pennsylvania
DEPARTMENT OF EDUCATION

Pennsylvania Keystone Exams

Biology

Item and Scoring Sampler

2016

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INTRODUCTION

The Pennsylvania Department of Education (PDE) provides districts and schools with tools to assist in delivering focused instructional programs aligned to the Pennsylvania Core Standards. These tools include the standards, assessment anchor documents, Keystone Exams Test Definition, Classroom Diagnostic Tool, Standards Aligned System, and content-based item and scoring samplers. This 2016 Biology Item and Scoring Sampler is a useful tool for Pennsylvania educators in preparing students for the Keystone Exams.

This Item and Scoring Sampler contains released operational multiple-choice and constructed-response items that have appeared on previously administered Keystone Exams. These items will not appear on any future Keystone Exams. Released items provide an idea of the types of items that have appeared on operational exams and that will appear on future operational Keystone Exams. Each item has been through a rigorous review process to ensure alignment with the Assessment Anchors and Eligible Content. This sampler includes items that measure a variety of Assessment Anchor or Eligible Content statements, but it does not include sample items for all Assessment Anchor or Eligible Content statements.

The items in this sampler may be used as examples for creating assessment items at the classroom level and may be copied and used as part of a local instructional program.[1] Classroom teachers may find it beneficial to have students respond to the constructed-response items in this sampler. Educators can then use the sampler as a guide to score the responses either independently or together with colleagues.

ABOUT THE KEYSTONE EXAMS

The Keystone Exams are end-of-course assessments currently designed to assess proficiencies in Algebra I, Biology, and Literature. For detailed information about how the Keystone Exams are being integrated into the Pennsylvania graduation requirements, please contact the Pennsylvania Department of Education or visit the PDE website at http://www.education.pa.gov.

Alignment

The Biology Keystone Exam consists of questions grouped into **two modules**: Module 1—Cells and Cell Processes and Module 2—Continuity and Unity of Life. Each module corresponds to specific content, aligned to statements and specifications included in the course-specific assessment anchor documents. The Biology content included in the Keystone Biology multiple-choice questions will align with the assessment anchors as defined by the Eligible Content statements. The process skills, directives, and action statements will also specifically align with the Assessment Anchors as defined by the Eligible Content statements.

The content included in Biology constructed-response items aligns with content included in the Eligible Content statements. The process skills, directives, and action statements included in the performance demands of the Biology constructed-response items align with specifications included in the Assessment Anchor statements, the Anchor Descriptor statements, and/or the Eligible Content statements. In other words, the verbs or action statements used in the constructed-response items or stems can come from the Eligible Content, Anchor Descriptor, or Assessment Anchor statements.

[1] The permission to copy and/or use these materials does not extend to commercial purposes.

Depth of Knowledge

Webb's Depth of Knowledge (DOK) was created by Dr. Norman Webb of the Wisconsin Center for Education Research. Webb's definition of depth of knowledge is the cognitive expectation demanded by standards, curricular activities, and assessment tasks. Webb's DOK includes four levels, from the lowest (basic recall) level to the highest (extended thinking) level.

Depth of Knowledge	
Level 1	Recall
Level 2	Basic Application of Skill/Concept
Level 3	Strategic Thinking
Level 4	Extended Thinking

Each Keystone item has been through a rigorous review process to ensure that it is as demanding cognitively as what is required by the assigned Assessment Anchor as defined by the Eligible Content. For additional information about depth of knowledge, please visit the PDE website at http://static.pdesas.org/Content/Documents/Keystone_Exam_Program_Overview.PDF.

Exam Format

The Keystone Exams are delivered in a paper-and-pencil format as well as in a computer-based online format. The multiple-choice questions require students to select the best answer from four possible answer options and record their answers in the spaces provided. The correct answer for each multiple-choice question is worth one point. The constructed-response items require students to develop and write (or construct) their responses. Constructed-response items in Biology are scored using item-specific scoring guidelines based on a 0–3-point scale. Each multiple-choice question is designed to take about one minute to one-and-a-half minutes to complete. Each constructed-response item is designed to take about eight minutes to complete. The estimated time to respond to a test question is the same for both test formats. During an actual exam administration, students are given additional time as necessary to complete the exam.

ITEM AND SCORING SAMPLER FORMAT

This sampler includes the test directions and scoring guidelines that appear in the Keystone Exams. Each sample multiple-choice question is followed by a table that includes the alignment, the answer key, the DOK, the percentage[2] of students who chose each answer option, and a brief answer option analysis or rationale. Each constructed-response item is followed by a table that includes the item alignment, the DOK, and the mean student score. Additionally, each of the included item-specific scoring guidelines is combined with sample student responses representing each score point to form a practical, item-specific scoring guide. The General Description of Scoring Guidelines for Biology used to develop the item-specific scoring guidelines should be used if any additional item-specific scoring guidelines are created for use within local instructional programs.

Example Multiple-Choice Question Information Table

<table>
<tr><th colspan="5">Item Information</th><th>Option Annotations</th></tr>
<tr><td colspan="3">Alignment</td><td colspan="2">Assigned AAEC</td><td rowspan="8">Brief answer option analysis or rationale</td></tr>
<tr><td colspan="3">Answer Key</td><td colspan="2">Correct Answer</td></tr>
<tr><td colspan="3">Depth of Knowledge</td><td colspan="2">Assigned DOK</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">p-values</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Percentage of students who selected each option</td></tr>
</table>

Example Constructed-Response Item Information Table

Alignment	Assigned AAEC	**Depth of Knowledge**	Assigned DOK	**Mean Score**	

[2] All *p*-value percentages listed in the item information tables have been rounded.

BIOLOGY EXAM DIRECTIONS

Below are the exam directions available to students. These directions may be used to help students navigate through the exam.

On the following pages of this test booklet are the Keystone Biology Exam questions for Module 1 [or Module 2].

There are two types of questions in this module.

Multiple-Choice Questions

These questions will ask you to select an answer from among four choices.

- Read each question, and choose the correct answer.
- Only one of the answers provided is correct.
- Record your answer in the Biology answer booklet.

Constructed-Response Questions

These questions will require you to write your response.

- Be sure to read the directions carefully.
- You cannot receive the highest score for a constructed-response question without following all directions.
- If the question asks you to do multiple tasks, be sure to complete all tasks.
- If the question asks you to explain, be sure to explain. If the question asks you to analyze, describe, or compare, be sure to analyze, describe, or compare.
- All responses must be written in the appropriate location within the response box in the Biology answer booklet. If you use scratch paper to write your draft, be sure to transfer your final response to the Biology answer booklet.

In addition, the modules may also include scenarios. A scenario contains text, graphics, charts, and/or tables describing a biological concept, an experiment, or other scientific research. You can use the information contained in a scenario to answer certain exam questions. Before responding to any scenario questions, be sure to study the entire scenario and follow the directions for the scenario. You may refer back to the scenario at any time when answering the scenario questions.

If you finish early, you may check your work in Module 1 [or Module 2] only.

- Do not look ahead at the questions in Module 2 [or back at the questions in Module 1] of your exam materials.
- After you have checked your work, close your exam materials.

You may refer to this page at any time during this portion of the exam.

GENERAL DESCRIPTION OF SCORING GUIDELINES FOR BIOLOGY

3 POINTS

- The response demonstrates a *thorough* understanding of the scientific content, concepts, and/or procedures required by the task(s).
- The response provides a clear, complete, and correct response as required by the task(s). The response may contain a minor blemish or omission in work or explanation that does not detract from demonstrating a *thorough* understanding.

2 POINTS

- The response demonstrates a *partial* understanding of the scientific content, concepts, and/or procedures required by the task(s).
- The response is somewhat correct with *partial* understanding of the required scientific content, concepts, and/or procedures demonstrated and/or explained. The response may contain some work that is incomplete or unclear.

1 POINT

- The response demonstrates a *minimal* understanding of the scientific content, concepts, and/or procedures required by the task(s).
- The response is somewhat correct with *minimal* understanding of the required scientific content, concepts, and/or procedures demonstrated and/or explained. The response may contain some work that is incomplete or unclear.

0 POINTS

- The response provides *insufficient* evidence to demonstrate any understanding of the scientific content, concepts, and/or procedures required by the task(s).
- The response may show only information copied or rephrased from the question or *insufficient* correct information to receive a score of 1.

BIOLOGY MODULE 1
MULTIPLE-CHOICE QUESTIONS

1. Most prokaryotes and eukaryotes maintain a reserve of ATP. Which feature of prokaryotes and eukaryotes makes the ATP reserve necessary?

A. They have cell membranes.

B. They can change over time.

C. They use energy to function.

D. They have the ability to reproduce.

Item Information	
Alignment	BIO.A.1.1.1
Answer Key	C
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
10%	8%	69%	13%

Option Annotations

A. Cell membranes permit the movement of certain materials in and out of the cell without energy.

B. Change over time is not a process that occurs within an organism's lifetime.

C. Key: ATP is the energy currency of a cell, and both prokaryotes and eukaryotes depend on ATP to fuel their cellular functions.

D. Reproduction primarily involves the distribution of genetic material to offspring cells.

2. Which structure and function are common to all plants and some protists and distinguish them from all animals?

A. chloroplasts that conduct photosynthesis

B. mitochondria that conduct photosynthesis

C. chloroplasts that conduct cellular respiration

D. mitochondria that conduct cellular respiration

Item Information	
Alignment	BIO.A.1.2.1
Answer Key	A
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
60%	15%	15%	10%

Option Annotations

A. Key: Chloroplasts, which are absent in all animal cells, convert light energy into chemical energy within all plants and some protists.

B. Mitochondria perform cellular respiration in all eukaryotic cells, not photosynthesis.

C. Chloroplasts, which are absent in all animal cells, perform photosynthesis—not cellular respiration.

D. Mitochondria perform cellular respiration, and they are a shared characteristic among plants, protists, and animals.

3. Which characteristic allows carbon atoms to form chains and rings with other carbon atoms?

A. Carbon has several forms.

B. Carbon can form four covalent bonds.

C. Carbon is the fourth most abundant element in the universe.

D. Carbon is a structural part of lipids, carbohydrates, proteins, and nucleic acids.

Item Information	
Alignment	BIO.A.2.2.1
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
8%	63%	7%	22%

Option Annotations

A. Carbon has several forms, which is a result of its ability to form chains and rings with other carbon atoms.

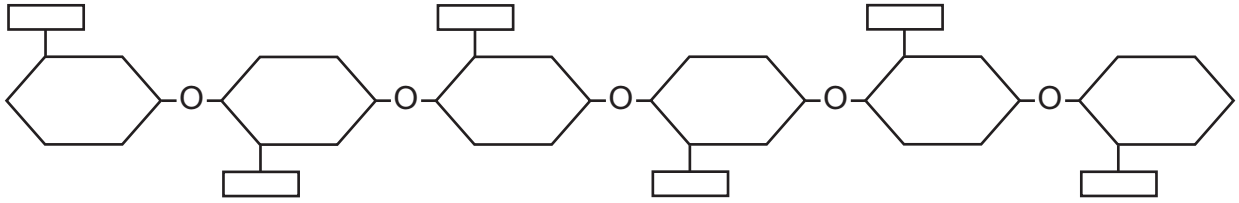
B. Key: Carbon forms a variety of chains and shapes because it can form four covalent bonds with its four valence electrons.

C. Carbon's abundance makes it available for reactions, but carbon's chemical properties permit its bonding variety.

D. Carbon's presence in the structures of major macromolecules is a result of its ability to form different types of bonds.

Use the diagram below to answer question 4.

Cellulose Model



4. Cellulose is a carbohydrate and a polymer of glucose. Which statement **best** describes how cellulose is formed within living organisms?

A. It is assembled by bonding individual atoms.

B. It is constructed by connecting smaller monomer subunits.

C. It is the product of the decomposition of a much larger molecule.

D. It is the result of a physical change that alters the shape of a compound.

Item Information	
Alignment	BIO.A.2.2.2
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
25%	52%	12%	11%

Option Annotations

A. Glucose is a monomer assembled by bonding individual atoms; cellulose is a polymer of glucose monomers.

B. Key: Cellulose is a polymer, which is formed when many glucose monomers bond together.

C. During decomposition, a cellulose polymer breaks down into smaller monomer subunits.

D. Chemical changes that involve new bond formations between monomers produce polymers.

5. Many plants have a waxy coating on their leaves. Which statement describes the **most likely** structure and function of the waxy coating?

A. The waxy coating is a protein that can help attract other organisms for pollination.

B. The waxy coating is a protein that can help release waste molecules during transpiration.

C. The waxy coating is a lipid that can help absorb more sunlight in hot environments.

D. The waxy coating is a lipid that can help prevent excess water loss in dry environments.

Item Information	
Alignment	BIO.A.2.2.3
Answer Key	D
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
8%	9%	19%	63%

Option Annotations

A. The waxy coating is a lipid, not a protein.
B. The waxy coating is a lipid, not a protein.
C. The waxy coating helps prevent water loss rather than absorb sunlight energy.
D. Key: The waxy coating is a type of lipid molecule, and it prevents water loss due to evapotranspiration.

6. The enzyme pepsin is found in the stomach. Which medicine is **most likely** to directly interfere with pepsin's function?

A. a medicine that affects pH

B. a medicine that prevents clotting

C. a medicine that blocks neural impulses

D. a medicine that lowers cholesterol levels

Item Information	
Alignment	BIO.A.2.3.2
Answer Key	A
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
52%	12%	14%	21%

Option Annotations

A. Key: Enzymes function within a specific pH range, so a medicine that alters pH would disrupt the enzyme's function.

B. A medicine that prevents clotting would interfere with the function of platelets or proteins in the liquid part of blood.

C. A medicine that blocks neural impulses would disrupt nervous system function rather than the digestive system.

D. A medicine that lowers cholesterol would likely affect the circulatory system more than the digestive system.

7. Which statement **best** describes a relationship between mitochondria and chloroplasts?

A. Mitochondria release chemical energy from molecules and store it in chloroplasts.

B. Chloroplasts release chemical energy from molecules and store it in mitochondria.

C. Mitochondria convert chemical energy into light energy that can be used by chloroplasts.

D. Chloroplasts convert light energy into chemical energy that can be used by mitochondria.

Item Information	
Alignment	BIO.A.3.1.1
Answer Key	D
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
16%	20%	16%	47%

Option Annotations

A. Mitochondria release chemical energy to fuel cell processes; it is not stored in chloroplasts.

B. Chloroplasts convert light energy into chemical energy in the form of glucose.

C. Chloroplasts use light energy originally from the Sun, not from mitochondria.

D. Key: Chloroplasts convert light energy into chemical energy (glucose), which is used by the mitochondria.

8. Which process uses the products of photosynthesis as reactants?

A. active transport
B. cellular respiration
C. DNA replication
D. protein synthesis

Item Information	
Alignment	BIO.A.3.2.1
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
16%	59%	9%	16%

Option Annotations

A. ATP, a product of cellular respiration, is used to fuel the process of active transport.
B. Key: Glucose and oxygen are products of photosynthesis that are also reactants in cellular respiration.
C. DNA replication is a semiconservative process that uses a single DNA molecule to produce two identical DNA double-helix molecules.
D. The reactants in protein synthesis are amino acids, not the glucose and oxygen products of photosynthesis.

9. Which action is prevented by the plasma membrane?

A. the flow of light into or out of the cell

B. the flow of oxygen into or out of the cell

C. unlimited flow of heat into or out of the cell

D. unlimited flow of water into or out of the cell

Item Information	
Alignment	BIO.A.4.1.1
Answer Key	D
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
13%	24%	16%	46%

Option Annotations

A. The plasma membrane allows the flow of light into or out of a cell.

B. Oxygen is a small molecule and constantly diffuses into the cell for use in cellular respiration.

C. Heat is a form of energy that moves without restriction in and out of a cell.

D. Key: Water flow into or out of a cell is limited; it depends on the solute concentration inside or outside the cell.

10. Which transport mechanisms require the formation of a vesicle to transport material into or out of a cell?

A. diffusion and osmosis

B. exocytosis and endocytosis

C. exocytosis and calcium pumps

D. diffusion and facilitated diffusion

Item Information	
Alignment	BIO.A.4.1.2
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
26%	51%	9%	14%

Option Annotations

A. Particle transport during diffusion and osmosis depend on the solute concentration inside and outside a cell.

B. Key: Exocytosis and endocytosis both require the formation of a vesicle to carry materials into or out of a cell.

C. Exocytosis requires a vesicle for material transport, but calcium pumps require energy and protein channels.

D. Particle transport during diffusion depends on the solute concentration inside and outside a cell, and facilitated diffusion requires a carrier protein in the plasma membrane.

