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# AP<sup>®</sup> Biology

## Sample Student Responses and Scoring Commentary

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#### **Free Response Question 7**

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# AP<sup>®</sup> BIOLOGY

## 2019 SCORING GUIDELINES

### Question 7

A researcher is studying patterns of gene expression in mice. The researcher collected samples from six different tissues in a healthy mouse and measured the amount of mRNA from six genes. The data are shown in Figure 1.

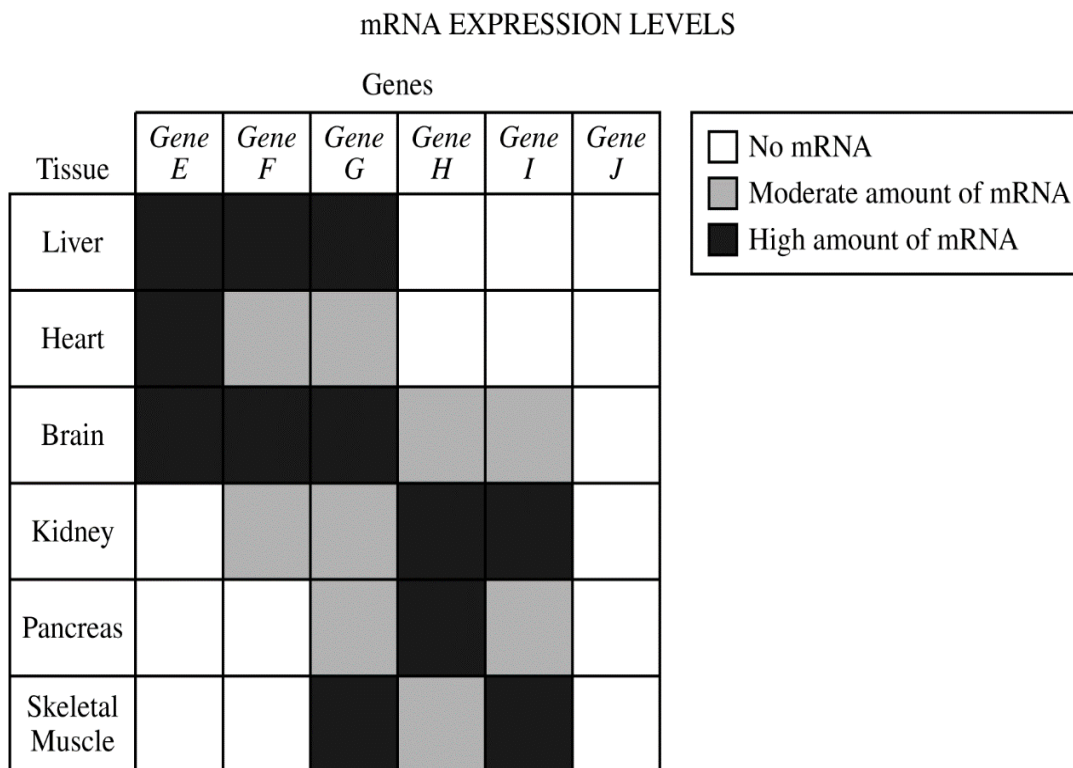


Figure 1. mRNA expression levels of six genes

(a) Based on the data provided, **identify** the gene that is most likely to encode a protein that is an essential component of glycolysis. **Provide reasoning** to support your identification.

**Identification (1 point)**

- *Gene G*

**Reasoning (1 point)**

- (*Gene G*) is the only gene expressed in all (six) tissues, AND glycolysis occurs in all (six) tissues.
- (*Gene G*) mRNA is the only mRNA present in all (six) tissues, AND glycolysis occurs in all (six) tissues.

(b) The researcher observed that tissues with a high level of *gene H* mRNA did not always have gene H protein. **Provide reasoning** to explain how tissues with high *gene H* mRNA levels can have no gene H protein.

**Reasoning (1 point)**

- The mRNA is not exported from the nucleus.
- *Gene H* mRNA is not translated/RNA interference prevent(s) translation.
- Post-transcriptional modifications.

7. A researcher is studying patterns of gene expression in mice. The researcher collected samples from six different tissues in a healthy mouse and measured the amount of mRNA from six genes. The data are shown in Figure 1.

