

Chapter 17 Ap Bio Reading Guide Answers

Chapter 17 Ap Bio Reading Guide Answers Chapter 17 From Gene to Protein How Information Flows in the Cell Reading Guide Answers This chapter delves into the central dogma of molecular biology exploring how the genetic information encoded in DNA is used to create proteins that carry out the functions of life We will dissect the process of gene expression which involves two major steps transcription and translation

Section 1 The Genetic Code

1 What is the genetic code The genetic code is a set of rules that translates the nucleotide sequence of DNA into the amino acid sequence of proteins It consists of threenucleotide codons which each specify a particular amino acid or a stop signal for protein synthesis

2 Why is the genetic code considered redundant but not ambiguous The genetic code is redundant because multiple codons can code for the same amino acid For example UCU UCC UCA UCG AGU and AGC all code for Serine However the code is not ambiguous because each codon codes for only one specific amino acid This means that a single codon will not produce two different amino acids

3 Explain the concept of reading frame and how it affects protein synthesis A reading frame is a way of dividing the sequence of nucleotides in DNA or mRNA into three nucleotide codons each specifying an amino acid A single nucleotide change can shift the reading frame resulting in a completely different amino acid sequence and potentially a nonfunctional protein

4 What is a mutation and how can it affect protein function A mutation is a change in the nucleotide sequence of DNA Depending on the location and type of mutation it can have varying effects on protein function A point mutation changing a single nucleotide might have no effect silent mutation change a single amino acid missense mutation or introduce a premature stop codon nonsense mutation Larger mutations like deletions or insertions can significantly alter the reading frame and lead to 2 the production of a completely different or nonfunctional protein

Section 2 Transcription

5 Describe the process of transcription Transcription is the process by which the genetic information in DNA is copied into a messenger RNA mRNA molecule Heres a breakdown

Initiation RNA polymerase an enzyme binds to a specific DNA sequence called a promoter upstream of the gene This marks the beginning of the gene

Elongation RNA polymerase moves along the DNA template strand using it as a guide to assemble a complementary RNA molecule Instead of thymine uracil is used in RNA

Termination RNA polymerase encounters a specific DNA sequence called a terminator signaling the end of the gene The polymerase detaches from the DNA releasing the newly synthesized mRNA molecule

6 What is a promoter and what is its role in transcription A promoter is a specific DNA sequence located upstream of a gene that serves as a binding site for RNA polymerase It acts as a switch to turn on and off gene transcription controlling the rate at which a particular gene is transcribed

7 Explain the difference between mRNA tRNA and rRNA mRNA messenger RNA Carries the genetic code from DNA in the nucleus to the ribosomes in the cytoplasm where proteins are synthesized tRNA transfer RNA Transports specific amino acids to the ribosomes during protein synthesis matching them with the appropriate mRNA codon rRNA ribosomal RNA Forms the structural and catalytic core of

ribosomes the molecular machines that translate mRNA into proteins

Section 3 Translation

8 Describe the process of translation

Translation is the process by which the genetic information in mRNA is used to build a protein. Here's a breakdown:

Initiation The small subunit of a ribosome binds to the mRNA and scans for the start codon AUG. The initiator tRNA carrying methionine binds to the start codon. The large subunit of the ribosome then joins the complex.

Elongation tRNA molecules carrying specific amino acids bind to the mRNA codons in the 3' ribosome one by one. The ribosome moves along the mRNA bringing together amino acids in the order dictated by the codons, forming a polypeptide chain.

Termination The ribosome encounters a stop codon UAA, UAG, or UGA on the mRNA. This signals the end of the protein synthesis. The polypeptide chain is released from the ribosome and the ribosome disassembles.

9 What is a ribosome and what is its role in translation? A ribosome is a cellular organelle that serves as the site of protein synthesis. It consists of two subunits: a small subunit that binds mRNA and a large subunit that holds tRNA molecules and facilitates the formation of peptide bonds between amino acids.

10 What is the role of tRNA in translation? tRNA molecules act as adapters during translation. Each tRNA molecule has a specific anticodon that can base pair with a complementary codon on mRNA. It also carries a specific amino acid which it delivers to the growing polypeptide chain at the ribosome.

11 Explain how a polypeptide chain folds into a functional protein. The primary structure of a protein is the linear sequence of amino acids. This sequence dictates its three-dimensional structure. The polypeptide chain folds and twists into a specific shape due to interactions between amino acids, including hydrogen bonds, ionic bonds, hydrophobic interactions, and disulfide bridges. This complex structure allows the protein to perform its specific function.

Section 4 Mutations in Gene Expression

12 How can mutations affect the expression of genes? Mutations can affect gene expression at various stages.

Transcription Mutations in promoter regions can alter the binding of RNA polymerase, affecting the rate of transcription.

Translation Mutations in the coding sequence can alter the mRNA sequence, leading to missense, nonsense, or frameshift mutations, all of which can affect protein function.

Protein folding Mutations can alter the amino acid sequence, disrupting the protein's folding pattern and rendering it nonfunctional.

13 Explain the differences between basepair substitutions and insertions/deletions.

Basepair substitutions A single nucleotide is replaced by another. These can be silent (no change in amino acid), missense (change in amino acid), or nonsense (introducing a premature stop codon).

Insertions/deletions Nucleotides are added or removed from the sequence. These can lead to frameshift mutations, altering the reading frame and drastically changing the amino acid sequence downstream of the mutation.

14 Why are some mutations more harmful than others? The severity of a mutation depends on its location and effect on protein function. Mutations in critical regions of a gene, such as those encoding active sites of enzymes, can have more drastic effects than mutations in less important regions. Furthermore, mutations that alter the reading frame or introduce premature stop codons are generally more harmful than single basepair substitutions.

Section 5 Gene Regulation

15 Why is gene regulation essential for life? Gene regulation is the process of controlling which genes are expressed and at what level. This is crucial for ensuring that the correct proteins are produced at the right time and in the right amounts, allowing cells to respond to environmental cues, differentiate into specialized cell types, and maintain proper function.

16 Describe the different levels at which gene expression can be regulated. Gene expression can be regulated at multiple levels:

- Transcriptional control** Regulating the rate of transcription by controlling the accessibility of DNA to RNA polymerase.
- Posttranscriptional control** Modifying the mRNA transcript.

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