11. The Golgi apparatus is broken down during mitosis and then reformed. Which function would a cell be unable to perform during the time that its Golgi apparatus is broken down?

A. copying genetic material to include in the new cell

B. forming vesicles to import molecules into the cell

C. processing and packaging proteins for cellular export

D. correcting errors in the process of building a new cell

Item Information	
Alignment	BIO.A.4.1.3
Answer Key	C
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
14%	12%	66%	8%

Option Annotations

A. Copying genetic material to include in a new cell occurs in the nucleus.

B. Vesicle formation to bring materials into the cell occurs at the plasma membrane.

C. Key: The Golgi apparatus is responsible for modifying and packaging proteins for secretion from the cell.

D. Both the ribosomes and the endoplasmic reticulum play a role in checking proteins for errors.

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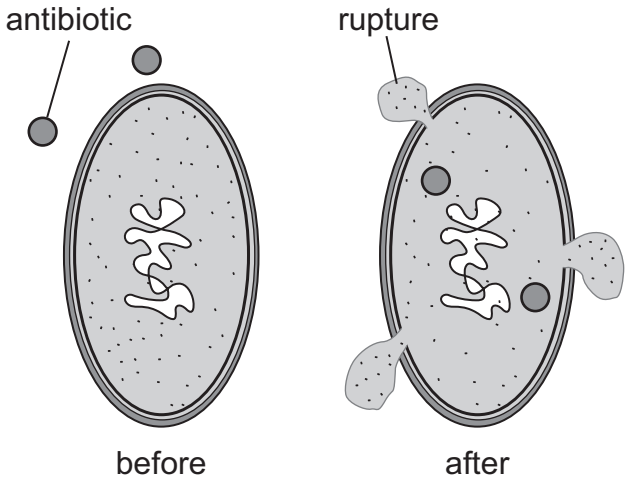
Directions: Use the information presented on page 18 to answer questions 12 and 13.

Bacteria and Antibiotics

Bacteria are single-celled microorganisms. The cell walls of these microorganisms serve as barriers to chemicals that might affect the processes that occur within a bacterial cell. Antibiotics are a type of substance used to stop bacterial growth. Some antibiotics cause the bacterial cell wall to rupture.

Antibiotic Action on a Bacterium



12. The function of which human organ is **most** like the cell walls of bacteria?

A. heart

B. liver

C. pancreas

D. skin

Item Information	
Alignment	BIO.A.1.2.2
Answer Key	D
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
6%	13%	7%	74%

Option Annotations

A. The heart does not provide protection as a regulatory structure.
B. The liver does not provide protection as a regulatory structure.
C. The pancreas does not provide protection as a regulatory structure.
D. Key: The cell walls of bacteria act as regulatory structures similar to the skin of humans.

13. Which statement **best** describes how antibiotics affect cellular homeostasis?

A. Antibiotics remove chloroplasts from plant cells to cause starvation.

B. Antibiotics interfere with the transport of intracellular and extracellular materials.

C. Antibiotics increase the rate of DNA replication in human cells by forming nucleotides.

D. Antibiotics decrease the rate of cellular respiration in animal cells by producing oxygen.

Item Information	
Alignment	BIO.A.4.2.1
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
11%	62%	18%	9%

Option Annotations

A. Antibiotics work on bacterial cells, not plant cells. Antibiotics do not remove chloroplasts.
B. Key: Homeostasis is maintained by different processes to regulate an organism's internal environment. The antibiotic action described in the scenario causes the cell wall to rupture and the cell to burst, so there can no longer be regulation of transport across the plasma membrane.
C. Antibiotics do not affect the rate of DNA replication and do not function against human cells.
D. Antibiotics do not produce oxygen and do not function against animal cells.

CONSTRUCTED-RESPONSE ITEM

14. A student studying muscle contraction made the following hypothesis:

"A muscle cell will contain a large number of ATP molecules, but other living body cells will have less ATP, or none at all."

The student's teacher stated that part of the hypothesis was correct, and part was incorrect.

Part A: Describe the role of ATP in the muscle cell.

Go to the next page to finish question 14.

14. ***Continued.*** Please refer to the previous page for task explanation.

Part B: Give one reason why the student's teacher stated that part of the hypothesis is **correct**.

Part C: Give one reason why the student's teacher stated that part of the hypothesis is **incorrect**.

SCORING GUIDE

#14 ITEM INFORMATION

Alignment	BIO.A.3.2.2	**Depth of Knowledge**	3	**Mean Score**	1.40

ITEM-SPECIFIC SCORING GUIDELINE

Score	Description
3	The response demonstrates a *thorough* understanding of the role of ATP in biochemical reactions by describing **all three** of the following tasks: • describing the role of ATP in the muscle cell **AND** • giving one reason why part of the student's hypothesis is correct **AND** • giving one reason why part of the student's hypothesis is incorrect The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of the role of ATP in biochemical reactions by describing **any two** of the following tasks: • describing the role of ATP in the muscle cell **OR** • giving one reason why part of the student's hypothesis is correct **OR** • giving one reason why part of the student's hypothesis is incorrect The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of the role of ATP in biochemical reactions by describing **any one** of the following tasks: • describing the role of ATP in the muscle cell **OR** • giving one reason why part of the student's hypothesis is correct **OR** • giving one reason why part of the student's hypothesis is incorrect The response may contain some work that is incomplete or unclear.
0	The response provides *insufficient* evidence to demonstrate any understanding of the concept being tested.
Non-scorables	B – No response written or refusal to respond F – Foreign language K – Off task U – Unreadable

Note: No deductions should be taken for misspelled words or grammatical errors.

Responses that will receive credit:

Part A (1 point):

ATP provides the energy necessary for the muscle to contract.

Part B (1 point):

The student is correct in stating that muscle cells do contain a large number of ATP molecules because of the energy necessary for repeated contraction.

Part C (1 point):

The student is incorrect in stating that there are living body cells that have no ATP. All living body cells have ATP. All living body cells need ATP to perform the chemical reactions necessary for life.

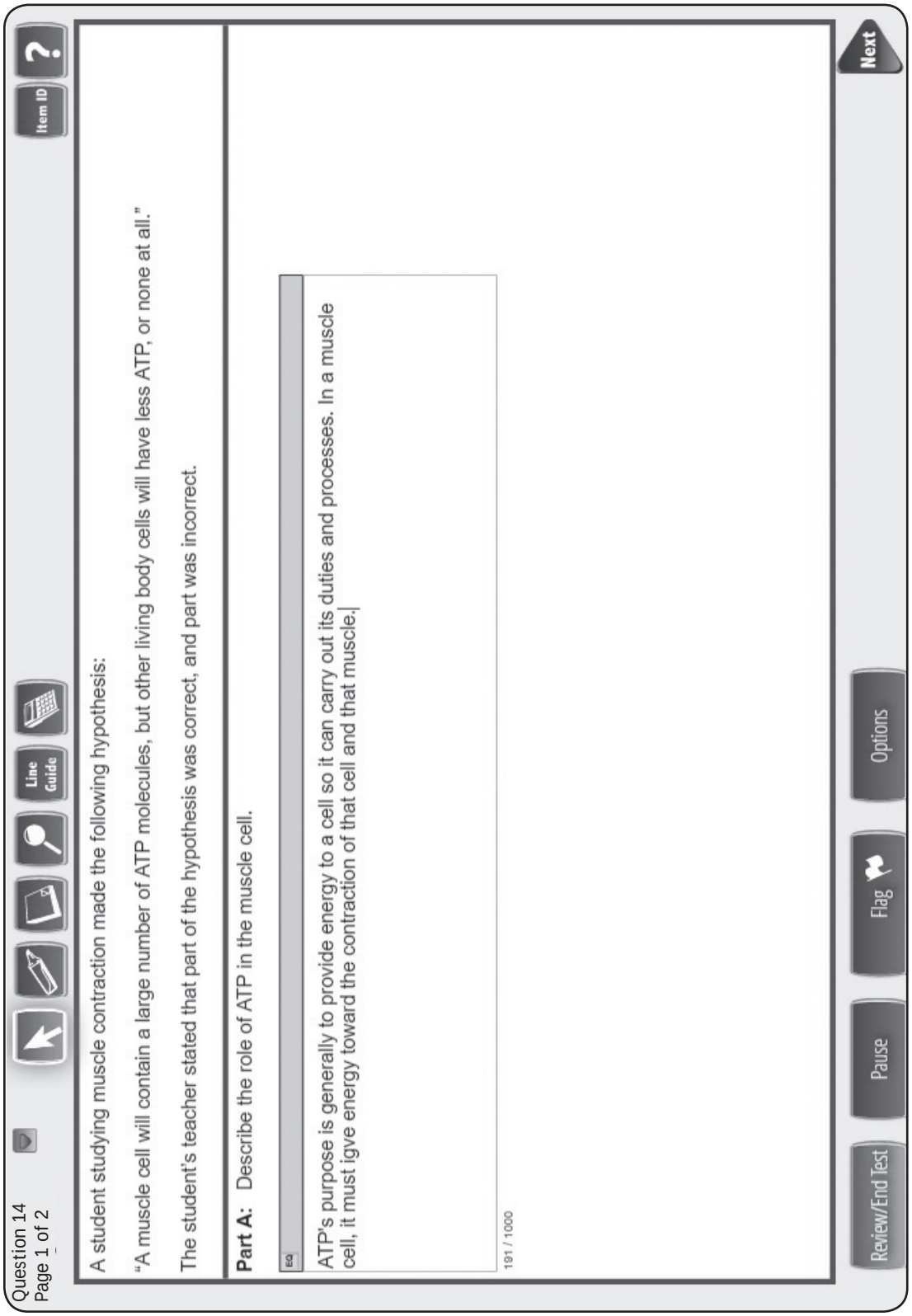
Background Information:

ATP is the ubiquitous source of energy currency in living organisms and is found in all living cells. Muscle cells contain a large number of ATP molecules for the simple reason that a lot of energy is expended in muscle contraction, but at no time is any living cell entirely devoid of ATP.

STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS

PART A



Question 14
Page 2 of 2

Line Guide

Item ID

A student studying muscle contraction made the following hypothesis:

"A muscle cell will contain a large number of ATP molecules, but other living body cells will have less ATP, or none at all."

The student's teacher stated that part of the hypothesis was correct, and part was incorrect.

Part B: Give one reason why the student's teacher stated that part of the hypothesis is **correct**.

"A muscle cell will contain a large number of ATP molecules". This is correct. It is because most muscles are used quite often and takes a large amount of energy to use them. The only way then can get the higher-than-average amount of energy is to use more ATP molecules.

271 / 1000

Part C: Give one reason why the student's teacher stated that part of the hypothesis is **incorrect**.

"Other living body cells will have no [ATP] at all". This is incorrect. Even though muscle cells need more energy than normal, the other cells still need energy to function. The way the cells produce their own energy is making ATP, so if they had no ATP, the cells would die.

275 / 1000

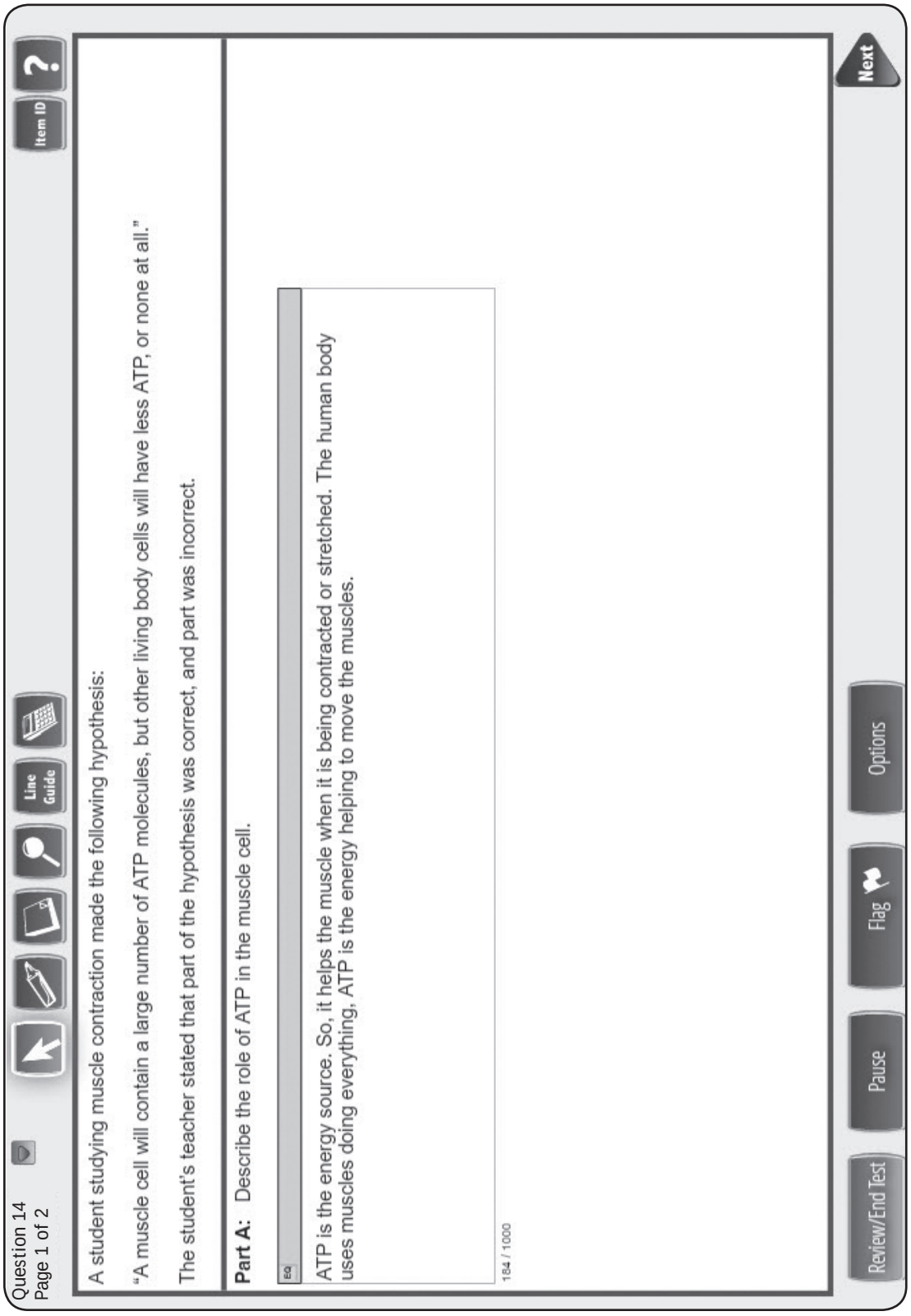
Review/End Test | Pause | Flag | Options | Back

The response demonstrates a *thorough* understanding of the role of ATP in biochemical reactions by describing all **three** of the tasks presented in the item. The response describes the role of ATP in the muscle (*"ATP's purpose is generally to provide energy"*) and gives one reason why part of the student's hypothesis is correct (*"muscles are used quite often and takes a large amount of energy to use them"*) and one reason why part of the student's hypothesis is incorrect (*"other cells still need energy to function . . . if they had no ATP, the cells would die"*). The response is clear, complete, and correct.

