TUTORIAL 4: DNA Translation

Q1. Define translation in the context of molecular biology. (2 marks)
Translation is the process by which the sequence of messenger RNA (mRNA) is decoded by a ribosome to synthesize a specific protein, using transfer RNA (tRNA) molecules to add corresponding amino acids to the growing polypeptide chain.

Q2. What are the start and stop codons in translation? (2 marks)
- The start codon is AUG, which codes for methionine and signals the beginning of translation.
- The stop codons are UAA, UAG, and UGA, which signal the termination of translation.

Q3. Name the three sites on the ribosome involved in translation. (1 mark)
- A site
- P site
- E site

Q4. Explain the significance of the Shine-Dalgarno sequence in bacterial translation. (3 marks)
- Alignment of the ribosome: It helps align the ribosome with the start codon (AUG) by complementary base-pairing with a sequence in the 16S rRNA of the small ribosomal subunit.
- Initiation of translation: Ensures proper positioning of the start codon in the ribosome's P site, facilitating the binding of the initiator tRNA carrying methionine.
- Efficiency of translation: Enhances the efficiency and accuracy of translation by promoting proper ribosome assembly at the correct site on the mRNA.

Q5. Describe the role of tRNA in protein synthesis. (3 marks)
Read and recognise the codon on mRNA at one end and carry corresponding AA attached to their other end.

Q6. Given the mRNA sequence 5'-AUG GUC GCU AAA AGU UGA-3', determine the corresponding amino acid sequence. (3 marks)
- Starting codon : AUG is Methionine (Met)
- GUC – Valine (Val)
- GCU – Alanine (Ala)
- AAA – Lysine (Lys)
- AGU – Serine (Ser)
- Stop codon : UGA

Q7. How does tmRNA rescue stalled ribosomes? (3 marks)
- Bacteria cells contains a small but heroic RNA molecule that rescue stalled ribosomes.
- tmRNA carries an amino acid (Alanine) and when it sees stalled ribosome it bind beside the defective mRNA.
- Protein synthesis continues using alanine first which was carried by tmRNA and then continue with translating other short stretch messages.
- Finally tmRNA provides appropriate stop codon so that the release factor can disassemble the ribosome.

Q8. Compare the roles of initiation factors and elongation factors in translation. (4 marks)
- Initiation factor assemble ribosome and start transition, while elongation factor add amino acid to growing chain.
- Initiation factor bind mRNA, initiation tRNA and ribosomal subunit while elongation factor deliver tRNA and translocate ribosome.

Q9. Analyze the importance of the central dogma in understanding protein synthesis. (4 marks)
- The central dogma is crucial for understanding protein synthesis as it explains the flow of genetic information from DNA to RNA to protein, which is fundamental to gene expression.
- Through transcription, DNA is converted into mRNA, which carries the genetic code to the ribosomes.
- In translation, this code is used to assemble amino acids into specific proteins, determining an organism's traits and functions.
- This concept provides a framework for studying genetic regulation, mutations, and biotechnological applications like genetic engineering and protein therapeutics.