

2026 MCAS Sample Student Work and Scoring Guide

High School Biology

Question 19: Constructed-Response

Reporting Category: Molecules to Organisms

Practice Category: Evidence, Reasoning, and Modeling

Standard: [HS.LS.1.1](#) Construct a model of transcription and translation to explain the roles of DNA and RNA that code for proteins that regulate and carry out essential functions of life.

Item Description: Analyze DNA sequences to explain why a cell has a mutation, determine mRNA and amino acid sequences based on DNA sequences, and explain why the mutation is not likely to cause a phenotypic change.

This item can be found in the released item sets on the [MCAS Resource Center](#).

Scoring Guide

Select a score point in the table below to view the sample student response.

Score*	Description
4A 4B	The response demonstrates a thorough understanding of transcription and translation. The response correctly identifies which cell type has a mutation in its DNA sequence and clearly explains the reasoning. The response correctly identifies the mRNA sequence of the cell type with the mutation and the mRNA sequence without the mutation. The response correctly identifies the amino acid sequence that is coded for by each mRNA sequence. The response also correctly identifies whether a phenotypic change is expected in the cell type with the mutation and clearly explains the reasoning.
3	The response demonstrates a general understanding of transcription and translation.
2	The response demonstrates a limited understanding of transcription and translation.
1	The response demonstrates a minimal understanding of transcription and translation.
0	The response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

*Letters are used to distinguish between sample student responses that earned the same score (e.g., 4A and 4B).

Question Introduction

This question has four parts.

Scientists sequenced the DNA from four cell types. Part of the DNA sequence from the same gene location of each cell type is shown in the table. One cell type has a mutation.

Cell Type	DNA Sequence
liver	GTA TCA GAA GAA
stomach	GTA TCA GAA GAA
skin	GTA TCA GAC GAA
sperm	GTA TCA GAA GAA

Score Point 4A

Part A

Identify the cell type that has a mutation. Explain your reasoning using evidence from the table.

The skin cell has a mutation because instead of GAA in the DNA sequence it has GAC, meaning that is has a different sequence from the rest of the cells.

Part B

Identify the mRNA sequence of the cell type with the mutation you identified in Part A **and** the mRNA sequence from a cell type without the mutation.

mRNA sequence with mutation: CAU AGU CUG CUU

mRNA sequence without mutation: CAU AGU CUU CUU

Part C

The table below shows the amino acids coded for by mRNA codons.

mRNA Codon Table

UUU Phe	UCU Ser	UAU Tyr	UGU Cys
UUC Phe	UCC Ser	UAC Tyr	UGC Cys
UUA Leu	UCA Ser	UAA STOP	UGA STOP
UUG Leu	UCG Ser	UAG STOP	UGG Trp
CUU Leu	CCU Pro	CAU His	CGU Arg
CUC Leu	CCC Pro	CAC His	CGC Arg
CUA Leu	CCA Pro	CAA Gln	CGA Arg
CUG Leu	CCG Pro	CAG Gln	CGG Arg
AUU Ile	ACU Thr	AAU Asn	AGU Ser
AUC Ile	ACC Thr	AAC Asn	AGC Ser
AUA Ile	ACA Thr	AAA Lys	AGA Arg
AUG Met	ACG Thr	AAG Lys	AGG Arg
GUU Val	GCU Ala	GAU Asp	GGU Gly
GUC Val	GCC Ala	GAC Asp	GGC Gly
GUA Val	GCA Ala	GAA Glu	GGA Gly
GUG Val	GCG Ala	GAG Glu	GGG Gly

Identify the amino acid sequence that is coded for by each mRNA sequence you identified in Part B.

amino acid sequence coded for by mRNA with mutation: His Ser Leu Leu

amino acid sequence coded for by mRNA without mutation: His Ser Leu Leu

Part D

Identify whether a phenotypic change is expected in the cell type with the mutation. Explain your reasoning.

A phenotypic change is not expected in the cell type with the mutation because even though there is a different DNA sequence, the amino acid sequence coded has no change between the mutation and the normal, meaning after transcribing then translating the code, there is no change in the sequence.

Score Point 4B

Part A

Identify the cell type that has a mutation. Explain your reasoning using evidence from the table.

The skin cell has a mutation. The other cell types have GAA in the sequence, but the skin cell has GAC.