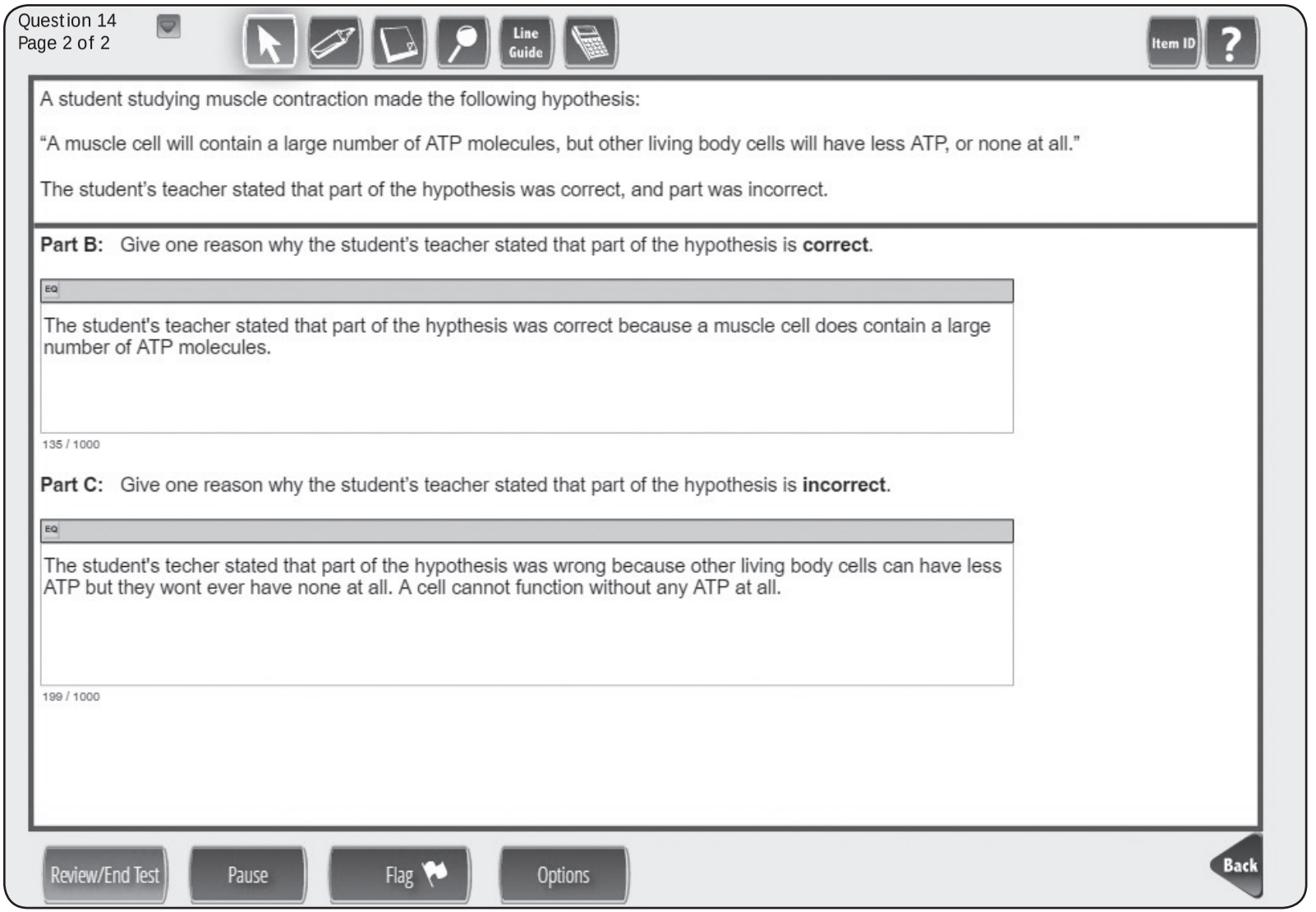
STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS

PART A



PARTS B AND C

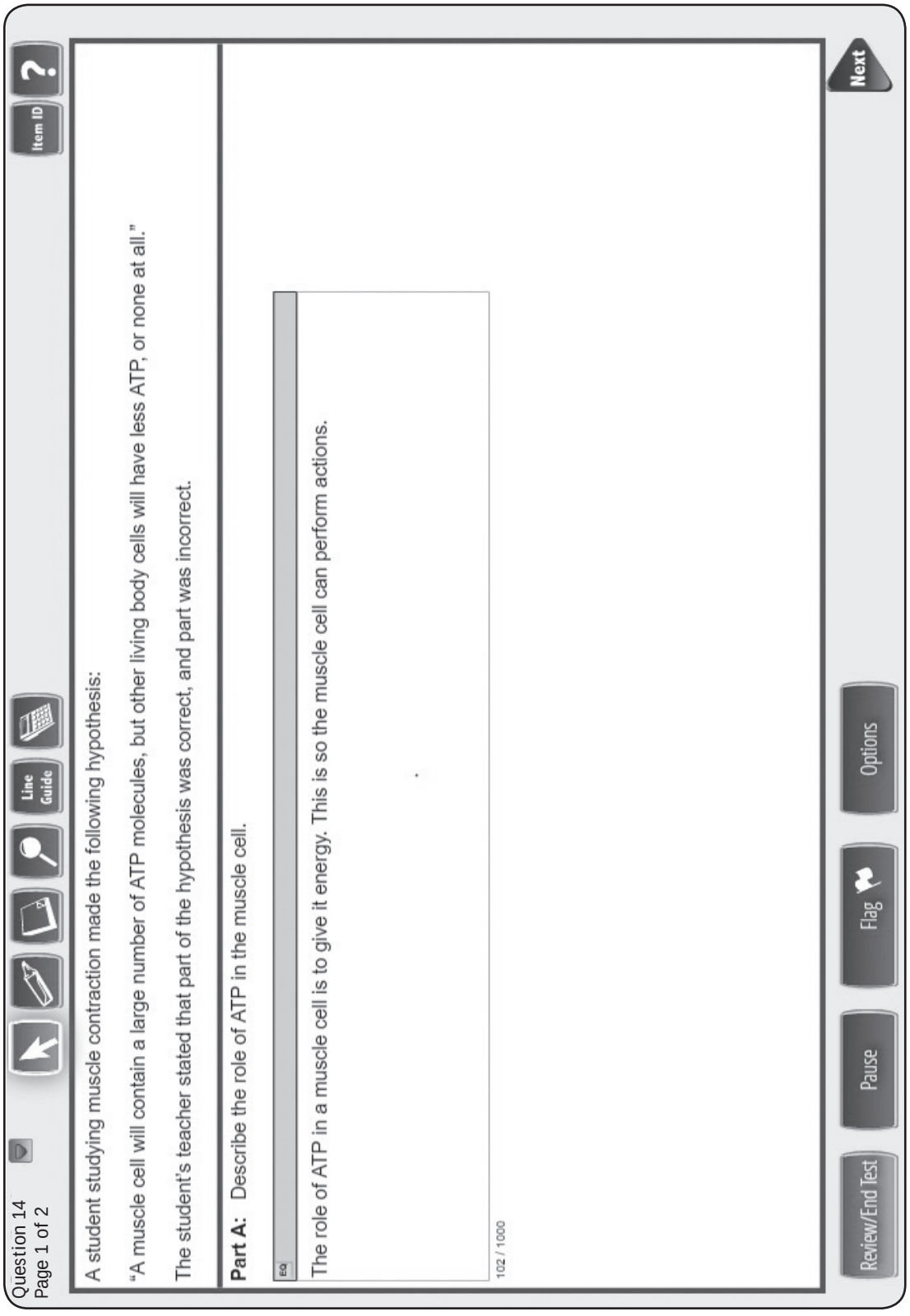


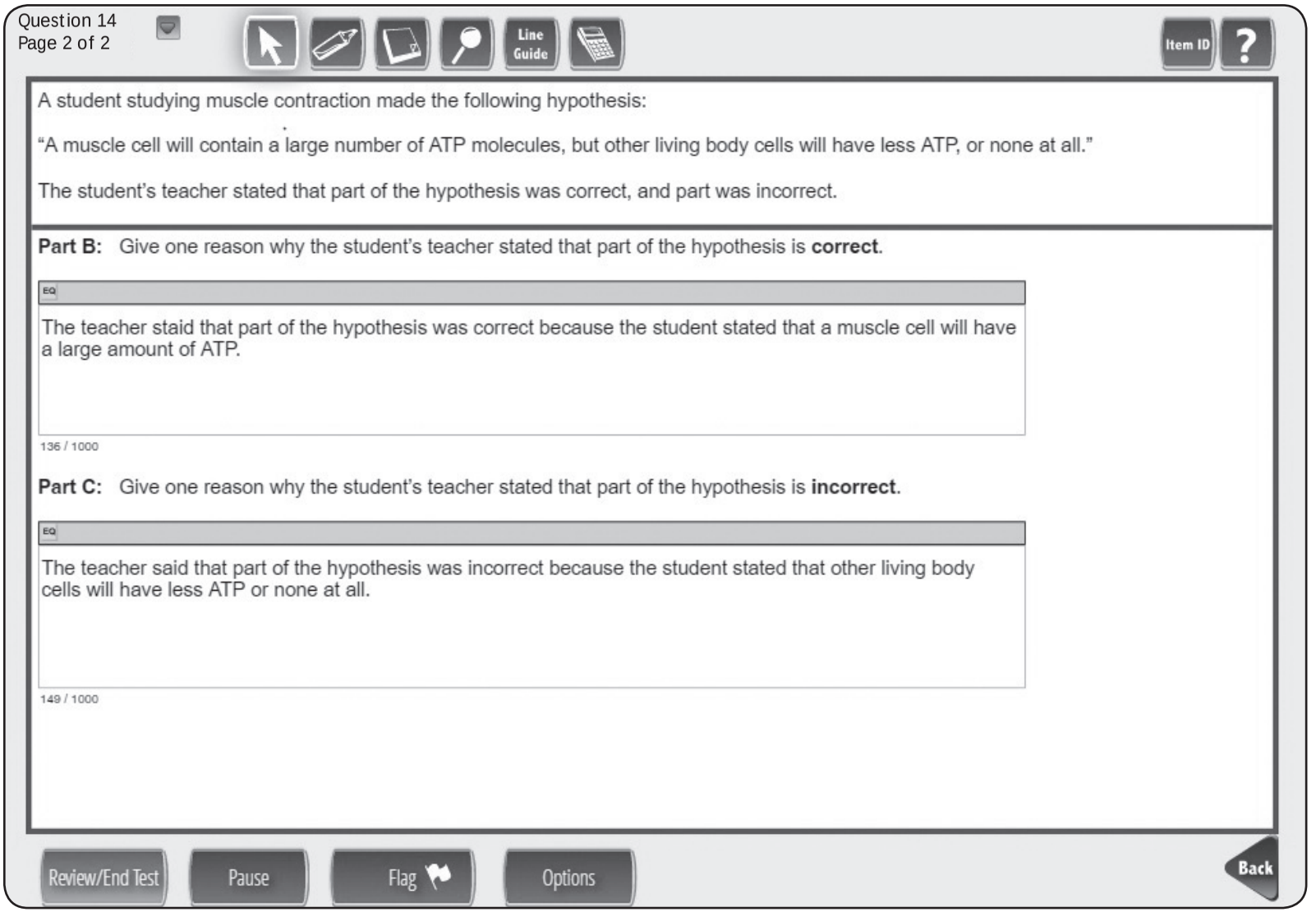
The response demonstrates a *partial* understanding of the role of ATP in biochemical reactions by describing **two** of the tasks presented in the item. The response describes the role of ATP in the muscle (*"ATP is the energy source"*) but provides an incomplete reason why part of the student's hypothesis is correct. The response correctly states (*"a muscle cell does contain a large number of ATP molecules"*) but fails to give the reason **why** that part of the hypothesis is correct. The response correctly gives a reason why part of the student's hypothesis is incorrect (*"cells can have less ATP but they wont ever have none at all. A cell cannot function without any ATP at all"*). The response contains some work that is incomplete or unclear.

