Instructions in Motion

How molecular structures support storing and using genetic information

GEN.2A.1 "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 two ways DNA and RNA are alike, circle three structural differences, and number each difference and the job it helps explain with the same number.

From Insulin Gene to Insulin

1. A pancreatic beta cell makes insulin, a protein that helps control blood sugar. The cell must keep the instructions for insulin even after it divides. Those instructions are stored in DNA, whose nucleotides each contain a phosphate group, deoxyribose sugar, and a base. Two DNA strands twist into a double helix. Their bases pair in a predictable way: adenine (A) with thymine (T), and cytosine (C) with guanine (G). The paired strands help protect information because one strand can serve as a guide when the other is damaged. Deoxyribose also makes DNA relatively resistant to chemical breakdown.

2. When the beta cell needs insulin, it does not send its DNA to a ribosome. Instead, it makes a messenger RNA (mRNA) copy of the insulin gene. RNA nucleotides also have a phosphate group, a sugar, and a base, but their sugar is ribose. RNA uses uracil (U) instead of thymine (T); both molecules use A, C, and G. During copying, a DNA A pairs with an RNA U. The mRNA usually forms one strand, which can travel from the nucleus to a ribosome in the cytoplasm. The ribosome reads its sequence to build a protein that will be processed into insulin.

3. RNA's usual single-stranded form also lets parts of a strand pair with each other and fold into useful shapes. Transfer RNA (tRNA) folds so it can carry an amino acid to the ribosome; ribosomal RNA helps form the ribosome itself. RNA's ribose has an extra oxygen-containing group compared with deoxyribose, making RNA more likely to break down chemically. Cells often replace RNA copies as their protein needs change, while keeping DNA as a longer-lasting record. Both molecules store information in the order of their bases, but DNA is suited to maintaining instructions and RNA to carrying or using them.

2 ANSWER WITH EVIDENCE

Use the passage

1. How do the strand arrangements of DNA and mRNA differ, and how does each arrangement help the beta cell?

2. How do the bases in DNA and RNA differ? Explain how an RNA copy records a DNA A.

3. How do mRNA and tRNA use their strand structures differently when insulin is produced?

4. Both DNA and RNA contain a sugar and phosphate. How does their sugar difference help explain why the cell keeps DNA but replaces RNA copies?

3 YOUR TURN

Your own words

A skin cell needs to make extra collagen while a cut heals. Write four sentences explaining why DNA keeps the collagen instructions while RNA helps use them. Include one shared structural feature, two structural differences, and how each difference relates to a job.

ANSWER KEY

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PART 1 · READ AND MARK

Underline two ways DNA and RNA are alike, circle three structural differences, and number each difference and the job it helps explain with the same number. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How do the strand arrangements of DNA and mRNA differ, and how does each arrangement help the beta cell?	**DNA has two paired strands, so one can guide repair of the other. mRNA is usually one strand and can carry the insulin gene's message from the nucleus to a ribosome.**
2	How do the bases in DNA and RNA differ? Explain how an RNA copy records a DNA A.	**DNA uses thymine, while RNA uses uracil; both use A, C, and G. During copying, a DNA A pairs with an RNA U.**
3	How do mRNA and tRNA use their strand structures differently when insulin is produced?	**Single-stranded mRNA carries a base sequence for the ribosome to read. tRNA folds into a shape that lets it carry an amino acid to the ribosome.**
4	Both DNA and RNA contain a sugar and phosphate. How does their sugar difference help explain why the cell keeps DNA but replaces RNA copies?	**DNA has deoxyribose, which makes it relatively resistant to chemical breakdown and useful for long-term storage. RNA has ribose, which makes it more likely to break down, so cells replace RNA copies as needed.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Both DNA and RNA have sugar-phosphate backbones and bases that carry information. DNA's deoxyribose helps keep the collagen gene stable, while RNA's ribose makes an mRNA copy more likely to break down after use. DNA has two paired strands that can guide repair if one is damaged, while mRNA is usually one strand that carries the gene's message to a ribosome. Single-stranded tRNA can also fold into a shape that helps deliver amino acids for building collagen.

Accept explanations that accurately connect paired DNA strands with repair, single-stranded RNA with carrying a message or folding, and the sugar difference with relative chemical stability. Students need not name every RNA type.