Year 12 Science: DNA, transcription and translation

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Write the complementary strand of 5' ATGCCA 3', with its ends labelled.

2. A DNA template triplet is TTC. What is the mRNA codon?

3. What anticodon pairs with the mRNA codon GGU?

4. Which amino acid does AUG code for, and what else does AUG do?

5. Of the 64 codons, how many code for amino acids?

6. A DNA sample is 30% adenine. What percentage is guanine?

Exam-style question: a section of a keratin gene

Keratin is the structural protein in hair and nails. A short, made-up section of the template strand of a keratin gene, written 3' to 5', reads TAC AAA CGT GGC ATT.

7. Give the mRNA codons and the amino acid sequence this section codes for.

8. Give the anticodons of the tRNAs that bring the first four amino acids.

9. Explain why changing the codon GCA to GCC would not change the keratin.

10. Discuss how the base sequence of the gene decides the shape and function of keratin, and why the ribosome reads mRNA rather than the DNA itself.

Fix the mistake

11. Correct this statement: "The template triplet TAC gives the mRNA codon ATG."

12. Correct this statement: "The codon AUG has the anticodon AUG."

13. Correct this statement: "Given the coding strand ATG, I complemented it to get the mRNA UAC."

14. Correct this statement: "Translation happens in the nucleus, where the DNA is."

Answer key (for parents and tutors)

1. Write the complementary strand of 5' ATGCCA 3', with its ends labelled.
   3' TACGGT 5' (complementary and antiparallel).
2. A DNA template triplet is TTC. What is the mRNA codon?
   AAG (T→A, T→A, C→G).
3. What anticodon pairs with the mRNA codon GGU?
   CCA (G→C, G→C, U→A).
4. Which amino acid does AUG code for, and what else does AUG do?
   Methionine (Met); it is also the start codon.
5. Of the 64 codons, how many code for amino acids?
   61; the other 3 are stop codons.
6. A DNA sample is 30% adenine. What percentage is guanine?
   A = T = 30%, so G + C = 100 − 60 = 40%, and G = 20%.
7. Give the mRNA codons and the amino acid sequence this section codes for.
   mRNA AUG UUU GCA CCG UAA; Met–Phe–Ala–Pro, then stop (Achieved for the correct row).
8. Give the anticodons of the tRNAs that bring the first four amino acids.
   UAC AAA CGU GGC; UAA is a stop codon, so no tRNA matches it (Achieved).
9. Explain why changing the codon GCA to GCC would not change the keratin.
   The code is degenerate: GCA and GCC both code for alanine, so the same amino acid is added and the polypeptide is unchanged (Merit, because it gives the reason).
10. Discuss how the base sequence of the gene decides the shape and function of keratin, and why the ribosome reads mRNA rather than the DNA itself.
    Achieved: the gene is transcribed into mRNA and translated into a chain of amino acids. Merit: each mRNA codon pairs with a complementary tRNA anticodon carrying one specific amino acid, so the base order sets the amino acid order. Excellence: the amino acid order decides how the chain folds, so keratin gets the strong, fibrous shape it needs for hair and nails; the DNA is copied into single-stranded mRNA because DNA stays protected in the nucleus while ribosomes work in the cytoplasm, and many mRNA copies let many ribosomes make keratin at once.
11. Correct this statement: "The template triplet TAC gives the mRNA codon ATG."
    RNA has uracil, not thymine, so the codon is AUG.
12. Correct this statement: "The codon AUG has the anticodon AUG."
    The anticodon is complementary to the codon, so AUG pairs with UAC.
13. Correct this statement: "Given the coding strand ATG, I complemented it to get the mRNA UAC."
    The mRNA copies the coding strand (with U for T), so it is AUG; only the template strand is complemented.
14. Correct this statement: "Translation happens in the nucleus, where the DNA is."
    Transcription is in the nucleus; translation is at ribosomes in the cytoplasm.