STUDENT RESPONSE

RESPONSE SCORE: 1 POINT

PART A



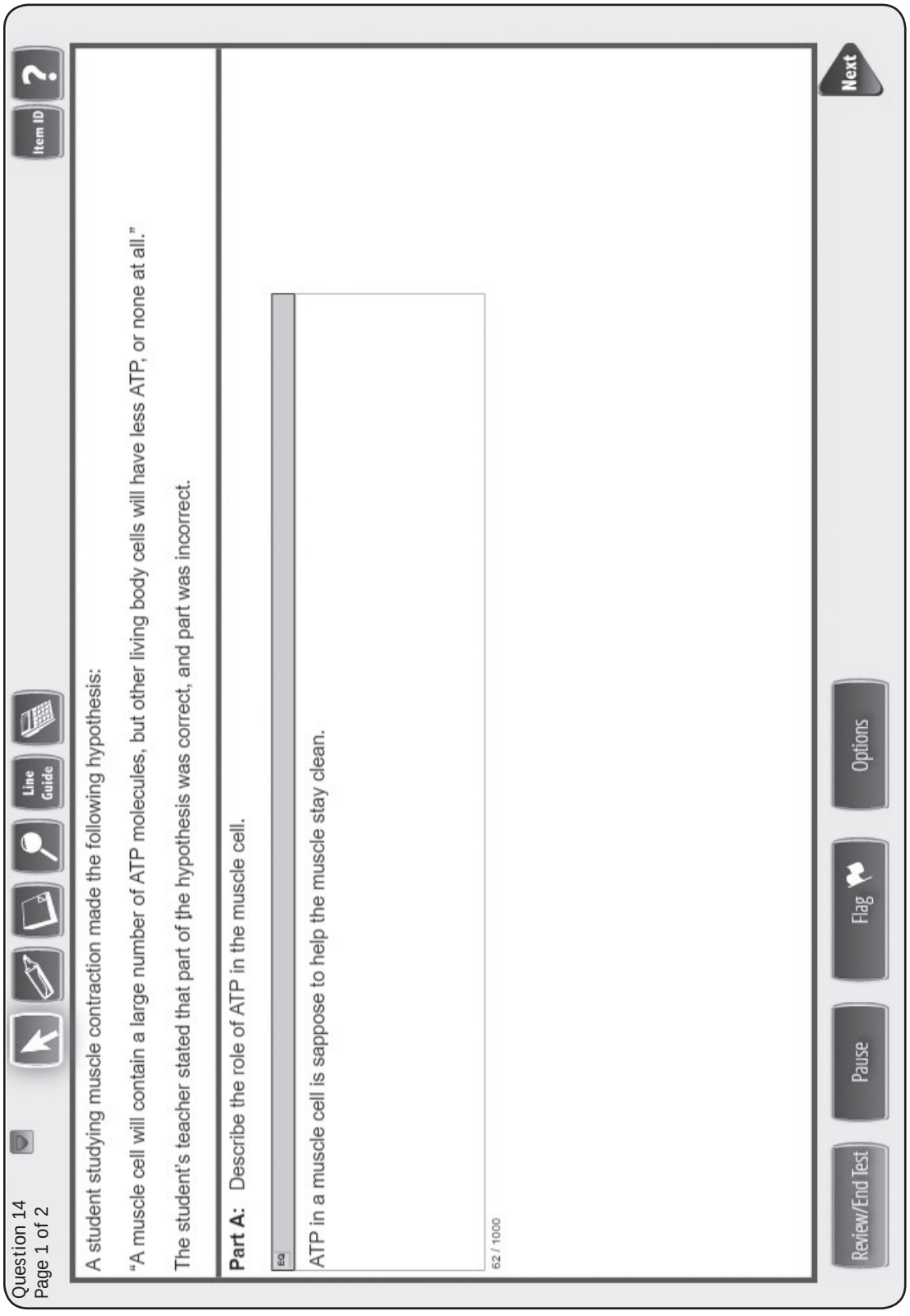


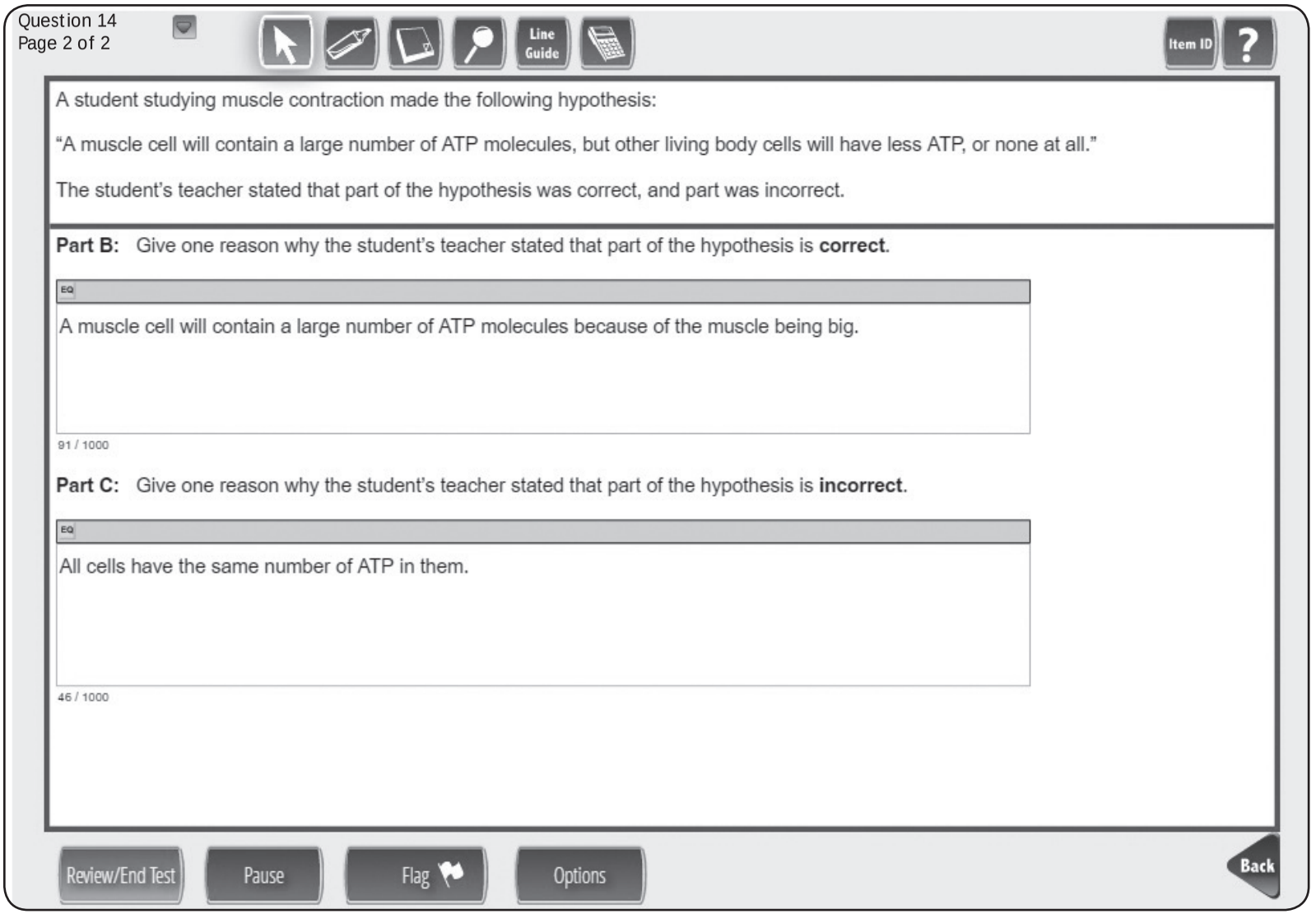
The response demonstrates a *minimal* understanding of the role of ATP in biochemical reactions by describing **one** of the tasks presented in the item. The response describes the role of ATP in the muscle (*"The role of ATP in a muscle cell is to give it energy. This is so the muscle cell can perform actions"*) but provides an incomplete reason why part of the student's hypothesis is correct. The response correctly states (*"a muscle cell will have a large amount of ATP"*) but does not give the reason **why** that part of the hypothesis is correct. The response also correctly states the portion of the student's hypothesis that is incorrect (*"other living body cells will have less ATP or none at all"*) but does not give the reason **why** that part of the hypothesis is incorrect. The response contains some work that is incomplete or unclear.

STUDENT RESPONSE

RESPONSE SCORE: 0 POINTS

PART A

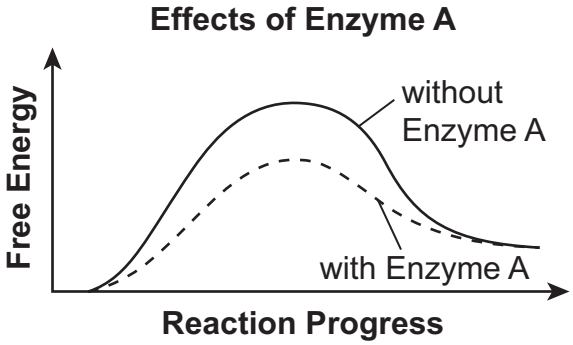


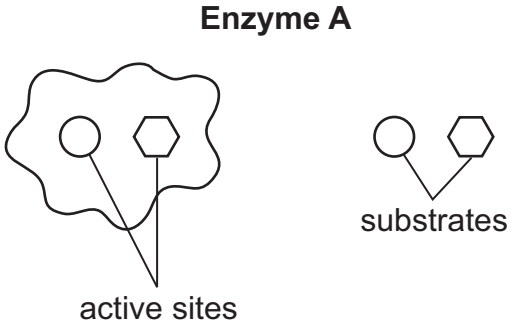


The response provides *insufficient* evidence to demonstrate any understanding of the role of ATP in biochemical reactions. The response incorrectly describes the role of ATP in the muscle cell (*"to help the muscle stay clean"*). Part B provides an incorrect reason why the student's hypothesis is correct (*"contain a large number . . . because of the muscle being big"*), and Part C incorrectly states the student's hypothesis is incorrect because *"all cells have the same number of ATP."*

CONSTRUCTED-RESPONSE ITEM

Use the graph and diagram below to answer question 15.





15.

Part A: Explain how Enzyme A acts as a catalyst in the reaction. Be sure to include energy and time in your answer.

Go to the next page to finish question 15.

15. ***Continued.*** Please refer to the previous page for task explanation.

Part B: Conditions around an enzyme change and affect the shape of the enzyme's active sites. Predict how this would affect the enzyme's ability to catalyze the reaction.

SCORING GUIDE

#15 ITEM INFORMATION

Alignment	BIO.A.2.3.1	**Depth of Knowledge**	3	**Mean Score**	0.89

ITEM-SPECIFIC SCORING GUIDELINE

Score	Description
3	The response demonstrates a *thorough* understanding of the role of an enzyme as a catalyst in regulating a specific biochemical reaction by • explaining how Enzyme A acts as a catalyst in the reaction with respect to energy **AND** • explaining how Enzyme A acts as a catalyst in the reaction with respect to time **AND** • predicting how changing the shape of the enzyme's active site would affect the enzyme's ability to catalyze the reaction. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of the role of an enzyme as a catalyst in regulating a specific biochemical reaction by fulfilling **two** of the three bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of the role of an enzyme as a catalyst in regulating a specific biochemical reaction by fulfilling **one** of the three bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
0	The response provides *insufficient* evidence to demonstrate any understanding of the concept being tested.
Non-scorables	B – No response written or refusal to respond F – Foreign language K – Off task U – Unreadable

Note: No deductions should be taken for misspelled words or grammatical errors.

Responses that will receive credit:

Part A (2 points):

- Enzyme A acts as a catalyst by reducing the activation energy, or the energy that is needed to get the reaction started. (When the substrates attach to the enzyme's active sites, they are brought close together, facilitating the reaction.) The reaction takes less time to occur ("the reaction is faster" is also acceptable).

Part B (1 point):

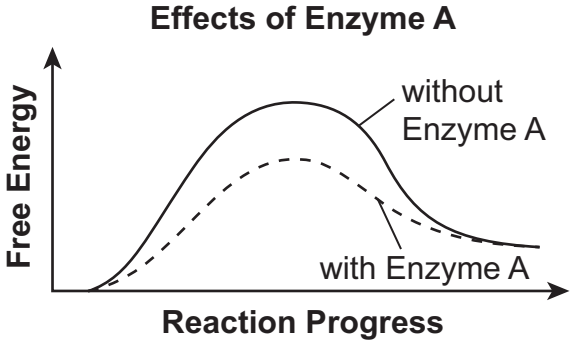
- When the shape of an enzyme's active site is changed, the substrate cannot attach to the active site; it will not "fit." The enzyme would not be able to catalyze the reaction.
- When the shape of the enzyme's active site is slightly changed (caused by a change in pH, for example), the enzyme activity can become greatly reduced.

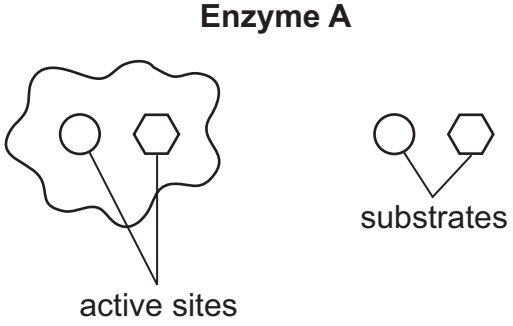
(Note: Information in parentheses is not necessary to receive full credit for Part A or Part B.)

STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS

Use the graph and diagram below to answer question 15.





15.

Part A: Explain how Enzyme A acts as a catalyst in the reaction. Be sure to include energy and time in your answer.

Enzyme A acts a catalyst because with enzyme A their is less free energy being used. With enzyme A, it speeds up the reaction time. That is how it acts as a catalyst.

Go to the next page to finish question 15.

15. ***Continued.*** Please refer to the previous page for task explanation.

Part B: Conditions around an enzyme change and affect the shape of the enzyme's active sites. Predict how this would affect the enzyme's ability to catalyze the reaction.

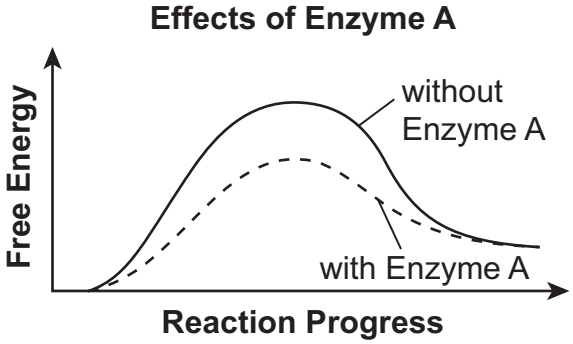
It would affect the enzyme's ability to catalyze the reaction because they might not react right. The active sites could change, and then they wouldn't fit like a lock and key anymore, so therefore, the enzyme would no longer act as a catalyst.

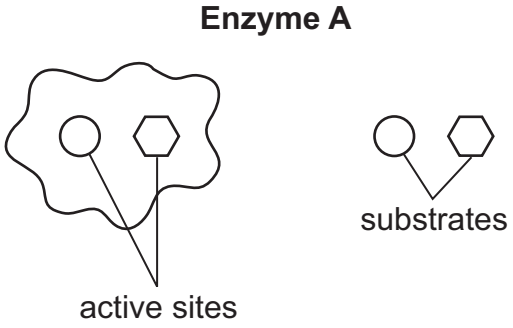
The response demonstrates a *thorough* understanding of the role of an enzyme as a catalyst in regulating a specific biochemical reaction by completing all **three** tasks presented in the item. The student explains that Enzyme A is a catalyst since the reaction uses less energy and the reaction time is reduced. The explanation provided includes both energy and time. In Part B, the student predicts that the enzyme would not act as a catalyst since the active sites would change. The response is clear, complete, and correct.

STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS

Use the graph and diagram below to answer question 15.





15.

Part A: Explain how Enzyme A acts as a catalyst in the reaction. Be sure to include energy and time in your answer.

Enzyme A acts like a catalyst because it uses less energy and the reaction time get faster.

Go to the next page to finish question 15.

15. ***Continued.*** Please refer to the previous page for task explanation.

Part B: Conditions around an enzyme change and affect the shape of the enzyme's active sites. Predict how this would affect the enzyme's ability to catalyze the reaction.

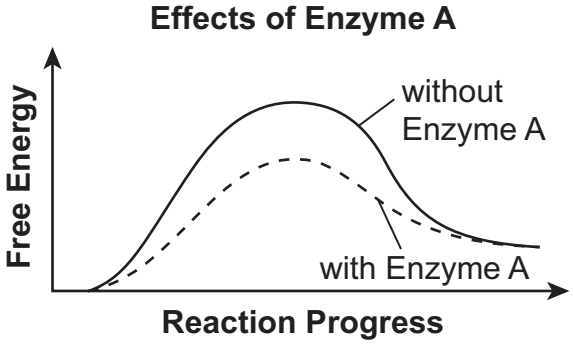
The enzyme may cause the opposite effects with the catalyze being wed.

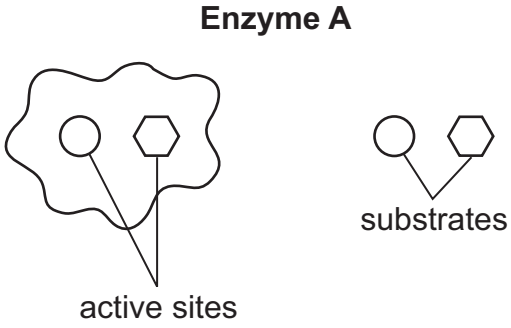
The response demonstrates a *partial* understanding of the role of an enzyme as a catalyst in regulating a specific biochemical reaction by completing **two** of the tasks presented in the item. The student provides an acceptable response about how Enzyme A acts as a catalyst in the reaction by explaining that less energy is used and the reaction time is reduced. The prediction of how a change in shape would affect the enzyme's ability to catalyze the reaction is unclear. *"The enzyme may cause the opposite effects with the catalyze being used"* is not enough for credit. The student should have more completely described the opposite effects for additional credit. This response contains work that is incomplete or unclear.

STUDENT RESPONSE

RESPONSE SCORE: 1 POINT

Use the graph and diagram below to answer question 15.





15.

Part A: Explain how Enzyme A acts as a catalyst in the reaction. Be sure to include energy and time in your answer.

the enzyme A reduces the activation energy.

Go to the next page to finish question 15.

15. ***Continued.*** Please refer to the previous page for task explanation.

Part B: Conditions around an enzyme change and affect the shape of the enzyme's active sites. Predict how this would affect the enzyme's ability to catalyze the reaction.

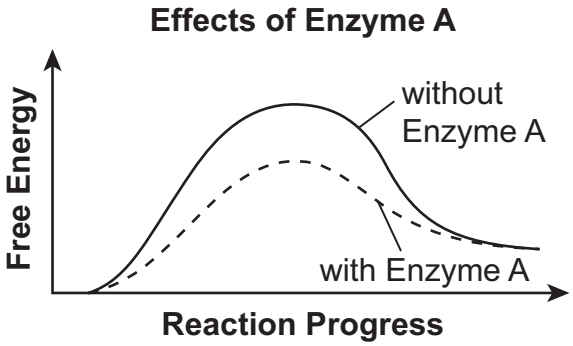
It's ability would be to speed up the reaction by reducing the activation energy.

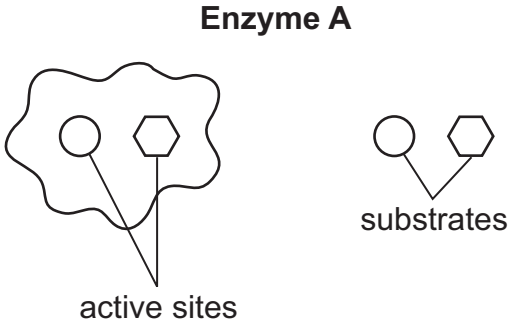
The response demonstrates a *minimal* understanding of the role of an enzyme as a catalyst in regulating a specific biochemical reaction by completing **one** of the tasks presented in the item. The student correctly states that Enzyme A reduces the activation energy but fails to provide any information about the effect on time in the response. The response in Part B does not correctly answer the question presented by predicting that the enzyme would catalyze the reaction (which is a repeat of the information given in Part A). The response contains work that is incomplete or unclear.

STUDENT RESPONSE

RESPONSE SCORE: 0 POINTS

Use the graph and diagram below to answer question 15.





15.

Part A: Explain how Enzyme A acts as a catalyst in the reaction. Be sure to include energy and time in your answer.

Enzyme A acts as a catalyst in the reaction because during the reaction progress the substrates within the active cites of a cell becomes greater and increases the free energy to a point and then falls slowly. That is why Enzyme A acts like a catalyst in the reaction.

Go to the next page to finish question 15.

15. ***Continued.*** Please refer to the previous page for task explanation.

Part B: Conditions around an enzyme change and affect the shape of the enzyme's active sites. Predict how this would affect the enzyme's ability to catalyze the reaction.

This would affect the enzyme's ability to catalyze the reaction because as the conditions around the enzyme change, the enzymes active sites would change as the substrates of an enzyme change. The oxogen amount, and amount of ATP and Mitochondria also affect the conditions of an enzyme.

The response demonstrates an *insufficient* understanding of the role of an enzyme as a catalyst in regulating a specific biochemical reaction by not completing any of the tasks presented in the item. The explanation in Part A does not correctly explain how Enzyme A acts as a catalyst in the reaction. The student describes the shape of the graph shown but does not explain the effect Enzyme A would have on the energy or time. The student does not provide a prediction about how the change in shape would affect the enzyme's ability to catalyze the reaction. The response attempts to explain how the conditions would change and not the effect these changes would have. The response contains work that is incomplete or unclear.

