From Gene to Function

Trace how genetic information produces a working protein.

7.12 "Develop and use models to explain how genes are expressed through the flow of genetic information from DNA to RNA to a functional protein."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the sentence that traces information from DNA to RNA to protein, circle the sentence that explains how an amino acid chain becomes a working protein, and number the three effects of turning down the gene in cause-and-effect order.

How Cells Make Lactase

1. A glass of milk contains lactose, a sugar that some people digest easily. Cells in the small intestine can make lactase, a protein that breaks lactose into two smaller sugars, glucose and galactose. The instructions for making lactase are stored in a stretch of DNA called the lactase gene. This gene is part of a chromosome inside the cell's nucleus. A gene is not the protein itself: it holds information that the cell can use to build that protein.

2. When an intestinal cell needs lactase, it makes an RNA copy of the gene's instructions. This step is called transcription. The RNA message, or mRNA, leaves the nucleus and travels to a ribosome. There, the ribosome reads the mRNA and joins amino acids in the order given by its instructions. This step is called translation. The amino acid chain then folds into a shape that lets lactase work. In this way, information moves from DNA to RNA to a working protein.

3. A change in a gene's DNA may change the RNA message and the order of amino acids. A different order can change the protein's shape, so lactase may not break down lactose as well. But a cell can also make less lactase without changing the gene's protein-building instructions. If the gene is turned down, the cell makes fewer RNA messages and usually less lactase. Either way, less working lactase means less lactose is broken into smaller sugars in the small intestine.

2 ANSWER WITH EVIDENCE

Use the passage

1. Make a four-step arrow model showing how the lactase gene leads to lactose being broken down. Include mRNA and the ribosome.

2. If a ribosome cannot read a cell's lactase mRNA, why would the cell fail to make new working lactase?

3. Suppose a change in the lactase gene changes the order of amino acids. Trace one possible effect on lactose digestion.

4. The lactase gene's protein-building instructions stay the same, but the gene is turned down. Use a cause-and-effect chain to explain why less lactose is broken down.

3 YOUR TURN

Your own words

In a firefly, a gene codes for luciferase, a protein needed for its light-making reaction. Draw a labeled arrow model from DNA to working luciferase, add a second path showing how a DNA change could stop the reaction, and explain the cause in one sentence.

ANSWER KEY

From Gene to Function

GRADE 7 · 7.12

PART 1 · READ AND MARK

Underline the sentence that traces information from DNA to RNA to protein, circle the sentence that explains how an amino acid chain becomes a working protein, and number the three effects of turning down the gene in cause-and-effect order. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Make a four-step arrow model showing how the lactase gene leads to lactose being broken down. Include mRNA and the ribosome.	**Lactase gene in DNA → lactase mRNA → ribosome uses mRNA to build lactase → lactase breaks down lactose.**
2	If a ribosome cannot read a cell's lactase mRNA, why would the cell fail to make new working lactase?	**The ribosome cannot use the mRNA instructions to join amino acids in the needed order, so it cannot build new working lactase.**
3	Suppose a change in the lactase gene changes the order of amino acids. Trace one possible effect on lactose digestion.	**The changed order may alter lactase's shape, making it work less well, so less lactose is broken down.**
4	The lactase gene's protein-building instructions stay the same, but the gene is turned down. Use a cause-and-effect chain to explain why less lactose is broken down.	**The cell makes fewer lactase mRNA messages → usually makes less lactase → breaks down less lactose.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Working path: DNA luciferase gene → luciferase mRNA → ribosome joins amino acids → folded luciferase → light-making reaction. Changed path: changed DNA → changed mRNA → different amino acid order → incorrectly folded protein → light-making reaction may stop. A DNA change can alter the protein's shape so it no longer works in the light-making reaction.

Accept models that show DNA instructions copied into mRNA and used by a ribosome to build a protein. A DNA change may affect protein function, but it does not always do so.