From DNA to RNA

Trace transcription in two kinds of cells

GEN.2A.2 "Describe and model how the process of transcription produces RNA from a DNA template in both prokaryotes and eukaryotes."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the steps that build RNA in both kinds of cells. Circle words that show where transcription happens or what happens to the RNA afterward.

One Process, Two Places

1. A bacterium that encounters a new sugar may switch on a gene for breaking it down. A human insulin-producing pancreas cell may switch on the insulin gene. In both cases, transcription begins when RNA polymerase binds near a gene at a promoter. The enzyme separates a short stretch of DNA and uses one strand as a template. It reads that template from 3' to 5' while building RNA from 5' to 3'. As RNA grows, DNA template A pairs with RNA U, T with A, C with G, and G with C.

2. In a bacterium, there is no nucleus. Its DNA lies in a region of the cytoplasm called the nucleoid, so RNA polymerase builds the RNA there. As the enzyme moves along the gene, the DNA strands rejoin behind it and the new RNA peels away. A stop signal in the DNA causes the enzyme to release the RNA transcript. Bacterial RNA that carries protein instructions usually needs little processing before use. Because ribosomes also work in the cytoplasm, they can begin translating an RNA molecule while RNA polymerase is still making its far end.

3. In a human cell, the DNA is inside a nucleus, so transcription takes place there. RNA polymerase also follows a DNA template and makes a complementary RNA strand, but the first copy of a protein-coding gene is called pre-mRNA. Before it leaves the nucleus, a cap is added to its 5' end and a tail of A bases is added to its 3' end. Splicing removes introns and joins the remaining exons. The mature mRNA then passes into the cytoplasm, where ribosomes can translate it. This separation keeps translation from starting while the RNA is still being transcribed.

2 ANSWER WITH EVIDENCE

Use the passage

1. How does RNA polymerase begin transcription, and how does it use DNA to build RNA?

2. If RNA polymerase reads a T followed by a C on the DNA template, which two RNA bases does it add in that order? Explain your choices.

3. Where does a bacterium make RNA, and how can that location affect when translation begins?

4. Where does a human cell make its first RNA copy of a protein-coding gene? Describe two changes to that copy before translation.

3 YOUR TURN

Your own words

A new gene has the DNA template 3'-TAC GGA CTT-5'. In two panels, model how a bacterium and a human cell make RNA from it. Label the DNA and RNA directions, show the RNA sequence and location, and note one difference in what happens before translation.

ANSWER KEY

From DNA to RNA

HIGH SCHOOL · GEN.2A.2

PART 1 · READ AND MARK

Underline the steps that build RNA in both kinds of cells. Circle words that show where transcription happens or what happens to the RNA afterward. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How does RNA polymerase begin transcription, and how does it use DNA to build RNA?	**It binds near a gene at a promoter and separates a short stretch of DNA. It reads one template strand from 3' to 5' and builds complementary RNA from 5' to 3'.**
2	If RNA polymerase reads a T followed by a C on the DNA template, which two RNA bases does it add in that order? Explain your choices.	**It adds A, then G, because DNA template T pairs with RNA A and DNA template C pairs with RNA G.**
3	Where does a bacterium make RNA, and how can that location affect when translation begins?	**It makes RNA in the nucleoid region of the cytoplasm. Ribosomes in the cytoplasm can begin translation before transcription finishes.**
4	Where does a human cell make its first RNA copy of a protein-coding gene? Describe two changes to that copy before translation.	**It makes pre-mRNA in the nucleus. A 5' cap and a 3' tail of A bases are added, and splicing removes introns and joins exons. Accept any two of these changes.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Bacterium panel: In the nucleoid region of the cytoplasm, RNA polymerase reads DNA template 3'-TAC GGA CTT-5' and builds RNA 5'-AUG CCU GAA-3'. A ribosome can begin translation while transcription continues. Human cell panel: In the nucleus, RNA polymerase reads DNA template 3'-TAC GGA CTT-5' and builds RNA 5'-AUG CCU GAA-3'. The RNA is processed and leaves the nucleus before translation begins in the cytoplasm.

For the panels, check complementary base pairing, opposite strand directions, and the correct location in each cell. Accept a 5' cap, a 3' A tail, or splicing as the human-cell processing detail.