BIOLOGY MODULE 1—SUMMARY DATA

MULTIPLE-CHOICE

Sample Number	Alignment	Answer Key	Depth of Knowledge	*p*-values			
				A	B	C	D
1	BIO.A.1.1.1	C	2	10%	8%	69%	13%
2	BIO.A.1.2.1	A	2	60%	15%	15%	10%
3	BIO.A.2.2.1	B	2	8%	63%	7%	22%
4	BIO.A.2.2.2	B	2	25%	52%	12%	11%
5	BIO.A.2.2.3	D	2	8%	9%	19%	63%
6	BIO.A.2.3.2	A	2	52%	12%	14%	21%
7	BIO.A.3.1.1	D	2	16%	20%	16%	47%
8	BIO.A.3.2.1	B	2	16%	59%	9%	16%
9	BIO.A.4.1.1	D	2	13%	24%	16%	46%
10	BIO.A.4.1.2	B	2	26%	51%	9%	14%
11	BIO.A.4.1.3	C	2	14%	12%	66%	8%
12	BIO.A.1.2.2	D	2	6%	13%	7%	74%
13	BIO.A.4.2.1	B	2	11%	62%	18%	9%

CONSTRUCTED-RESPONSE

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
14	BIO.A.3.2.2	3	3	1.40
15	BIO.A.2.3.1	3	3	0.89

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BIOLOGY MODULE 2
MULTIPLE-CHOICE QUESTIONS

1. Which statement describes one difference between mitosis and meiosis in animal cells?

A. Mitosis produces sex cells, and meiosis produces diploid cells.

B. Mitosis produces haploid cells, and meiosis produces somatic cells.

C. Mitosis produces four daughter cells, and meiosis produces two diploid cells.

D. Mitosis produces two daughter cells, and meiosis produces four daughter cells.

Item Information	
Alignment	BIO.B.1.1.2
Answer Key	D
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
19%	15%	19%	46%

Option Annotations

A. Mitosis produces somatic cells, and meiosis produces haploid cells.
B. Mitosis produces diploid cells, and meiosis produces sex cells.
C. Mitosis produces two diploid daughter cells, and meiosis produces four haploid daughter cells.
D. Key: Mitosis produces two diploid daughter cells; meiosis produces four haploid daughter cells.

2. Which statement **best** describes the process by which the millions of body cells that form a housefly can all contain the same genetic information?

A. Original DNA is duplicated during replication and then distributed into two new cells.

B. Original RNA is duplicated during replication and then distributed into two new cells.

C. Original DNA is duplicated during replication and then distributed into four new cells.

D. Original RNA is duplicated during replication and then distributed into four new cells.

Item Information	
Alignment	BIO.B.1.2.1
Answer Key	A
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
60%	12%	23%	5%

Option Annotations

A. Key: DNA replication produces two copies of genetic information that are identical to the original DNA and are distributed into two new cells.

B. DNA is duplicated during replication, not RNA.

C. DNA replication produces two copies that are distributed to two new cells, not four.

D. DNA, not RNA, is duplicated during replication and distributed to two new cells.

3. The presence of a specific trait is genetically inherited. There are only two possible outcomes for this trait: an individual either inherits the trait or does not inherit the trait. Which statement **best** describes how parents influence this trait?

A. Each parent contributes two genes for this trait.

B. Each parent contributes one allele for this trait.

C. Each parent contributes two chromosomes for this trait.

D. Each parent contributes one nitrogenous base for this trait.

Item Information	
Alignment	BIO.B.1.2.2
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
24%	54%	17%	5%

Option Annotations

A. Each parent contributes one gene for the trait, not two.

B. Key: Each parent contributes one allele for the trait; alleles are different forms of the same gene.

C. Each parent contributes half of the chromosomes to an offspring individual, and the chromosomes contain genes that code for specific traits.

D. Each parent contributes many nitrogenous bases that compose the large and complex DNA molecule containing thousands of genes that code for traits.

Use the diagram below to answer question 4.

DNA Section

A G T G C C G A C ← original strand

A G G C C G A C ← altered strand

4. A section of DNA in a cell is altered. Which mutation is being illustrated in the DNA section above?

A. deletion

B. insertion

C. duplication

D. nondisjunction

Item Information				Option Annotations
Alignment	BIO.B.2.1.2			A. Key: The altered strand of DNA is shorter than the original strand; this suggests that one or more bases were deleted. B. An insertion mutation involves the addition of one or more bases to the DNA strand, making it longer. C. A duplication occurs when a section of DNA is copied one or more times, making the strand longer. D. Nondisjunction results in one daughter cell having too many chromosomes or chromatids and the other having none.
Answer Key	A			
Depth of Knowledge	2			
***p*-values**				
A	**B**	**C**	**D**	
61%	18%	11%	9%	

5. Which statement is true for **all** prokaryotic and eukaryotic organisms?

A. Both types of organisms transform energy from sunlight into chemical energy.

B. Both types of organisms assemble proteins through transcription and translation.

C. Both types of organisms are made of cells, tissues, and organs that work together.

D. Both types of organisms have DNA contained within a nucleus as genetic material.

Item Information	
Alignment	BIO.B.2.2.1
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
14%	41%	31%	14%

Option Annotations

A. Only some prokaryotic and eukaryotic organisms can transform energy from sunlight into chemical energy.

B. Key: Both prokaryotic and eukaryotic organisms assemble proteins using transcription and translation involving RNA and ribosomes.

C. Prokaryotes are single-celled organisms.

D. Prokaryotes have genetic material within circular strands of DNA, but prokaryotes lack a nucleus.

Use the diagram below to answer question 6.

RNA Codon Table

First Base in Codon	Second Base in Codon: U	Second Base in Codon: C	Second Base in Codon: A	Second Base in Codon: G	Third Base in Codon
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	stop	stop	A
	Leu	Ser	stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

6. A mutation occurred that caused a change in an mRNA sequence. The mRNA codon UAC was replaced by the codon UAA. Which statement describes the **most likely** outcome of the mutation?

A. It will produce the same protein using a different set of codons.

B. It will result in an incomplete protein that does not function properly.

C. It will cause mRNA to attach a new amino acid chain during transcription.

D. It will change the bonding pattern between the amino acids joining together.

Item Information	
Alignment	BIO.B.2.3.1
Answer Key	B
Depth of Knowledge	3

***p*-values**			
A	**B**	**C**	**D**
12%	47%	22%	19%

Option Annotations

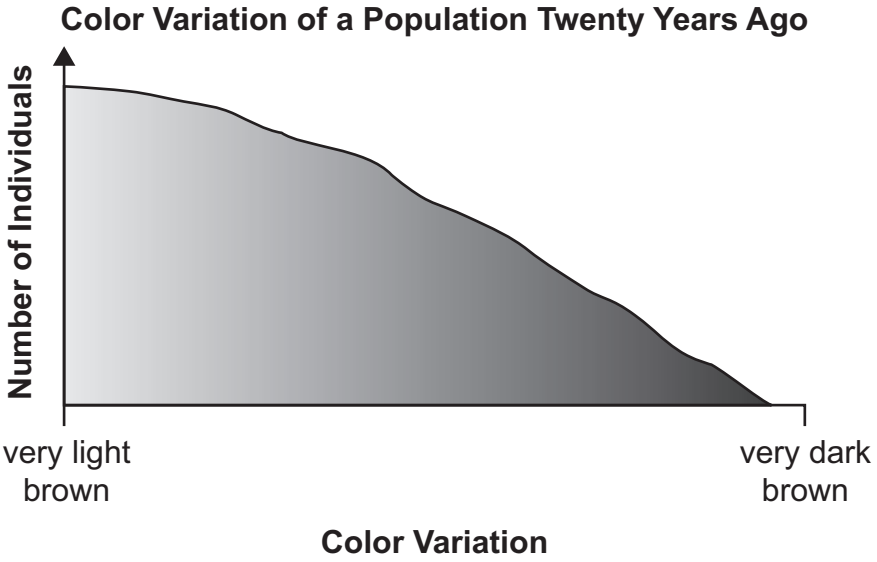
A. Instead of coding for Tyr, this mutation produces a stop, which will result in the formation of an incomplete protein.

B. Key: The codon UAA codes for a stop, which will result in the formation of an incomplete protein.

C. The codon UAA codes for a stop, so no additional amino acids will attach to this protein.

D. Since the mutation codes for a stop, no additional amino acids will join the protein chain.

Use the graph below to answer question 7.



7. The graph represents the number of light brown and dark brown organisms living on the bottom of a clear, sandy lake 20 years ago. Over time, the lake bottom has become covered with dark sand and sediment. Which change has **most likely** occurred in the population?

A. The number of light-brown individuals increased.

B. The number of dark-brown individuals increased.

C. The number of light-brown and dark-brown individuals increased.

D. The number of light-brown and dark-brown individuals became equal.

Item Information	
Alignment	BIO.B.3.1.1
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
25%	53%	11%	11%

Option Annotations

A. The number of light-brown individuals decreased because they blended in less with the dark sand and sediment.

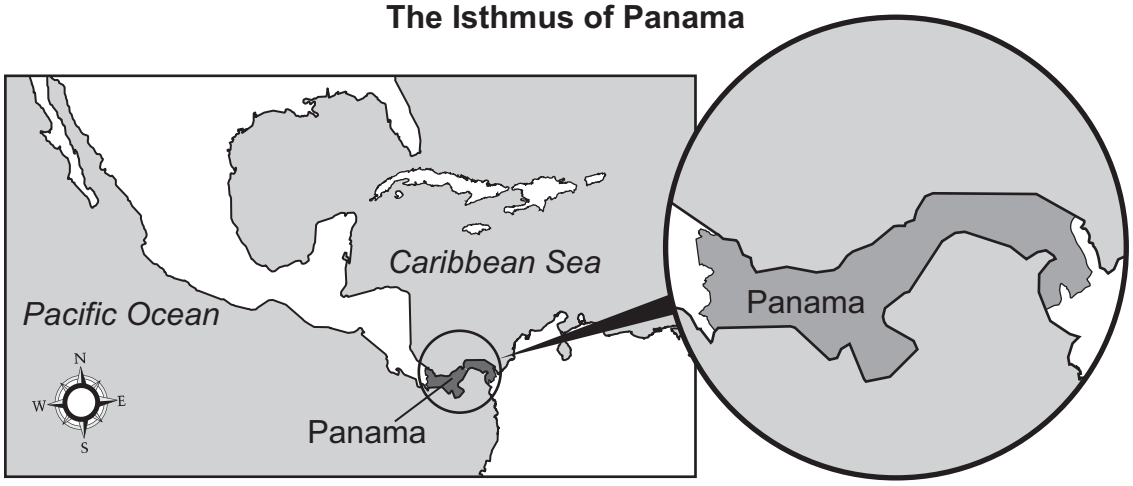
B. Key: The number of dark-brown individuals increased because they blended in with the dark sand and sediment—enabling them to survive and reproduce.

C. The number of light-brown individuals decreased, but the number of dark-brown individuals increased.

D. It is unlikely that the number of light- and dark-brown individuals became equal because they are unequally adapted to blend into the environment.

Use the map below to answer question 8.

The Isthmus of Panama



8. The Isthmus of Panama is a narrow strip of land that lies between the Caribbean Sea and the Pacific Ocean. It forms a land bridge that links North and South America. The formation of this isthmus separated two bodies of water that had previously been connected. How did the formation of this land bridge **most likely** influence the development of distinct marine species on either side of the land bridge?

A. by decreasing genetic drift

B. by causing a founder effect

C. by increasing the rate of genetic mutation

D. by preventing related populations from interacting

Item Information	
Alignment	BIO.B.3.1.2
Answer Key	D
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
17%	12%	15%	55%

Option Annotations

A. Separating populations of marine species may initially reduce their sizes, thereby increasing genetic drift.

B. A founder effect occurs when a population's size is rapidly and drastically reduced; in this case, the populations were separated gradually and not drastically reduced in size.

C. The rate of genetic mutation is unlikely to be affected by the gradual separation of a population.

D. Key: Speciation often occurs when populations separate and are no longer able to interbreed due to physical barriers.

9. Which statement describes how a mutation would **most likely** affect a population?

A. Genotypic variation will increase in the population.

B. Genotypic variation will decrease in the population.

C. The occurrence of a preexisting gene will increase in the population.

D. The occurrence of a preexisting gene will decrease in the population.

Item Information	
Alignment	BIO.B.3.1.3
Answer Key	A
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
50%	17%	16%	17%

Option Annotations

A. Key: When a mutation occurs within genes, it generates new genotypic variations within the population.

B. Mutations typically increase, not decrease, genetic variation.

C. There is not enough information provided to predict frequency changes of preexisting genes.

D. There is not enough information provided to predict frequency changes of preexisting genes.

10. Strep throat is a common human illness often caused by the bacterium *Streptococcus pyogenes*. Which term **best** classifies the colonies of *Streptococcus pyogenes* in a person with strep throat?

A. a population

B. an organelle

C. a community

D. an ecosystem

Item Information	
Alignment	BIO.B.4.1.1
Answer Key	A
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
36%	27%	29%	8%

Option Annotations

A. Key: A population is composed of individuals of the same species (*Streptococcus pyogenes* bacteria colonies) within a habitat (a person's throat).
B. An organelle is a component of a cell.
C. A community is represented by different populations interacting within the same habitat.
D. An ecosystem includes all the living parts of a habitat along with the nonliving parts of the habitat that support life.

11. Which statement **best** describes a contribution that decomposers make to an ecosystem?

A. They reduce the atomic mass of carbon atoms.

B. They increase the recycling of carbon-containing molecules.

C. They reduce the total number of carbon atoms in the atmosphere.

D. They increase the total number of carbon nuclei within the atoms.

Item Information	
Alignment	BIO.B.4.2.3
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
13%	57%	23%	6%

Option Annotations

A. Decomposers release carbon into the atmosphere through respiration, but they do not change carbon's atomic mass.

B. Key: Decomposers break down remains of once-living organisms, thereby releasing the carbon from those organisms back into the atmosphere during respiration.

C. Decomposers add carbon atoms to the atmosphere when they release carbon during respiration.

D. Each carbon atom has a single nucleus, which is unchanged by decomposers.

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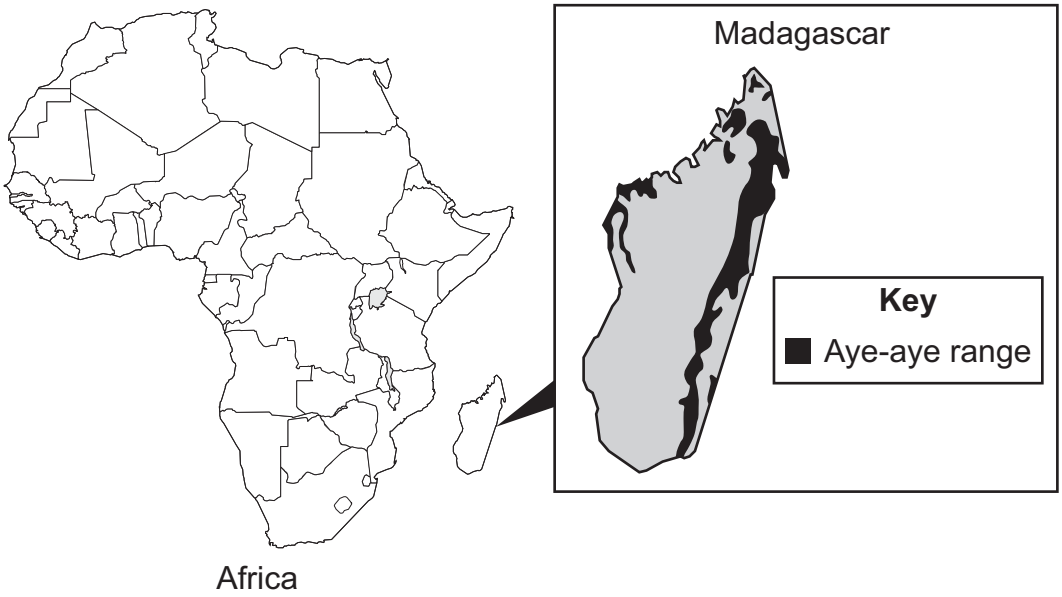
Directions: Use the information presented on page 58 to answer questions 12 and 13.

