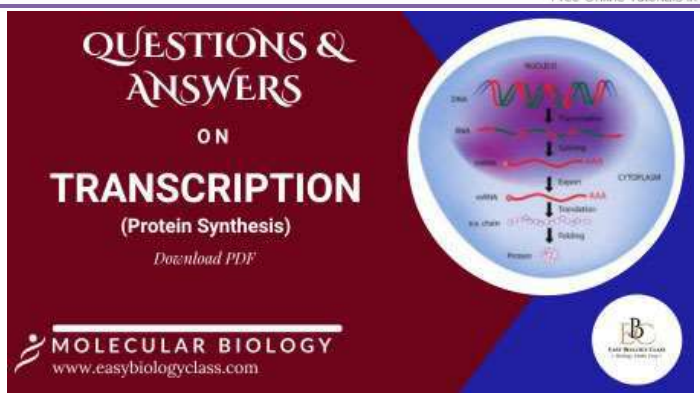

Transcription Questions and Answers (PDF)

Transcription is the biological process where the genetic information in DNA is copied into messenger RNA (mRNA) for protein synthesis. It is the first step in gene expression and occurs in the nucleus of eukaryotic cells and the cytoplasm of prokaryotic cells. Transcription involves several key enzymes and regulatory mechanisms to ensure that genes are expressed at the right time and in the right amounts. This process is vital to the central dogma of molecular biology, which outlines the flow of genetic information from DNA to RNA to proteins. This article is about Transcription Questions and Answers. You can download these questions as PDF from the download link provided below the post.

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Questions and Answers on Transcription

1. What are the main stages of transcription?

Transcription occurs in three main stages: initiation, elongation, and termination. In initiation, RNA polymerase binds to the promoter region of DNA, beginning the transcription process. During elongation, RNA polymerase synthesizes the RNA strand by adding nucleotides complementary to the DNA template. Termination occurs when RNA polymerase reaches a terminator sequence, signaling the end of transcription.

2. How does RNA polymerase recognize the promoter region?

RNA polymerase recognizes the promoter region through the presence of specific DNA sequences, such as the TATA box in eukaryotes. In prokaryotes, the sigma factor helps RNA polymerase identify the promoter. These sequences are highly conserved and serve as binding sites, ensuring that transcription begins at the correct location on the DNA strand.

3. What is the difference between prokaryotic and eukaryotic transcription?

Prokaryotic transcription occurs in the cytoplasm, while eukaryotic transcription takes place in the nucleus. In prokaryotes, transcription and translation can occur simultaneously, but in eukaryotes, transcription is separated from translation. Eukaryotic transcription also involves additional regulatory proteins called transcription factors, and RNA is processed (capping, splicing, polyadenylation) before leaving the nucleus.

4. What are transcription factors, and why are they important?

Transcription factors are proteins that help regulate the transcription process by binding to specific DNA sequences near promoters. They either promote or inhibit the binding of RNA polymerase to the promoter region. Transcription factors are crucial for controlling gene expression, ensuring that genes are transcribed only when needed.

5. What role does the TATA box play in transcription?

The TATA box is a DNA sequence found in the promoter region of many genes in eukaryotes. It serves as a binding site for transcription factors, particularly the TATA-binding protein (TBP), which is part of the larger transcription factor complex. The TATA box helps position RNA polymerase correctly to start transcription.

6. How is transcription terminated in prokaryotes?

In prokaryotes, transcription termination occurs through two mechanisms: Rho-dependent and Rho-independent termination. In Rho-dependent termination, the Rho protein binds to the mRNA and moves toward RNA polymerase, causing it to dissociate from the DNA. In Rho-independent termination, a hairpin loop forms in the mRNA, causing RNA polymerase to pause and detach.

7. What is the function of mRNA splicing in eukaryotes?

In eukaryotes, mRNA splicing removes non-coding regions called introns from the pre-mRNA, leaving only the coding regions called exons. This process ensures that the mature mRNA contains only the sequences necessary for protein synthesis. Splicing is carried out by the spliceosome, a complex of RNA and proteins.

8. How does alternative splicing contribute to protein diversity?

Alternative splicing allows a single gene to produce multiple mRNA variants by splicing different combinations of exons. This process results in the production of different proteins from the same gene, contributing to the diversity of proteins in an organism. It is a key mechanism in regulating gene expression and increasing genetic complexity.

9. What is the role of the 5' cap and poly-A tail in mRNA processing?

In eukaryotic cells, the 5' cap and poly-A tail are added to the mRNA during processing. The 5' cap protects the mRNA from degradation and assists in ribosome binding during translation. The poly-A tail, added to the 3' end, also stabilizes the mRNA and regulates its export from the nucleus to the cytoplasm.

10. What is the significance of the central dogma of molecular biology in transcription?

The central dogma of molecular biology describes the flow of genetic information from DNA to RNA (transcription) and then to proteins (translation). Transcription is the first step in this process, where the DNA sequence of a gene is copied into mRNA. Without transcription, the genetic code could not be expressed as proteins, which are essential for cellular functions.

11. How does RNA polymerase differ between prokaryotes and eukaryotes?

In prokaryotes, a single RNA polymerase synthesizes all types of RNA (mRNA, tRNA, rRNA). In contrast, eukaryotes have three distinct RNA polymerases: RNA polymerase I (for rRNA), RNA polymerase II (for mRNA and some small RNAs), and RNA polymerase III (for tRNA and other small RNAs). These polymerases have specialized functions in eukaryotic transcription.

12. What are enhancers and silencers in the context of transcription regulation?

Enhancers are DNA sequences that increase the rate of transcription when bound by specific transcription factors. They can act at a distance from the promoter. Silencers, on the other hand, are sequences that decrease or repress transcription when bound by repressor proteins. Both enhancers and silencers play critical roles in the precise regulation of gene expression.

13. How do epigenetic modifications affect transcription?

Epigenetic modifications, such as DNA methylation and histone modification, can alter the accessibility of DNA to transcription machinery. Methylation generally silences gene expression by preventing transcription factor binding, while histone acetylation

loosens chromatin structure, making genes more accessible for transcription. These modifications provide an additional layer of control over gene expression.

14. What is the function of RNA polymerase II in eukaryotes?

RNA polymerase II is responsible for synthesizing mRNA, as well as some small nuclear RNAs (snRNAs). It plays a central role in eukaryotic transcription and is involved in transcribing genes that encode proteins. RNA polymerase II must interact with various transcription factors and undergo phosphorylation to initiate and regulate the transcription process.

15. Why is transcriptional regulation important for cellular function?

Transcriptional regulation ensures that genes are expressed at the right time, in the right cells, and in the right amounts. This regulation is crucial for cellular differentiation, response to environmental signals, and overall organismal development. Disruptions in transcriptional regulation can lead to diseases, including cancer, due to uncontrolled gene expression.