# From Gene to Medicine

Trace how DNA instructions become a protein and affect cells.

**BIO.2** "Obtain and evaluate information to explain the role of DNA and RNA in transcription and translation leading to protein synthesis and cellular function. a. Use a model to describe the structure and sequence of DNA..."

NAME _____ DATE _____

## 1 READ AND MARK

Read it twice

**YOUR JOB** Underline the steps that turn the insulin gene into a protein. Circle one way a cell can control how much protein it makes, and number two facts that help you evaluate the claim about insulin made by bacteria.

### The Instructions for Insulin

1. A person's blood sugar rises after a meal. In response, certain cells in the pancreas make insulin, a protein that signals other cells to take up glucose. The instructions for insulin are stored in DNA. DNA forms a double helix, two strands twisted around each other. Each strand is a chain of nucleotides, and each nucleotide contains a sugar, a phosphate group, and one base. The bases are A, T, C, and G. Across the strands, A pairs with T, and C pairs with G. The order of bases in a gene carries information for a protein.

2. To make insulin, a pancreatic cell copies the insulin gene into messenger RNA, or mRNA, during transcription. RNA polymerase reads one DNA strand as a template. In RNA, U replaces T: DNA template A pairs with RNA U, T with A, C with G, and G with C. The mRNA travels to a ribosome, which reads its bases in groups of three during translation. Transfer RNAs bring amino acids in the order specified by those groups. The amino acid chain folds into a working insulin protein. Some other RNAs can attach to mRNA and lower the amount of protein made.

3. A muscle cell has the insulin gene but usually does not make insulin. Regulatory proteins can bind to regions of DNA and help or block RNA polymerase from copying a gene. This helps cells with the same DNA develop different functions. Scientists can place a copy of the human insulin gene in bacteria. The bacteria then produce insulin, which is purified for use by people with diabetes. A claim that these patients receive bacterial DNA is incorrect: they receive the purified protein, not the bacteria. Checking what a product contains helps people evaluate claims about genetic technology.

## 2 ANSWER WITH EVIDENCE

Use the passage

1. Describe the shape of DNA and the three parts of one nucleotide. If one DNA strand has a C, which base pairs with it?

2. A DNA template segment reads TAC. What mRNA segment would be made, and what is this copying step called?

3. Why can a muscle cell and a pancreatic cell have the same insulin gene but make different amounts of insulin? Name one action that controls production.

4. Someone claims that using insulin made by engineered bacteria gives patients bacterial DNA. Evaluate the claim using two facts from the passage.

## 3 YOUR TURN

Your own words

Imagine a liver cell makes a protein that helps break down a substance. Its DNA template begins ACG TTC. In four or five sentences, trace how this sequence leads to mRNA and a working protein, then explain how a regulatory factor could reduce the cell's ability to break down the substance.

# From Gene to Medicine



## PART 1 · READ AND MARK

Underline the steps that turn the insulin gene into a protein. Circle one way a cell can control how much protein it makes, and number two facts that help you evaluate the claim about insulin made by bacteria. Accept any marking that follows this job and points at the right text.

## PART 2 · ANSWERS

| # | QUESTION | ANSWER |
|---|---|---|
| 1 | Describe the shape of DNA and the three parts of one nucleotide. If one DNA strand has a C, which base pairs with it? | **DNA is a double helix of two twisted strands. A nucleotide contains a sugar, a phosphate group, and a base. C pairs with G.** |
| 2 | A DNA template segment reads TAC. What mRNA segment would be made, and what is this copying step called? | **The mRNA segment is AUG. Copying DNA into mRNA is transcription.** |
| 3 | Why can a muscle cell and a pancreatic cell have the same insulin gene but make different amounts of insulin? Name one action that controls production. | **The cells can regulate the gene differently. A regulatory protein can help or block RNA polymerase, or another RNA can attach to mRNA and reduce protein production.** |
| 4 | Someone claims that using insulin made by engineered bacteria gives patients bacterial DNA. Evaluate the claim using two facts from the passage. | **The claim is incorrect. Bacteria produce the insulin, but the insulin is purified. Patients receive the protein, not the bacteria.** |

## PART 3 · YOUR TURN (SAMPLE ANSWER)

The DNA template ACG TTC is transcribed into mRNA UGC AAG. A ribosome reads the mRNA in groups of three bases, and transfer RNAs bring amino acids in the specified order. The amino acid chain folds into a protein that helps the liver cell break down the substance. If a regulatory protein blocks transcription, the cell makes less mRNA. With less mRNA, the cell may make less of the protein and break down less of the substance.

For Part 3, accept a different plausible regulatory action, such as an RNA that reduces translation. The mRNA sequence must be UGC AAG.