Aye-aye

An aye-aye is a small nocturnal lemur that weighs about four pounds. This endangered species is found in Madagascar, a large island off the east coast of southern Africa. The main food for aye-ayes is larvae that live in wood. Aye-ayes find the larvae by tapping on tree branches. They also eat nuts and fruit. Aye-ayes spend most of their time alone. Each animal occupies about 15 acres and marks the territory, which alerts other aye-ayes of the boundary.

Aye-aye Range



Use the map below to answer question 12.

Four Locations of Aye-ayes

Madagascar

12. The map indicates four locations of aye-aye populations. Which location would **most likely** have an aye-aye population with the greatest variation in allele frequencies?

A. location 1

B. location 2

C. location 3

D. location 4

Item Information	
Alignment	BIO.B.3.1.1
Answer Key	D
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
5%	8%	7%	79%

Option Annotations

A. This location is a small isolated area that would likely have a smaller population that experiences inbreeding and low genetic diversity.

B. This location is a small isolated area that would likely have a smaller population that experiences inbreeding and low genetic diversity.

C. This location is an isolated area that would likely have a smaller population and less genetic diversity than the largest location.

D. Key: This population occupies the largest area of the island, which likely has a more diverse environment than the other locations; its population is likely much larger than the other populations, resulting in a greater variation in allele frequencies.

13. For the aye-aye species, what is **most likely** the primary value of individuals living alone?

A. decreased space needs for the species

B. increased survival rates with habitat loss

C. reduced competition for natural resources

D. greater genetic variability within the species

Item Information	
Alignment	BIO.B.4.2.2
Answer Key	C
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
11%	17%	64%	8%

Option Annotations

A. A population with individuals living alone likely requires more rather than less habitat space.

B. An increase in habitat loss would not increase survival rates among individuals that require large solitary territories.

C. Key: Individuals who live alone in a territory have the resources they need within their territory and are less likely to compete for resources such as shelter, food, and water.

D. Living alone, rather than in groups, often results in increased difficulty in finding mates, which could result in fewer chances of increasing genetic variability within a population or species.

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CONSTRUCTED-RESPONSE ITEM

14. State officials are considering constructing a road through a forested wilderness area. This action will likely affect the forest ecosystem in various ways.

Part A: Predict how the construction of a road could negatively affect plants in the forest ecosystem.

Part B: Predict how the construction of a road could negatively affect animals in the forest ecosystem.

Go to the next page to finish question 14.

14. ***Continued.*** Please refer to the previous page for task explanation.

Part C: Describe one way that the construction of a road could have a positive effect on the forest ecosystem.

SCORING GUIDE

#14 ITEM INFORMATION

Alignment	BIO.B.4.2.4	**Depth of Knowledge**	3	**Mean Score**	1.89

ITEM-SPECIFIC SCORING GUIDELINE

Score	Description
3	The response demonstrates a *thorough* understanding of how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires) by • predicting how the construction of a road could negatively affect plants in the forest ecosystem **and** • predicting how the construction of a road could negatively affect animals in the forest ecosystem **and** • describing one way that the construction of a road could have a positive effect on the forest ecosystem. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires) by fulfilling **two** of the three bullets listed in the 3-point response. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires) by fulfilling **one** of the three bullets listed in the 3-point response. The response may contain some work that is incomplete or unclear.
0	The response provides *insufficient* evidence to demonstrate any understanding of the concept being tested.
Non-scorables	B – No response written or refusal to respond F – Foreign language K – Off task U – Unreadable

Note: No deductions should be taken for misspelled words or grammatical errors.

Responses that will receive credit:

Part A (1 point):

- Many trees and other plants will be destroyed during the construction.
- Removal of trees causes an increase in sunlight reaching the forest floor. Plants that cannot tolerate the increased sunlight will not survive.
- Removal of trees and construction of dark-colored roads could increase the surface temperatures of the forest area, which some plants may not be able to tolerate.
- Dust from road traffic may settle on plants and disrupt photosynthesis, respiration, and transpiration.
- Emissions from vehicles and chemicals used for de-icing roads can contaminate the air and soil, causing damage or death to plants.
- A road could affect natural water drainage patterns in the area, which could harm some plants.
- Vehicles on the road could spill chemicals or waste that could harm plants.

Part B (1 point):

- Some animals could be struck by vehicles. Some animals are attracted to roads for warmth, dust, salt, gravel, or roadside vegetation. These animals are vulnerable to traffic. Some animals may be killed during the construction.
- Animals' habitats will be divided into sections. Animals may become separated from some food sources. (Some animals are averse to crossing roads, and will not cross even very narrow roads.)
- Animals' habitats will be fragmented. This will effectively reduce the population of some species. These species will be vulnerable to problems that arise from having a small gene pool, such as genetic deterioration from inbreeding.
- Animals that depend on plants that have been destroyed will not survive, unless they find another food source.
- Vehicles on the road could spill chemicals or waste that could harm animals.

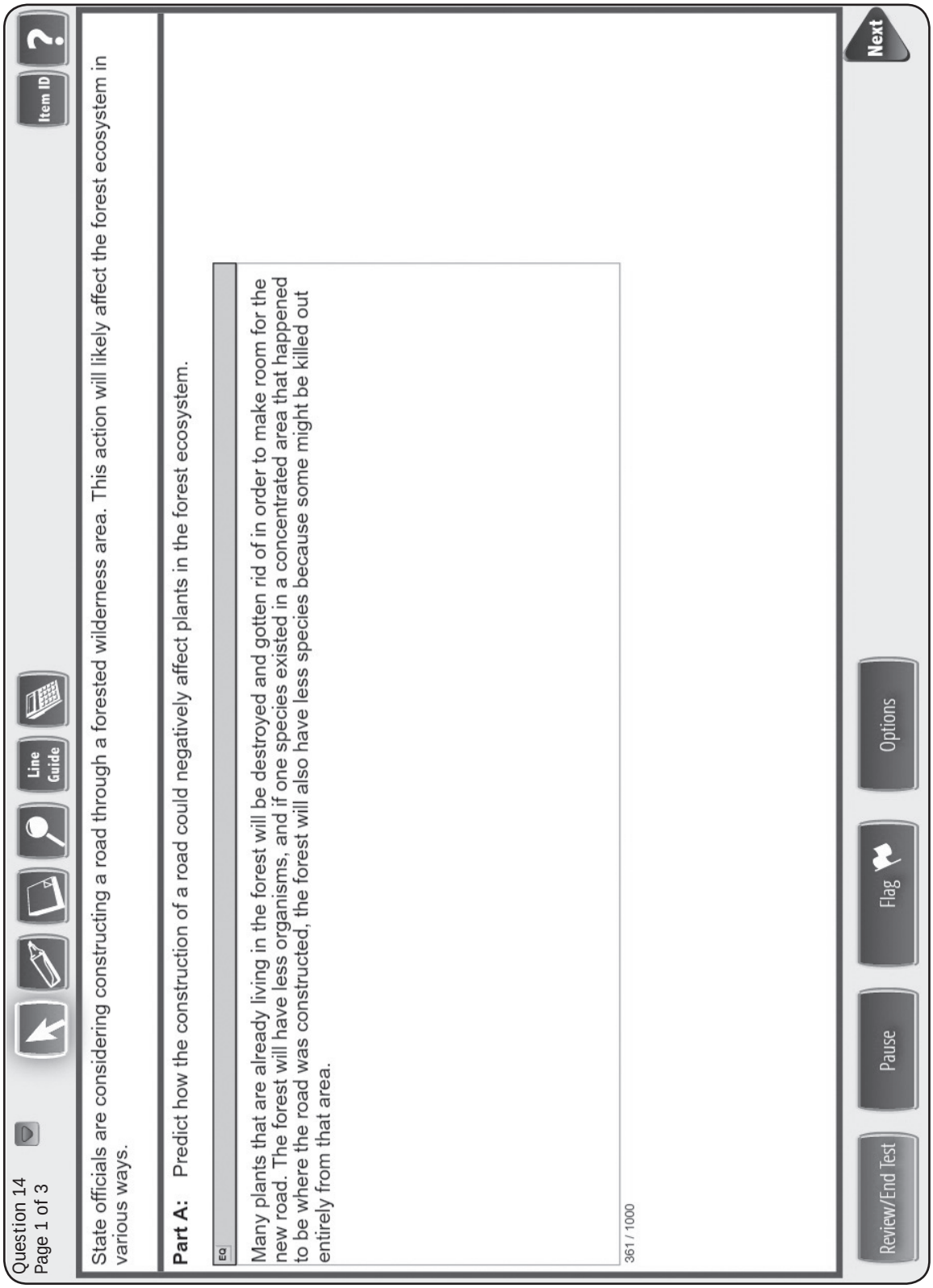
Part C (1 point):

- An increase in roads could bring more visitors to an area, which could increase awareness about the area and cause some people to take on the cause of restoring or protecting wilderness areas.
- An increase in roads could cause easier access to wilderness areas, allowing more people to experience and appreciate nature, leading to increased funding for the forest ecosystem.
- By the state allowing a road through a particular forested area, another area may be protected from human disturbances.
- The road may allow new species to populate the area. These species could be more capable of survival in the new environment.

STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS

PART A



PART B

Question 14
Page 2 of 3
Line Guide
Item ID
State officials are considering constructing a road through a forested wilderness area. This action will likely affect the forest ecosystem in various ways.
Part B: Predict how the construction of a road could negatively affect animals in the forest ecosystem.
EQ
Many animals will lose their homes by the construction of a road. Animals that live in underground burrows might lose their homes because the road will be built right overtop of them. Animals that live in plants and trees might lose their homes because they will have to be cut down in order to make room for the road. Also, animals might experience food shortages, as there will be much less plants for them to eat. These plants would be removed for the construction of the road, and certain animals might depend on those plants for survival, whether it be for food or shelter.
578 / 1000
Review/End Test
Pause
Flag
Options
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Next

Question 14
Page 3 of 3

Line Guide

Item ID

State officials are considering constructing a road through a forested wilderness area. This action will likely affect the forest ecosystem in various ways.

Part C: Describe one way that the construction of a road could have a positive effect on the forest ecosystem.

EQ

Building a road through the forest might have the positive effect of letting more light in. Because several trees will be cleared away, there will be more open space and more areas where the sun and sky are not blocked out. Therefore, more plants might be given access to this new light and will grow more rapidly as well as more healthily, and even taller. Also, different species of plants that require excessive amounts of sunlight will be able to grow in these ares that were not previously able to grow there due to the canopy of trees.

542 / 1000

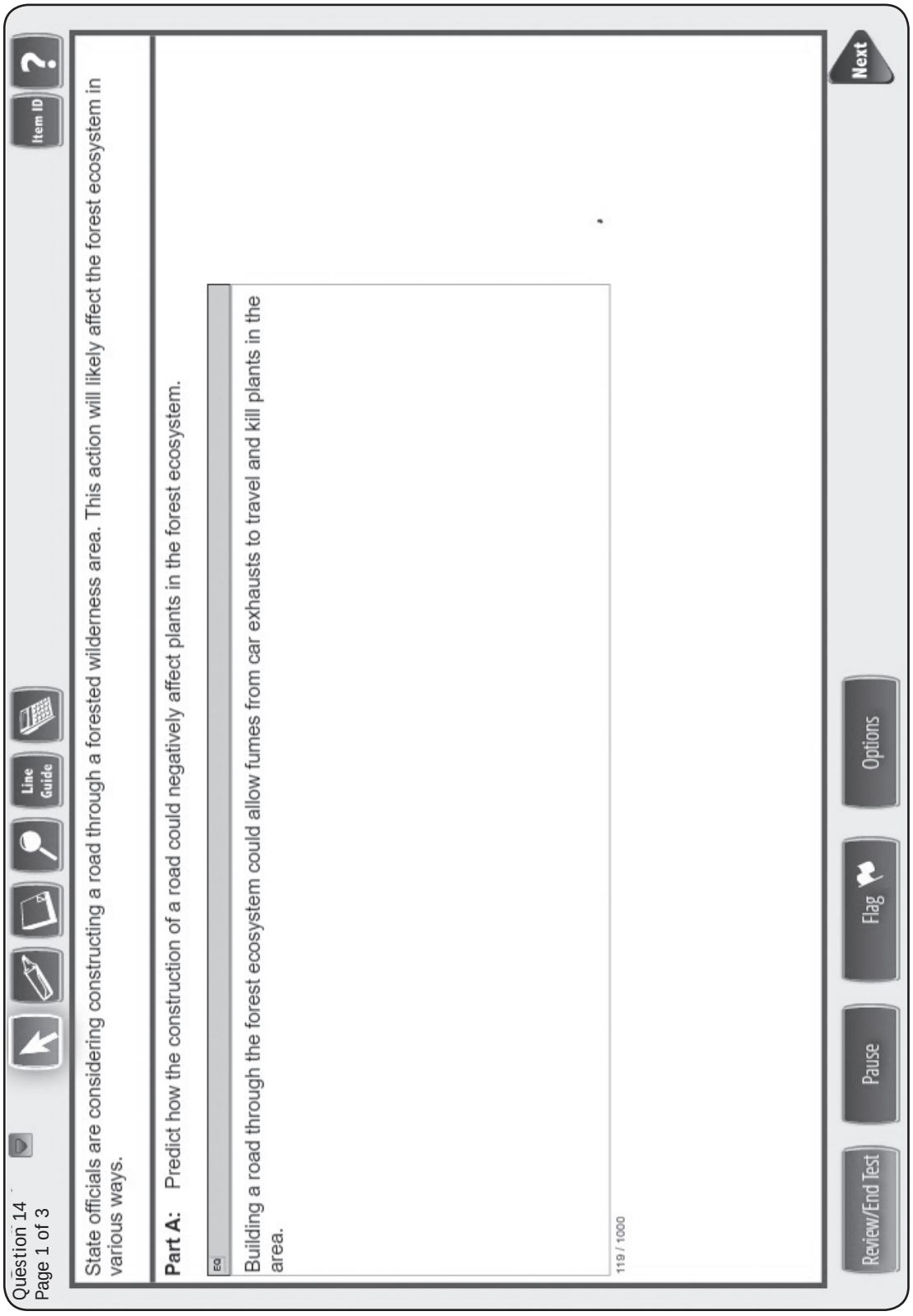
Review/End Test | Pause | Flag | Options | Back

The response demonstrates a *thorough* understanding of how ecosystems change in response to natural and human disturbances by fulfilling all **three** of the tasks presented in the item. The response correctly predicts how the construction of a road could negatively affect plants in the forest ecosystem (*"Many plants that are already living in the forest will be destroyed . . . the forest will also have less species"*) and predicts how the construction of a road could negatively affect animals in the forest ecosystem (*"animals will lose their homes . . . might experience food shortages"*). The response also correctly describes one way that the construction of a road could have a positive effect on the forest ecosystem (*"trees will be cleared away . . . the sun and sky are not blocked out . . . plants might be given access to this new light and will grow more rapidly"*). The response is clear, complete, and correct.

