Gene expression

Question 1 **Making proteins**

Evidence Statement

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| **Q2** | **Expected Coverage** | Achievement | Merit | Excellence |
| **a.** | **Transcription and translation named and where they occur described:**Transcription – occurs in the nucleus.Translation – occurs in the cytoplasm / at the ribosome. | Transcription and translation named and locations given |  |  |
| **b.** | **Transcription described:*** DNA is used as a template for making mRNA, using the base-pairing rule: A-U and C-G.
* A sequence of nucleotides, the promoter, acts as an attachment point for an enzyme (RNA polymerase).
* The enzyme (RNA polymerase) separates the DNA along the gene to be copied, forming a ‘transcription bubble’.
* The enzyme (RNA polymerase) moves along the template strand, but makes a copy of the other coding, or sense, strand.
* The enzyme (RNA polymerase) joins neighbouring nucleotides as they are assembled onto the DNA strand in the 5’ to 3’ direction.
* When completed, non-coding regions of DNA known as introns are removed to create ‘mature RNA’.

**Advantages of using mRNA:*** ‘Master’ copy/DNA not used; so less risk of damage, or degradation by enzymes.
* Can make multiple copies of mRNA; so can create more product (protein) than with a single copy of DNA.

**DNA is used as the master copy for the genetic information in the cell because:*** It is long – lots of possible base sequences, so many different genes can be coded for.
* It is stable – double-stranded, so mutations are less likely to occur, as bases can only pair A=T and C=G.
* Scaffolded around histone proteins that also protect DNA structure.
* Has self-repair mechanisms that find and correct most mistakes made during replication.
* Condenses prior to cell division so chromosomes less likely to be damaged during cytokinesis
 | 3 steps in transcription describedRNA polymerase named or its action describedOne advantage of using mRNA statedOne reason for using DNA as the master copy for genetic information given | 5 steps in transcription describedRNA polymerase mode of action explained in terms of template or coding strandOne advantage of using mRNA explainedOne reason for using DNA as the master copy for genetic information explained | Structure of DNA used to describe why it is the master copy Clear understanding of which DNA strand codes for mRNA (coding strand)Two advantages of using mRNA explainedTwo reasons for using DNA as the master copy for genetic information explained and linked to DNA structure |
| **Not Achieved** | **Achievement** | **Merit** | **Excellence** |
| **NØ** | **N1** | **N2** | **A3** | **A4** | **M5** | **M6** | **E7** | **E8** |
| No response; no relevant evidence. | Provides any ONE statement from Achievement. | Provides any TWO statements from Achievement. | Provides any THREE statements from Achievement. | Provides any FOUR statements from Achievement. | Provides any TWO statements from Merit. | Provides THREE statements from Merit. | Provides any TWO statements from Excellence. | Provides THREE statements from Excellence |

Question 2 **Breaking the Code**

Evidence Statement

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| --- | --- | --- | --- | --- |
| **Q1** | **Expected Coverage** | Achievement | Merit | Excellence |
|  | **Sequence of amino acids coded for by DNA stated:** mRNA AUG GGU UAU ACC GCG AUU amino acids Met Gly Tyr Thr Ala IsoTHREE point mutations named and described and possible effects if they were to occur at the third triplet explained **using examples from amino acid table:*** ***Insertion***

= addition of another base to base sequenceResults in *reading frame shift*, where new sequences of triplets are read, resulting in new amino acid sequences so the new protein has different properties, and is likely to be non-functional:* ***Deletion***

= loss of a base from base sequenceResults in in *reading frame shift*, where new sequences of triplets are read, resulting in new amino acid sequences so the new protein has different properties, and is likely to be non-functional:* ***Substitution***

= one base exchanged for anotherResults in a new amino acid being coded for, so the new protein is slightly different, causing it to be less effective, or non-functional:**The effect of the redundancy of the code explained in the context of one of the mutations, e.g., the mutation immediately above.*** The redundancy of the genetic code stems from the fact that there are 20 common amino acids, but 64 possible combinations stemming from 4 different bases being read in sets of 3. This means that some amino acids can be coded for by more than one triplet/codon. If a mutation results in one of the other possible combinations for an amino acid, then the same amino acid is still coded for. This provides some protection against point mutations.

***Or similar*** | Correct mRNA sequenceCorrect amino acid sequenceInsertion describedDeletion describedSubstitution describedRedundancy described | At least ONE possible outcome for 3 types of point mutations explainedAltered amino acid sequence shown for 3 types of point mutationsExplanation of what causes a protein to be non-functionalReading-frame shift explainedEarly termination explainedEffect of degeneracy explained in terms of multiple codons for many amino acids | At least TWO possible outcome for 3 types of point mutations explained ***AND*** altered amino acid sequence shownRecognition of multiple effects of different mutations (different amino acid(s), early termination)Effect of degeneracy explained in terms of multiple codons for many amino acids with examplesExplanation of how degeneracy of code provides some protection against point mutations |
| **Not Achieved** | **Achievement** | **Merit** | **Excellence** |
| **NØ** | **N1** | **N2** | **A3** | **A4** | **M5** | **M6** | **E7** | **E8** |
| No response; no relevant evidence. | Provides any ONE or TWO statements from Achievement. | Provides any THREE statements from Achievement. | Provides any FOUR or FIVE statements from Achievement. | Provides any SIX statements from Achievement. | Provides any TWO or THREE statements from Merit. | Provides FOUR to SIX statements from Merit. | Provides any TWO statements from Excellence. | Provides THREE statements from Excellence. |
| grade boundaries.**Score range** | **NA 0 – 5** | **A 6 – 9** | **M 10– 12** | **E 13 - 16** |