Part B

Identify the mRNA sequence of the cell type with the mutation you identified in Part A **and** the mRNA sequence from a cell type without the mutation.

mRNA sequence with mutation: CAU AGU CUG CUU

mRNA sequence without mutation: CAU AGU CUU CUU

Part C

The table below shows the amino acids coded for by mRNA codons.

mRNA Codon Table

UUU Phe	UCU Ser	UAU Tyr	UGU Cys
UUC Phe	UCC Ser	UAC Tyr	UGC Cys
UUA Leu	UCA Ser	UAA STOP	UGA STOP
UUG Leu	UCG Ser	UAG STOP	UGG Trp
CUU Leu	CCU Pro	CAU His	CGU Arg
CUC Leu	CCC Pro	CAC His	CGC Arg
CUA Leu	CCA Pro	CAA Gln	CGA Arg
CUG Leu	CCG Pro	CAG Gln	CGG Arg
AUU Ile	ACU Thr	AAU Asn	AGU Ser
AUC Ile	ACC Thr	AAC Asn	AGC Ser
AUA Ile	ACA Thr	AAA Lys	AGA Arg
AUG Met	ACG Thr	AAG Lys	AGG Arg
GUU Val	GCU Ala	GAU Asp	GGU Gly
GUC Val	GCC Ala	GAC Asp	GGC Gly
GUA Val	GCA Ala	GAA Glu	GGA Gly
GUG Val	GCG Ala	GAG Glu	GGG Gly

Identify the amino acid sequence that is coded for by each mRNA sequence you identified in Part B.

amino acid sequence coded for
by mRNA with mutation: His Ser Leu Leu

amino acid sequence coded for
by mRNA without mutation: His Ser Leu Leu

Part D

Identify whether a phenotypic change is expected in the cell type with the mutation. Explain your reasoning.

A phenotypic change is not expected in the skin cell. Although the DNA sequence is different, the amino acids coded by mRNA with and without the mutation are the same.

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Score Point 3

Part A

Identify the cell type that has a mutation. Explain your reasoning using evidence from the table.

The cell type that has a mutation is the skin. The reasoning for this is because the liver, the stomach, and the sperm have all of the same DNA sequences. The skin on the other hand has a mutation because in the third sequence, there is GAC instead of GAA, which all of the other sequences have.

Part B

Identify the mRNA sequence of the cell type with the mutation you identified in Part A **and** the mRNA sequence from a cell type without the mutation.

mRNA sequence with mutation: CAU AGU CUG CUU

mRNA sequence without mutation: CAU AGU CUU CUU

Part C

The table below shows the amino acids coded for by mRNA codons.

mRNA Codon Table

UUU Phe	UCU Ser	UAU Tyr	UGU Cys
UUC Phe	UCC Ser	UAC Tyr	UGC Cys
UUA Leu	UCA Ser	UAA STOP	UGA STOP
UUG Leu	UCG Ser	UAG STOP	UGG Trp
CUU Leu	CCU Pro	CAU His	CGU Arg
CUC Leu	CCC Pro	CAC His	CGC Arg
CUA Leu	CCA Pro	CAA Gln	CGA Arg
CUG Leu	CCG Pro	CAG Gln	CGG Arg
AUU Ile	ACU Thr	AAU Asn	AGU Ser
AUC Ile	ACC Thr	AAC Asn	AGC Ser
AUA Ile	ACA Thr	AAA Lys	AGA Arg
AUG Met	ACG Thr	AAG Lys	AGG Arg
GUU Val	GCU Ala	GAU Asp	GGU Gly
GUC Val	GCC Ala	GAC Asp	GGC Gly
GUA Val	GCA Ala	GAA Glu	GGA Gly
GUG Val	GCG Ala	GAG Glu	GGG Gly

Identify the amino acid sequence that is coded for by each mRNA sequence you identified in Part B.

amino acid sequence coded for by mRNA with mutation: His Ser Leu Leu

amino acid sequence coded for by mRNA without mutation: His Ser Leu Leu

Part D

Identify whether a phenotypic change is expected in the cell type with the mutation. Explain your reasoning.

A phenotypic change is expected in the cell type with the mutation. This is because when there is a genetic mutation in a DNA sequence, that most likely means that offspring is gonna look different.

Score Point 2

Part A

Identify the cell type that has a mutation. Explain your reasoning using evidence from the table.

The main DNA sequence shown is GTA TCA GAA GAA, but on the skin it is GTA TCA GA"C" GAA, there is a mutation in the skin.

Part B

Identify the mRNA sequence of the cell type with the mutation you identified in Part A **and** the mRNA sequence from a cell type without the mutation.

mRNA sequence with mutation: CAU AGU CUG CUU

mRNA sequence without mutation: CAU AGU CUU CUU

Part C

The table below shows the amino acids coded for by mRNA codons.

mRNA Codon Table

UUU Phe	UCU Ser	UAU Tyr	UGU Cys
UUC Phe	UCC Ser	UAC Tyr	UGC Cys
UUA Leu	UCA Ser	UAA STOP	UGA STOP
UUG Leu	UCG Ser	UAG STOP	UGG Trp
CUU Leu	CCU Pro	CAU His	CGU Arg
CUC Leu	CCC Pro	CAC His	CGC Arg
CUA Leu	CCA Pro	CAA Gln	CGA Arg
CUG Leu	CCG Pro	CAG Gln	CGG Arg
AUU Ile	ACU Thr	AAU Asn	AGU Ser
AUC Ile	ACC Thr	AAC Asn	AGC Ser
AUA Ile	ACA Thr	AAA Lys	AGA Arg
AUG Met	ACG Thr	AAG Lys	AGG Arg
GUU Val	GCU Ala	GAU Asp	GGU Gly
GUC Val	GCC Ala	GAC Asp	GGC Gly
GUA Val	GCA Ala	GAA Glu	GGA Gly
GUG Val	GCG Ala	GAG Glu	GGG Gly