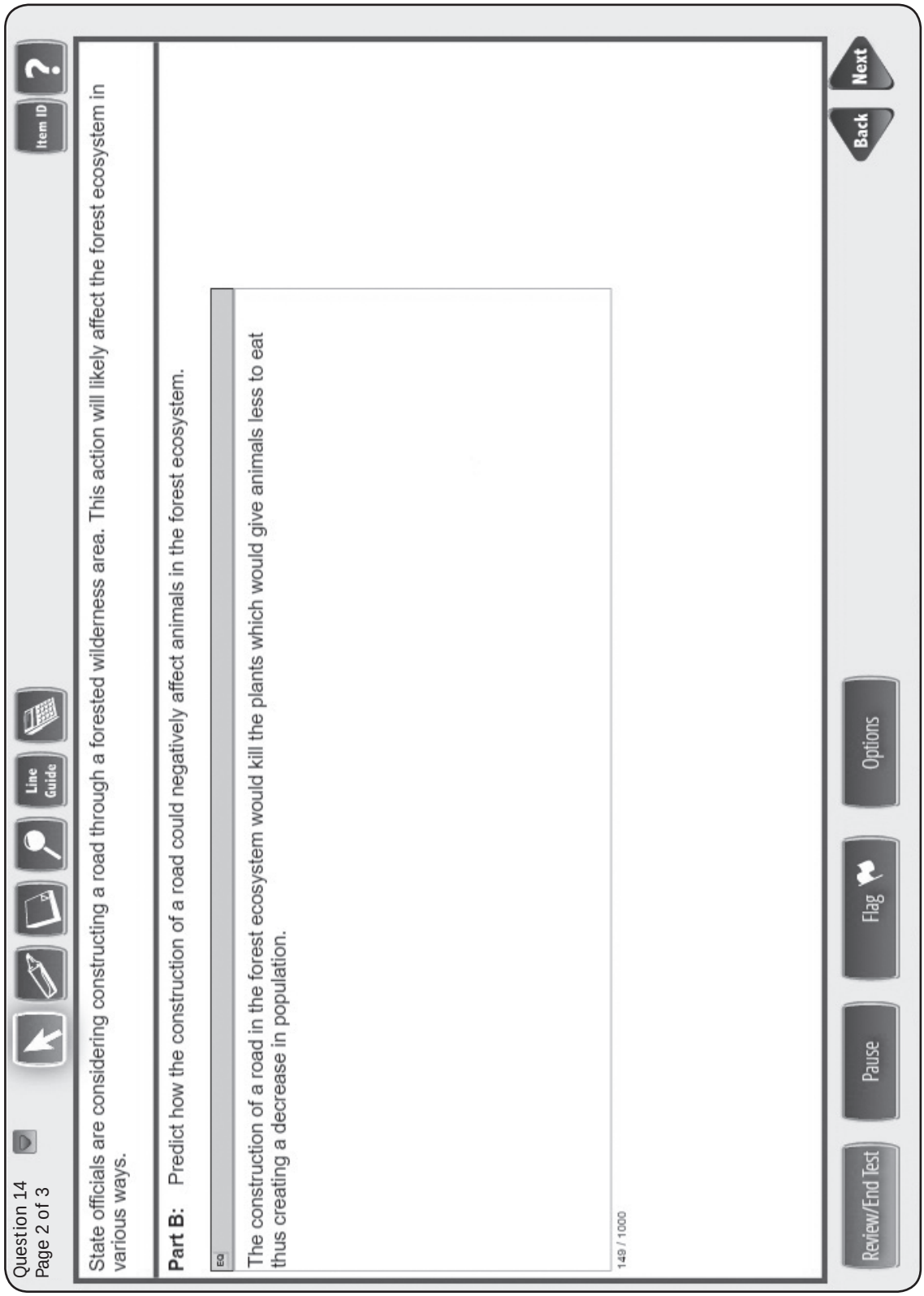
STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS

PART A



PART B


Question 14
Page 2 of 3
Line Guide
Item ID
State officials are considering constructing a road through a forested wilderness area. This action will likely affect the forest ecosystem in various ways.
Part B: Predict how the construction of a road could negatively affect animals in the forest ecosystem.
EQ
The construction of a road in the forest ecosystem would kill the plants which would give animals less to eat thus creating a decrease in population.
149 / 1000
Review/End Test
Pause
Flag
Options
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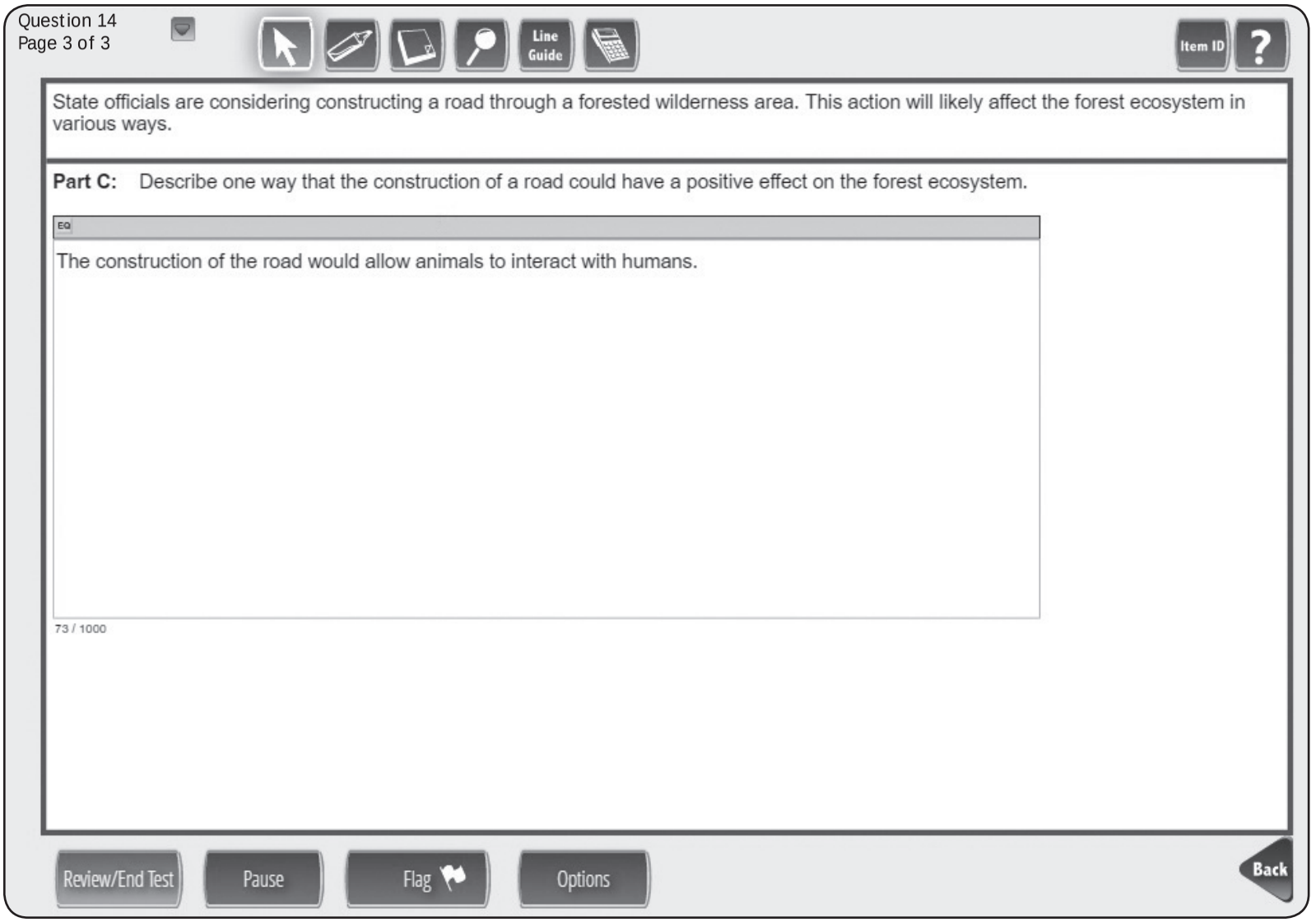
Next

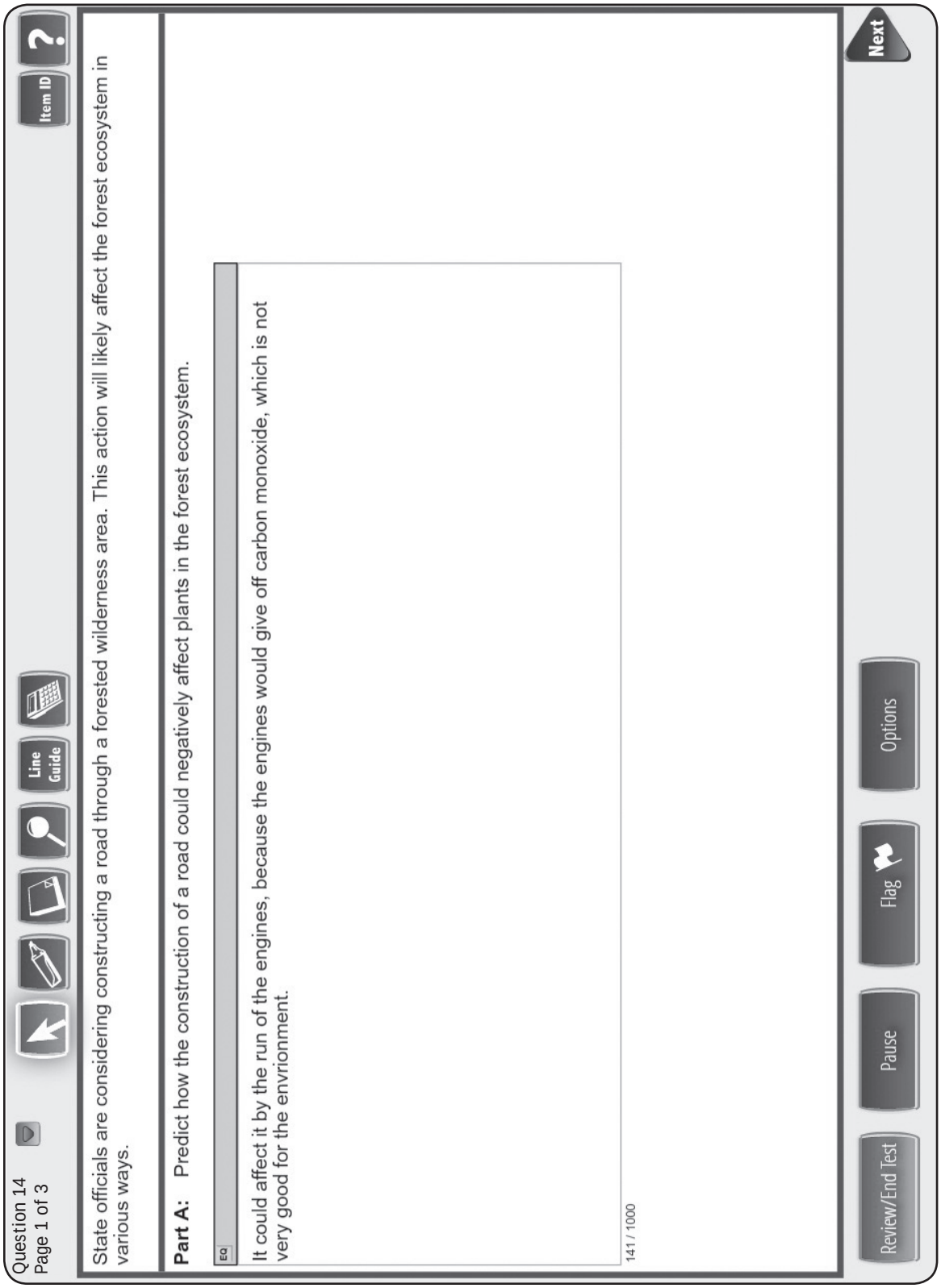


The response demonstrates a *partial* understanding of how ecosystems change in response to natural and human disturbances by fulfilling **two** of the tasks presented in the item. The response correctly predicts how the construction of a road could negatively affect plants in the forest ecosystem (*"car exhausts . . . kill plants in the area"*) and predicts how the construction of a road could negatively affect animals in the forest ecosystem (*"construction . . . would kill the plants which would give animals less to eat"*). The response fails to completely describe one way the construction of a road could positively affect the ecosystem. *"Allow animals to interact with humans"* does not clearly describe a positive effect. The response contains some work that is incomplete or unclear.

STUDENT RESPONSE

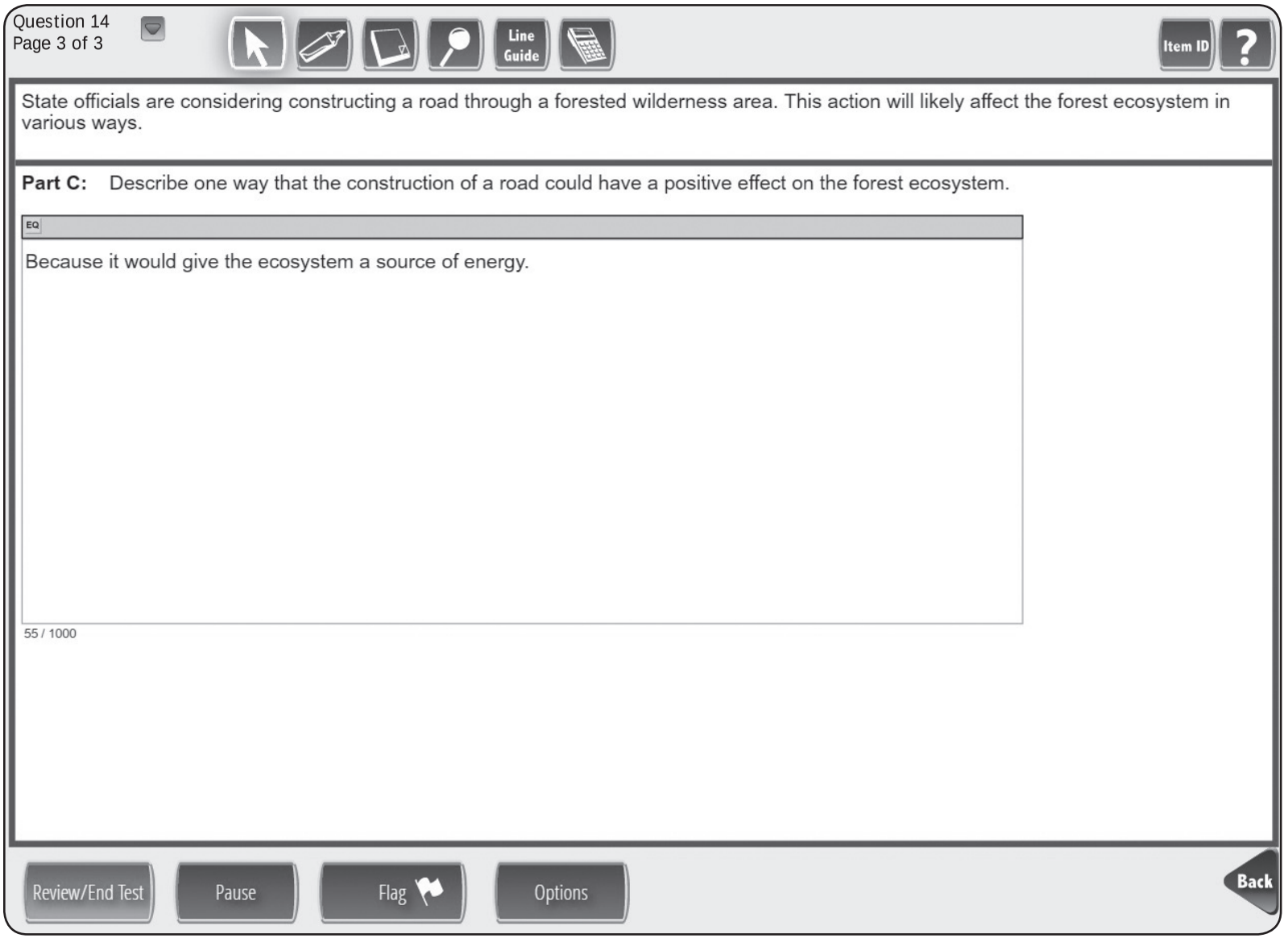
RESPONSE SCORE: 1 POINT

PART A



PART B

Question 14
Page 2 of 3
Line Guide
Item ID
State officials are considering constructing a road through a forested wilderness area. This action will likely affect the forest ecosystem in various ways.
Part B: Predict how the construction of a road could negatively affect animals in the forest ecosystem.
EQ
Like I said before carbon manoxide would kill of the animals because they wouldnt be able to breathe that fresh air. instead they would be breathing bad air which could kill the organisms off face of the earth. Also if they would have to knock down trees, then the animals would have no place to stay.
301 / 1000
Review/End Test
Pause
Flag
Options
Back
Next

