From Gene to Protein

Trace how cells copy, edit, and use genetic instructions.

GEN.2A "Students will analyze and explain the processes of transcription and translation in protein production. Compare and contrast the structures of RNA and DNA and relate this structure to the different functions of each molecule..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the steps that turn a DNA sequence into a protein, and circle each named RNA type to track its role.

Making a Membrane Protein

1. Inside a skin cell, the instructions for a membrane protein remain in DNA, a double-stranded molecule whose bases pair A with T and C with G. A gene's sequence can be copied into RNA without using up the DNA. RNA is usually single-stranded, uses U instead of T, and can fold into shapes that help it work. During transcription, RNA polymerase separates part of the DNA and reads one strand as a template. It builds an RNA strand by matching DNA A with RNA U, T with A, C with G, and G with C. The DNA strands join again behind the enzyme.

2. In a eukaryotic skin cell, transcription takes place in the nucleus. The first RNA copy may include introns, sections removed before translation. Small nuclear RNA (snRNA) joins proteins in a spliceosome that removes introns and connects the remaining exons. Different choices of exons can produce different mature messenger RNA (mRNA) molecules from one gene. The mRNA then leaves the nucleus. In bacteria, which have no nucleus, transcription occurs in the cytoplasm; most bacterial mRNAs do not undergo this kind of splicing. A ribosome can start translating a bacterial mRNA while RNA polymerase is still making it.

3. The ribosome reads an mRNA in groups of three bases called codons. Each transfer RNA (tRNA) carries a particular amino acid and has an anticodon that pairs with a matching mRNA codon. Ribosomal RNA (rRNA) forms much of the ribosome and helps link the amino acids into a chain. The chain folds into a protein that may become part of the cell membrane. Thus mRNA carries the copied instructions, tRNA delivers building blocks, and rRNA helps assemble them; snRNA helps prepare eukaryotic messages before translation. Changing which exons remain can change the codons, the amino acid sequence, and sometimes the protein's function.

2 ANSWER WITH EVIDENCE

Use the passage

1. Compare DNA and RNA in strand structure and bases. How does RNA's structure help it do more than carry a copy of a gene?

2. Compare where transcription occurs in a skin cell and a bacterium. How does the lack of a nucleus affect when a bacterium can begin translation?

3. Explain how snRNA helps one eukaryotic gene produce different mRNAs, and how those mRNAs could lead to different proteins.

4. At a ribosome, how do mRNA, tRNA, and rRNA work together to build a protein?

3 YOUR TURN

Your own words

Suppose the snRNA needed to remove an intron in the skin cell cannot function. In one paragraph, trace a possible effect from transcription to the membrane protein, including the roles of mRNA, tRNA, and rRNA; then contrast this with a bacterium whose gene has no introns.

From Gene to Protein

PART 1 · READ AND MARK

Underline the steps that turn a DNA sequence into a protein, and circle each named RNA type to track its role. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Compare DNA and RNA in strand structure and bases. How does RNA's structure help it do more than carry a copy of a gene?	**DNA is double-stranded and uses T; RNA is usually single-stranded and uses U. RNA can fold into shapes that help it perform other roles.**
2	Compare where transcription occurs in a skin cell and a bacterium. How does the lack of a nucleus affect when a bacterium can begin translation?	**A skin cell transcribes DNA in the nucleus, while a bacterium transcribes it in the cytoplasm. A bacterial ribosome can begin translation while transcription is still underway.**
3	Explain how snRNA helps one eukaryotic gene produce different mRNAs, and how those mRNAs could lead to different proteins.	**snRNA helps a spliceosome remove introns and join exons. Different exon choices can change mRNA codons and, in turn, the amino acid sequence of a protein.**
4	At a ribosome, how do mRNA, tRNA, and rRNA work together to build a protein?	**The ribosome reads mRNA codons. tRNAs pair with those codons and bring amino acids, which rRNA helps link into a chain.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

In the skin cell, RNA polymerase still copies the DNA gene into an RNA strand. If snRNA cannot help remove the intron, the mRNA may keep extra bases. Those bases might change the codons that a ribosome reads, so tRNAs could deliver a different sequence of amino acids. The ribosome's rRNA would still help link those amino acids, but the resulting protein might not work as a membrane protein. A bacterium with an intron-free gene would not need intron removal; its ribosomes could begin translating the mRNA before transcription ends.

Accept predictions that the intron might change the protein or prevent a working protein; the outcome is not certain. The bacterial comparison should distinguish an intron-free transcript from one that requires splicing.