

## From Gene to Protein Chapter 17

1. Protein synthesis occurs in two stages: transcription and translation. State the purpose of each.
2. Describe the relationship between a DNA triplet, a codon, and an anticodon.
3. A segment in the middle of an mRNA has the sequence 5'-AGAGAACCGCGA-3'. Translate this sequence, assuming it is downstream of the start codon.
4. The template strand of a gene contains the sequence 3'-TTCAGTCGT-5'. Imagine the non-template strand was transcribed instead of the template strand. Write the sequence of the mRNA that would result and translate it.
5. What is the evolutionary significance of the universal genetic code?
6. Briefly state what happens in the initiation, elongation and termination steps of transcription. Compare it to and contrast it with DNA replication.
7. What enables RNA polymerase to start transcribing a gene at the right place on the DNA in a prokaryotic cell? A eukaryotic cell?
8. Imagine radiation is used to cause a substitution mutation in the TATA box of a gene's promoter. Describe the expected result on the transcription of the gene.
9. Imagine that groups of cells are treated with two different chemicals. One removes the 5' cap from mRNAs while the other prevents the addition of a poly A tail. Describe the effect on each group of cells.
10. Humans have about 20,000 genes coding for proteins. How can human cells make between 75,000-100,000 different proteins?
11. Imagine you've recorded your favorite show on your PVR and are sitting down to watch it. How is RNA splicing similar? What are analogous to the introns?
12. What is the evolutionary significance of introns?
13. What two mechanisms ensure that the correct amino acid is added to a growing polypeptide?
14. Describe how a polypeptide to be secreted reaches the endomembrane system.
15. Draw a tRNA with the anticodon 3'-CGU-5'. What two different codons could it bind to? Draw each codon, labeling all 5' and 3' ends, the tRNA, and the amino acid it carries.
16. In eukaryotic cells, mRNAs have been found to have a circular shape with proteins holding one end of the mRNA near the other. How might this increase translation efficiency?
17. Identify some key differences between translation in prokaryotes and eukaryotes.
18. What happens when one nucleotide pair is lost from the middle of the coding sequence of a gene?
19. How do proteins get targeted to specific locations in the cell or for export?
20. The template strand of a gene includes the sequence 3'-TACTTGTCCGATATC-5'. It is mutated to 3'-TACTTGTCCAATATC-5'. For both the wild-type and mutant sequences, write the resulting mRNA and the amino acid sequence encoded. Describe the effect of the mutation on the amino acid sequence.
21. Individuals heterozygous for the sickle-cell allele are generally healthy but can show some symptoms when blood oxygen is low. Explain this in terms of gene expression.
22. Knowing the genetic code is universal, a molecular biologist inserts the human  $\beta$ -globin gene into bacterial cells hoping the cells will express it and produce functional  $\beta$ -globin protein. Instead, the protein is non-functional and contains many more amino acids than the protein produced by human cells. Propose an explanation for this observation.