RNA Assembly Crew

How four kinds of RNA help a cell make a protein

GEN.2A.4 "Analyze the multiple roles of RNA in translation. Compare the structure and function of tRNA, rRNA, mRNA, and snRNA."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline a structural feature of each kind of RNA. Circle the action that feature helps it perform.

Making Insulin, One Step at a Time

1. A pancreatic cell needs to make insulin, a protein that helps control blood sugar. Its insulin gene is copied into a preliminary RNA transcript in the nucleus. This transcript includes exons, stretches kept in the final message, and introns, stretches that must be removed. Small nuclear RNA, or snRNA, is short and joins proteins in a spliceosome. Some snRNAs base pair with the transcript near splice sites, helping the spliceosome recognize where to cut and reconnect RNA. If an intron remains, the message may carry the wrong instructions. This editing happens before the message travels to a ribosome.

2. After splicing, messenger RNA, or mRNA, carries the insulin instructions from the nucleus to a ribosome in the cytoplasm. Its long, single-stranded sequence contains codons, groups of three bases that specify amino acids or signal a stop. The ribosome reads these codons in order. Transfer RNA, or tRNA, has a compact, folded shape with an anticodon that pairs with a matching mRNA codon. At its other end, each tRNA carries an amino acid. The shape of tRNA lets it connect the code in the message to the material used to build a protein.

3. Ribosomal RNA, or rRNA, is folded RNA that combines with proteins to form the ribosome's two subunits. The ribosome holds mRNA and tRNAs in position while rRNA helps catalyze bonds between amino acids. As the ribosome advances, tRNAs arrive with amino acids and leave after their cargo is added to the growing chain. These jobs are linked but not interchangeable: mRNA supplies the ordered code, tRNA matches code to cargo, and rRNA helps assemble the chain. Unlike these three RNAs working at the ribosome, snRNA acts earlier in the nucleus to help prepare the message.

2 ANSWER WITH EVIDENCE

Use the passage

1. How do the structures of snRNA and mRNA suit their different roles in getting insulin instructions to the ribosome?

2. How do an mRNA codon and a tRNA anticodon work together to put an amino acid in the growing chain?

3. Why can tRNA not do rRNA's job at the ribosome, even though both help build the insulin chain?

4. A cell has working mRNA, tRNA, and rRNA, but its spliceosome cannot use snRNA properly. Why might it still make an incorrect protein?

3 YOUR TURN

Your own words

Invent a workshop analogy for making a protein. In five sentences, give snRNA, mRNA, tRNA, and rRNA different workshop roles, explain how each RNA's structure supports its role, and identify one limit of your analogy.

ANSWER KEY

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HIGH SCHOOL · GEN.2A.4

PART 1 · READ AND MARK

Underline a structural feature of each kind of RNA. Circle the action that feature helps it perform. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How do the structures of snRNA and mRNA suit their different roles in getting insulin instructions to the ribosome?	**Some short snRNAs base pair near splice sites to help prepare the message. Long, single-stranded mRNA carries the resulting sequence of codons to the ribosome.**
2	How do an mRNA codon and a tRNA anticodon work together to put an amino acid in the growing chain?	**The tRNA anticodon pairs with a matching mRNA codon, positioning the amino acid carried by that tRNA for addition to the chain.**
3	Why can tRNA not do rRNA's job at the ribosome, even though both help build the insulin chain?	**tRNA matches a codon and delivers an amino acid. rRNA forms part of the ribosome and helps catalyze bonds between amino acids.**
4	A cell has working mRNA, tRNA, and rRNA, but its spliceosome cannot use snRNA properly. Why might it still make an incorrect protein?	**Without snRNA helping the spliceosome recognize splice sites, an intron may remain in the mRNA. The ribosome may then read incorrect instructions, even if mRNA, tRNA, and rRNA carry out their usual roles.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

In my workshop, short snRNA is a proofreader's guide that pairs with splice-site marks to help remove extra text. Long, single-stranded mRNA is an instruction strip whose three-base units give the order of parts. Folded tRNA is a delivery cart whose anticodon tag matches an instruction unit while its other end carries an amino acid. Folded rRNA is the assembly station's framework and joining tool, holding the strip and carts while helping bond the parts. The analogy has a limit because RNA molecules use base pairing and chemical reactions, not people reading printed words.

Accept other workshop roles if each role matches the RNA's structure and function. The analogy's limit should name a meaningful difference between the workshop and the molecular process.