagen and gives example. • Explains how nutrition changes phenotype but not genotype by changing gene expression levels / genes on and off • Explains the link between environment, genotype and phenotype: that they both contribute to the phenotype • Explains why the queen's phenotype is fully expressed. • Explains why the worker bees' phenotype not fully expressed: due to some genes not being expressed / shown / turned on	• Comprehensive discussion linking the environmental factor of nutrients / royal jelly to differences in female honey bee development but does not change genotype and how is different to a mutation and links to genetic potential / link to reason e.g. co-factor / turn genes on and off. • Discussion on difference (in genetic potential) includes why diet / nutrient / royal jelly availability / amount causes the queen bee's phenotype to be fully expressed / e.g. epigenetics / enzymes fully functional / enables ovary proteins / more energy for cell division.

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Q	Expected Coverage	Achievement	Merit	Excellence
THREE (a)	Mutation is a permanent change in the DNA base sequence.	• Describes a (DNA) mutation.		
(b)	Substitution mutation – a single nucleotide change / swapped which may result in a codon that codes for a different amino acid. Deletion mutation – the deletion of base(s) in the DNA, resulting in a frameshift, or amino acid not being coded for in the final protein, or the final protein not being made.		• Explains the difference between a substitution mutation and deletion mutation. • Explains the effect of a frameshift.	
	However, in this case the deletion mutation is of 3 bases resulting in an amino acid not being coded for in the final protein, so the reading frame is correct but moved and the final protein is still made. / The amino acid is absent from the final protein because three bases have been deleted on the DNA sequence; therefore it is copied incorrectly to mRNA. tRNA that matches amino acid to codon on mRNA does not, and final protein is missing an amino acid. Consequently, the protein is not complete, and the folding is different from the normal protein, changing its shape (so it cannot bond with the cell membrane to carry out its function). Substitution mutation – a single nucleotide change / swapped, which may result in a codon that codes for a different amino acid. (Not all substitutions result in a new amino acid, due to redundancy of the code.) On the DNA strand, a single nucleotide is substituted / swapped for another so the strand still has the correct number of bases and the protein can be made. However, the different amino acid may cause the final protein to fold slightly differently, and therefore not function correctly. Deletion mutation may cause severe CF because three nucleotides are deleted, causing an amino acid not to be in the final protein. Thus the protein is not folded into the exact shape. Substitution mutation does not cause severe CF because one nucleotide is exchanged for another, causing a different amino acid to be added to the polypeptide chain.The shape may be slightly different; (however it can still reach the cell membrane and carry out its function to a reduced level.)	• Describes protein folding. • Describes amino acids. • Defines a deletion mutation. • Defines a substitution mutation. • Describes a frameshift. • Describes a final protein / has a role. • Describes 3 bases code for 1 amino acid.	• Explains why a deletion mutation causes one amino acid to be absent: eliminated 3 nucleotides. • Explains why deletion mutation may affect protein folding. • Explains why a substitution mutation causes a different amino acid in the final protein. • Explains why substitution mutation may not affect protein folding, e.g. redundancy in the code. • Explains why different mutations can cause differences in the disease phenotype.	• Comprehensive discussion which makes links between substitution mutation, changed amino acid, protein folding, and protein function, resulting in CF disease. Included in discussion makes links between deletion mutation, protein folding, and protein function, resulting in CF disease. • Discussion on why disease can take many forms includes knowledge (for eg) of the numerous (1000) mutations to the variation seen in disease explaining how some may get multiple mutations or simply mutations that more effect the protein shape / folding at critical points needs for its function. / says reading frame moves completely as only one amino acid.

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Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 13	14 – 18	19 – 24