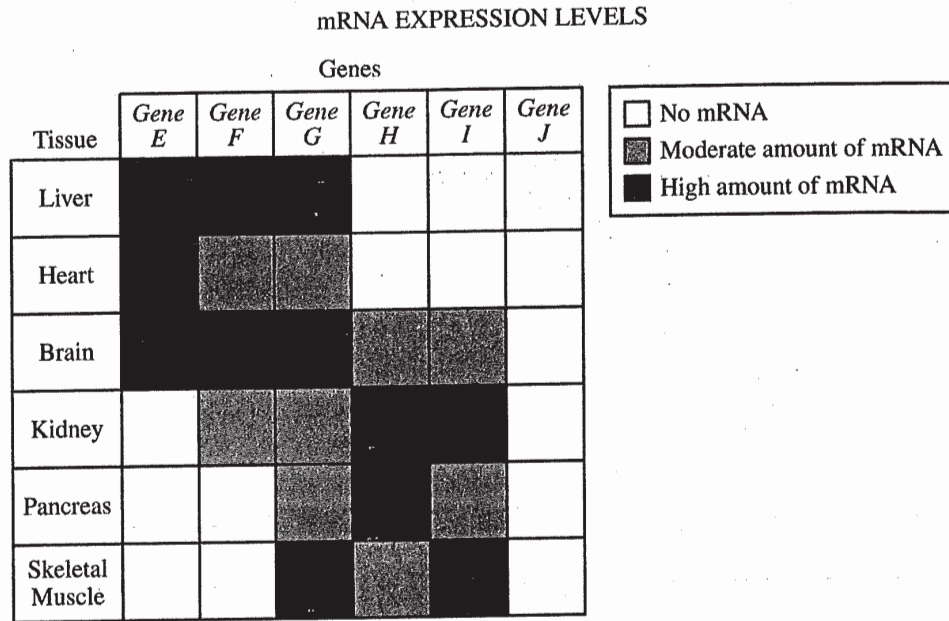


Figure 1. mRNA expression levels of six genes

- (a) Based on the data provided, **identify** the gene that is most likely to encode a protein that is an essential component of glycolysis. **Provide reasoning** to support your identification.
- (b) The researcher observed that tissues with a high level of *gene H* mRNA did not always have gene H protein. **Provide reasoning** to explain how tissues with high *gene H* mRNA levels can have no gene H protein.

PAGE FOR ANSWERING QUESTION 7

2) ~~Gene G~~ Gene G is most likely to encode a protein that is an essential component of glycolysis because ~~it~~ <sup>the mRNA</sup> is at least moderately present in all types of tissues. All tissues undergo glycolysis to get a small amount of ATP to function. ~~the~~ Gene G is the only gene that has mRNA present in all tissues so all of these tissues are able to code for the specific protein.

b.) tissues could have a high level of gene H mRNA, but not have <sup>a</sup> gene H protein because

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## ADDITIONAL PAGE FOR ANSWERING QUESTION 7

the mRNA was never translated. The gene H ~~may~~ may have been transcribed from DNA to mRNA, but if the rRNA and tRNA do not translate this particular strand it will not ~~be~~ code for the amino acids and therefore not become a functional protein.

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7B1

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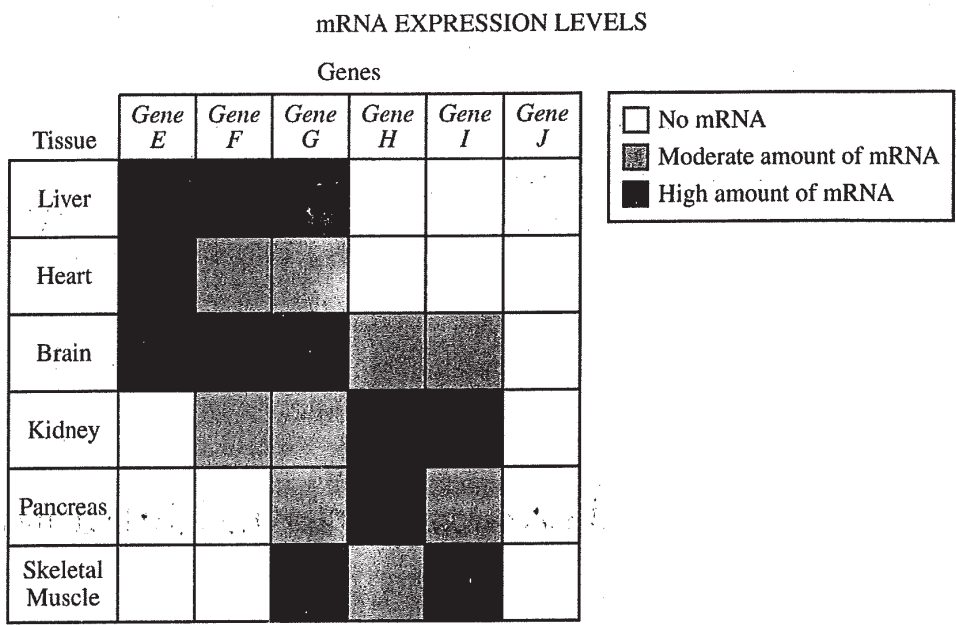