Identify the amino acid sequence that is coded for by each mRNA sequence you identified in Part B.

amino acid sequence coded for by mRNA with mutation: his met leu leu

amino acid sequence coded for by mRNA without mutation: his met leu leu

Part D

Identify whether a phenotypic change is expected in the cell type with the mutation. Explain your reasoning.

A change can probably occur in the skin with that small mutation, the code will not be the same as all the others so that would mean that it will be different than the others. The genotype helps make up that Phenotype, with a mutation, they both change.

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Score Point 1**Part A**

Identify the cell type that has a mutation. Explain your reasoning using evidence from the table.

Skin, all of the following have the same DNA sequence yet in the third column of code the skin has GAC rather than GAA like the rest of the cells.

Part B

Identify the mRNA sequence of the cell type with the mutation you identified in Part A **and** the mRNA sequence from a cell type without the mutation.

mRNA sequence with mutation:

mRNA sequence without mutation:

Part C

The table below shows the amino acids coded for by mRNA codons.

mRNA Codon Table

UUU Phe	UCU Ser	UAU Tyr	UGU Cys
UUC Phe	UCC Ser	UAC Tyr	UGC Cys
UUA Leu	UCA Ser	UAA STOP	UGA STOP
UUG Leu	UCG Ser	UAG STOP	UGG Trp
CUU Leu	CCU Pro	CAU His	CGU Arg
CUC Leu	CCC Pro	CAC His	CGC Arg
CUA Leu	CCA Pro	CAA Gln	CGA Arg
CUG Leu	CCG Pro	CAG Gln	CGG Arg
AUU Ile	ACU Thr	AAU Asn	AGU Ser
AUC Ile	ACC Thr	AAC Asn	AGC Ser
AUA Ile	ACA Thr	AAA Lys	AGA Arg
AUG Met	ACG Thr	AAG Lys	AGG Arg
GUU Val	GCU Ala	GAU Asp	GGU Gly
GUC Val	GCC Ala	GAC Asp	GGC Gly
GUA Val	GCA Ala	GAA Glu	GGA Gly
GUG Val	GCG Ala	GAG Glu	GGG Gly

Identify the amino acid sequence that is coded for by each mRNA sequence you identified in Part B.

amino acid sequence coded for
by mRNA with mutation:

amino acid sequence coded for
by mRNA without mutation:

Part D

Identify whether a phenotypic change is expected in the cell type with the mutation. Explain your reasoning.

Since there is a mutation the phenotypic change could vary in a negative or positive way. This could cause the skin to be abnormal.

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Score Point 0

Part A

Identify the cell type that has a mutation. Explain your reasoning using evidence from the table.

I think the cell type that has mutation is the liver because the DNA sequence does not look right.

Part B

Identify the mRNA sequence of the cell type with the mutation you identified in Part A **and** the mRNA sequence from a cell type without the mutation.

mRNA sequence with mutation: GAA

mRNA sequence without mutation: GCA

Part C

The table below shows the amino acids coded for by mRNA codons.

mRNA Codon Table

UUU Phe	UCU Ser	UAU Tyr	UGU Cys
UUC Phe	UCC Ser	UAC Tyr	UGC Cys
UUA Leu	UCA Ser	UAA STOP	UGA STOP
UUG Leu	UCG Ser	UAG STOP	UGG Trp
CUU Leu	CCU Pro	CAU His	CGU Arg
CUC Leu	CCC Pro	CAC His	CGC Arg
CUA Leu	CCA Pro	CAA Gln	CGA Arg
CUG Leu	CCG Pro	CAG Gln	CGG Arg
AUU Ile	ACU Thr	AAU Asn	AGU Ser
AUC Ile	ACC Thr	AAC Asn	AGC Ser
AUA Ile	ACA Thr	AAA Lys	AGA Arg
AUG Met	ACG Thr	AAG Lys	AGG Arg
GUU Val	GCU Ala	GAU Asp	GGU Gly
GUC Val	GCC Ala	GAC Asp	GGC Gly
GUA Val	GCA Ala	GAA Glu	GGA Gly
GUG Val	GCG Ala	GAG Glu	GGG Gly

Identify the amino acid sequence that is coded for by each mRNA sequence you identified in Part B.

amino acid sequence coded for by mRNA with mutation: ACU

amino acid sequence coded for by mRNA without mutation: ACA

Part D

Identify whether a phenotypic change is expected in the cell type with the mutation. Explain your reasoning.

No because it has already happened.

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