Figure 1. mRNA expression levels of six genes

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PAGE FOR ANSWERING QUESTION 7

(a) Gene G is important for glycolysis because with every tissue, ~~there~~ gene G is at least present there. Glycolysis is needed by every cell to produce some ATP or pyruvate, and gene G is in every tissue to serve that function. <sup>to survive</sup>

(b) It's possible that there is some sort of mechanism to prevent the translation of gene H into protein in case that gene H protein needs to be regulated. There's nothing

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preventing transcription, however, which might explain why mRNA levels are high

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7C

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mRNA EXPRESSION LEVELS

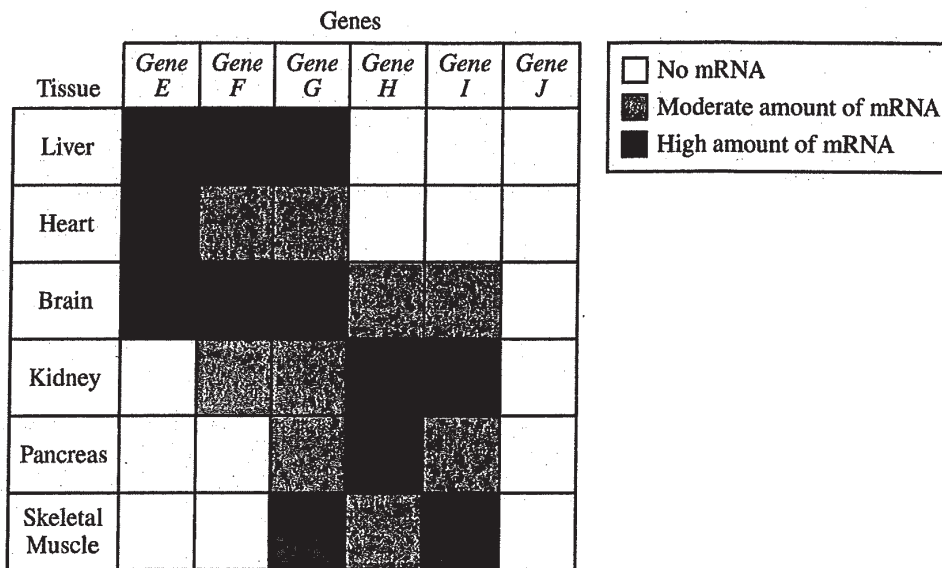


Figure 1. mRNA expression levels of six genes

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PAGE FOR ANSWERING QUESTION 7

a) Gene H, which encodes for ~~pancreas~~ mRNA present in pancreas tissue, is likely to support glycolysis because the pancreas is responsible for the absorption of glucose from blood — which is needed for glycolysis.

b) If the gene H mRNA is not transported from the nucleus to a ribosome, the tissues will not produce the gene H protein.

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**AP<sup>®</sup> BIOLOGY**  
**2019 SCORING COMMENTARY**

**Question 7**

**Note:** Student samples are quoted verbatim and may contain spelling and grammatical errors.

**Overview**

This question provided students with a data table of relative expression levels of mRNA from six different genes in six different tissues. They were asked to identify the gene most likely to encode a protein needed for glycolysis and provide reasoning to support their answer. They were then given the observation that tissues with a high level of *gene H* mRNA did not always have gene H protein and were asked to provide reasoning for this situation. This question required students to interpret data and apply it to their understanding of glycolysis. Students also needed to have knowledge of the processes of transcription and translation to provide a complete answer.

**Sample: 7A**

**Score: 3**

The response earned 1 point in part (a) for identifying *gene G*. The response earned 1 point in part (a) for reasoning that *gene G* mRNA is “at least moderately present in all types of tissues. All tissues undergo glycolysis.” The response earned 1 point in part (b) for reasoning that *gene H* mRNA “was never translated.”

**Sample: 7B**

**Score: 2**

The response earned 1 point in part (a) for identifying *gene G*. The response earned 1 point in part (b) for reasoning that “there is some sort of mechanism to prevent the translation of gene H into protein.”

**Sample: 7C**

**Score: 1**

The response earned 1 point in part (b) for reasoning that “[i]f the gene H mRNA is not transported from the nucleus to a ribosome, the tissues will not produce the gene H protein.”