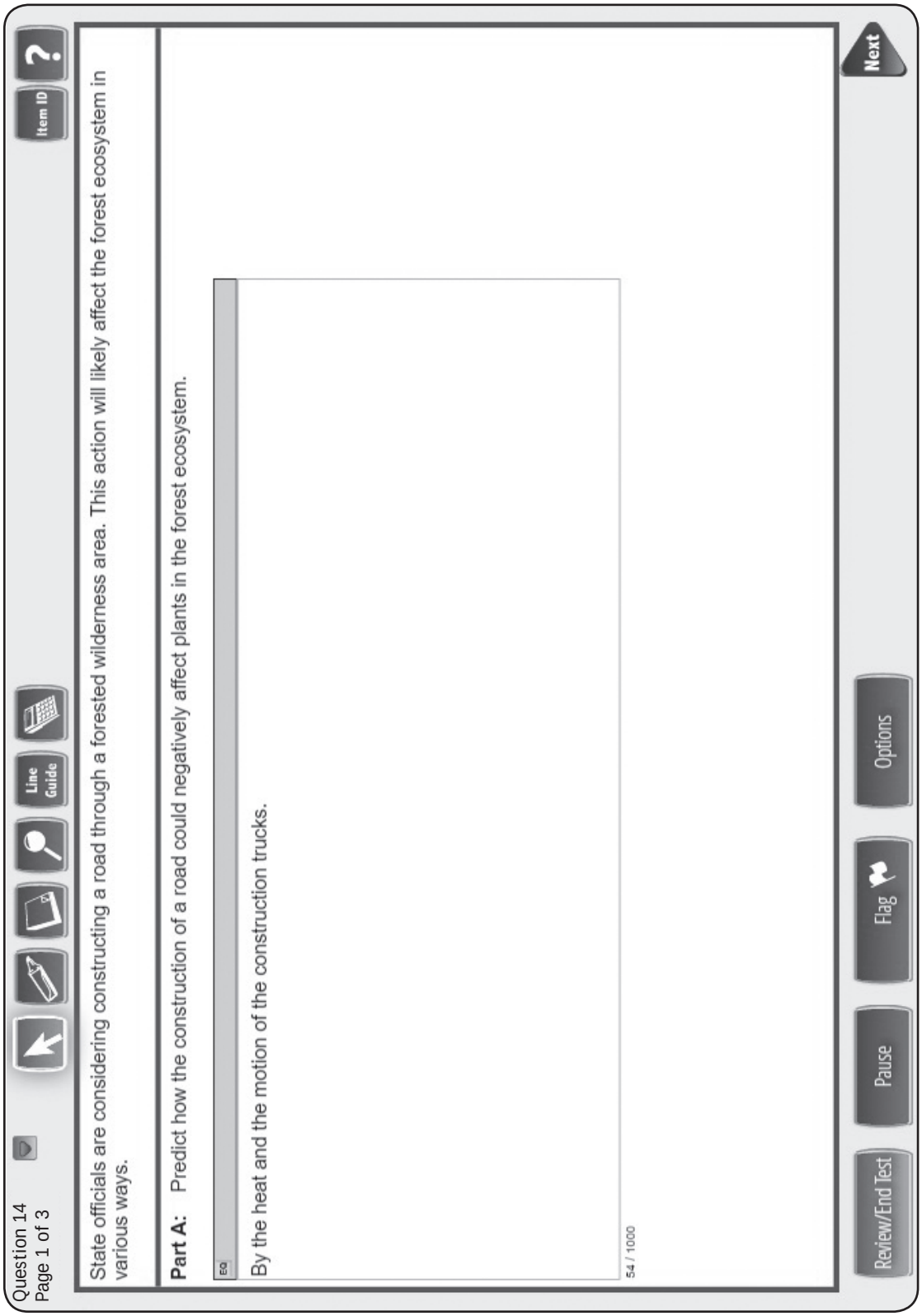


The response demonstrates a *minimal* understanding of how ecosystems change in response to natural and human disturbances by fulfilling **one** of the tasks presented in the item. The response (*"the engines would give off carbon monoxide . . . not very good for the envrionment"*) does not clearly predict how construction could negatively affect plants in the forest ecosystem and earns no credit, but the response does correctly predict how the construction of a road could negatively affect animals in the forest ecosystem (*"carbon manoxide would kill of the animals . . . knock down trees, then the animals would have no place to stay"*) and earns credit. The description (*"it would give the ecosystem a source of energy"*) is not complete enough to describe a positive effect on the forest ecosystem for credit. The response contains work that is incomplete or unclear.

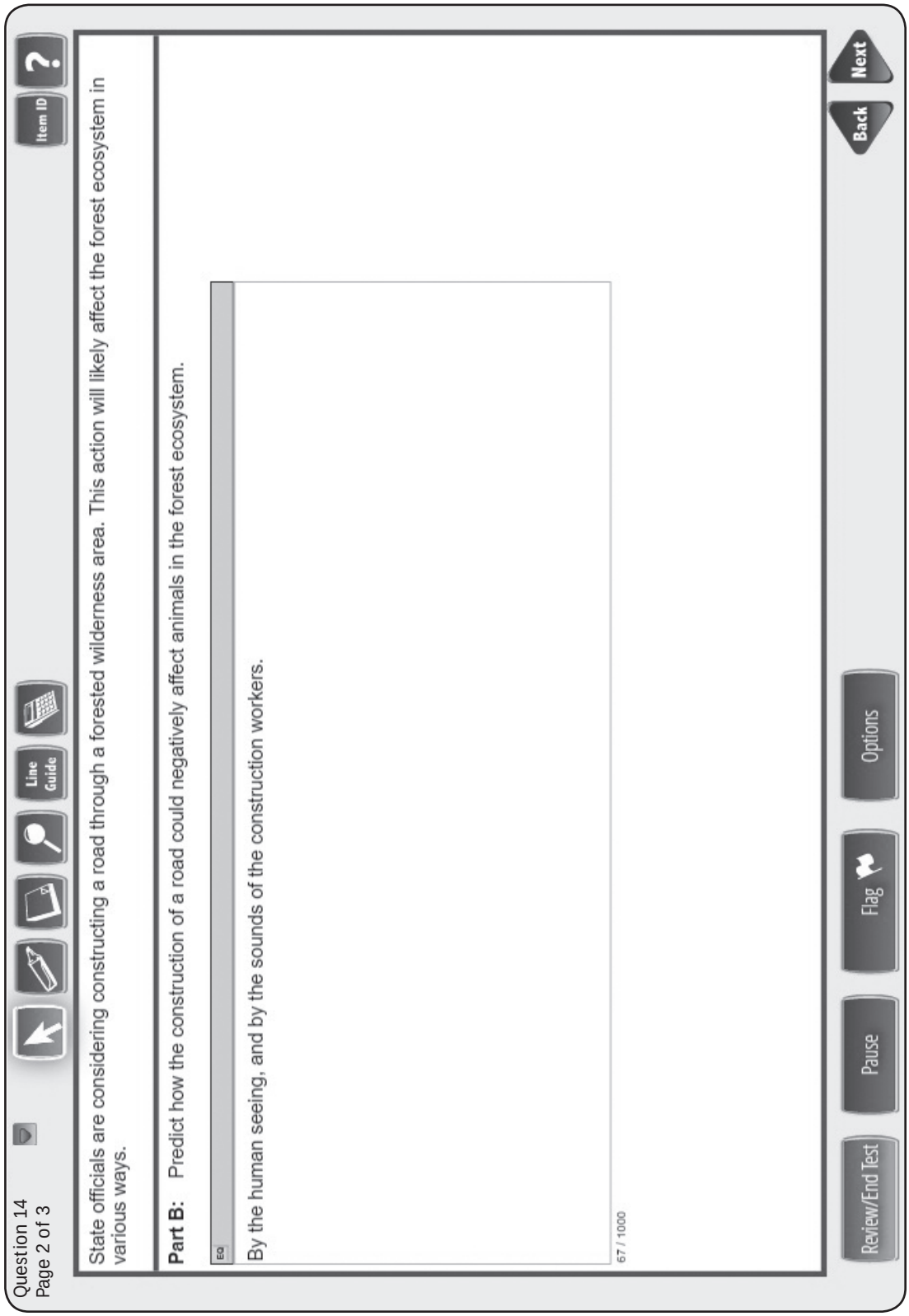
STUDENT RESPONSE

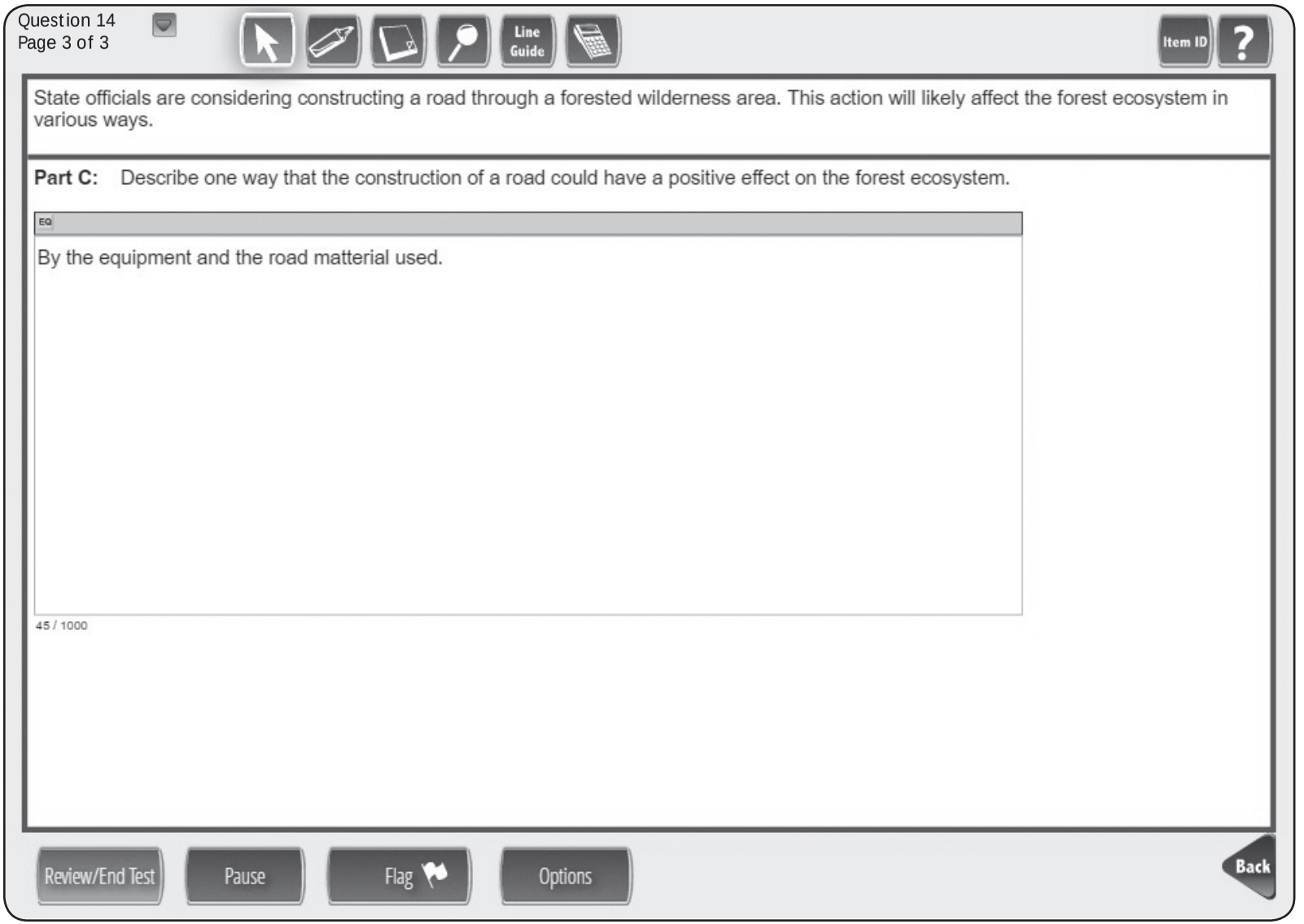
RESPONSE SCORE: 0 POINTS

PART A



PART B


Question 14
Page 2 of 3
Line Guide
Item ID
State officials are considering constructing a road through a forested wilderness area. This action will likely affect the forest ecosystem in various ways.
Part B: Predict how the construction of a road could negatively affect animals in the forest ecosystem.
EQ
By the human seeing, and by the sounds of the construction workers.
67 / 1000
Review/End Test
Pause
Flag
Options
Back
Next



The response provides *insufficient* evidence to demonstrate any understanding of how ecosystems change in response to natural and human disturbances. The response (*"by the heat and the motion of the construction trucks"*) does not clearly predict how construction could negatively affect plants in the forest ecosystem and earns no credit; also the response does not clearly predict how construction of a road could negatively affect animals in the forest ecosystem (*"human seeing, and by the sounds of the construction workers"*). The description (*"by the equipment and the road matterial used"*) is not complete enough to describe a positive effect on the forest ecosystem for credit.

CONSTRUCTED-RESPONSE ITEM

15. New technologies can extract certain oils from plants to make renewable biodiesel fuel. Scientists have altered the genome of a species of plant to increase the amount of this oil that each plant produces. To do this, scientists activated a gene that directs cells to store plant oils. To further increase the amount of plant oil produced, scientists are planning to duplicate the gene that codes for oil production.

Part A: Describe how the altering of the plant's genome by the scientists is similar to naturally occurring genetic mutations.

Part B: Explain how this process could impact agriculture in the United States.

Go to the next page to finish question 15.

15. ***Continued.*** Please refer to the previous page for task explanation.

Part C: Explain how altering the genome of a species has impacted the field of medicine.

SCORING GUIDE

#15 ITEM INFORMATION

Alignment	BIO.B.2.4.1	**Depth of Knowledge**	3	**Mean Score**	1.26

ITEM-SPECIFIC SCORING GUIDELINE

Score	Description
3	The response demonstrates a *thorough* understanding of how genetic engineering has impacted the fields of medicine, forensics, and agriculture by completing all **three** of the following tasks: • describing how the altering of the plant's genome by the scientists is similar to naturally occurring genetic mutations **AND** • explaining how this process could impact agriculture in the United States **AND** • explaining how altering the genome of a species could impact the field of medicine The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of how genetic engineering has impacted the fields of medicine, forensics, and agriculture by completing **two** of the following tasks: • describing how the altering of the plant's genome by the scientists is similar to naturally occurring genetic mutations **OR** • explaining how this process could impact agriculture in the United States **OR** • explaining how altering the genome of a species could impact the field of medicine The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of how genetic engineering has impacted the fields of medicine, forensics, and agriculture by completing **one** of the following tasks: • describing how the altering of the plant's genome by the scientists is similar to naturally occurring genetic mutations **OR** • explaining how this process could impact agriculture in the United States **OR** • explaining how altering the genome of a species could impact the field of medicine The response may contain some work that is incomplete or unclear.
0	The response provides *insufficient* evidence to demonstrate any understanding of the concept being tested.
Non-scorables	B – No response written or refusal to respond F – Foreign language K – Off task U – Unreadable

Note: No deductions should be taken for misspelled words or grammatical errors.

Responses that will receive credit:

Part A (1 point):

- The naturally occurring mutation could cause a similar effect as the scientific duplicating of a gene.
- The scientists' plan to alter the plant's gene uses a naturally occurring type of mutation.

Part B (1 point):

- This process could impact agriculture by reducing the demand for fossil fuels. Currently, fossil fuels are used extensively in agriculture, but if plants produce oil on a large scale, then the agricultural industry becomes more sustainable in terms of its fuel use.
- This process could impact agriculture in the United States by improving agricultural profits by giving farmers an additional way to earn revenue: from the plant oils, and from the food products being grown.
- This process could impact agriculture by increasing the amount of land devoted to agriculture in order to produce more of this plant-based oil.
- Or any other scientifically sound impact to agriculture

Part C (1 point):

- It allows for more treatment options for genetic disorders using techniques like gene therapy.
- Altering the genome of a species has impacted the field of medicine by giving scientists and researchers the additional experience and expertise in genetics that might allow for continued medical therapies for genetic disorders in humans or animals.
- Being able to modify the genetic code of an embryo to prevent the development of genetically inherited conditions.
- Or any other scientifically sound impact on the field of medicine

STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS

15. New technologies can extract certain oils from plants to make renewable biodiesel fuel. Scientists have altered the genome of a species of plant to increase the amount of this oil that each plant produces. To do this, scientists activated a gene that directs cells to store plant oils. To further increase the amount of plant oil produced, scientists are planning to duplicate the gene that codes for oil production.

Part A: Describe how the altering of the plant's genome by the scientists is similar to naturally occurring genetic mutations.

Naturally occuring genetic mutations will alter the plant's performance exactly like artificially modifying its genome, but it is entirely random and could take a very long time to get the right trait. Artificial modification is quick and not too difficult.

Part B: Explain how this process could impact agriculture in the United States.

The mass planting of biodiesel fuel plants could cause the agriculture industry to explode and farmers could make money, but other plants may suffer when they begin recieving less attention. That is, tomatos could be improperly taken care of and all of a sudden the population and quality of the vegetable will drop.

Go to the next page to finish question 15.

15. ***Continued.*** Please refer to the previous page for task explanation.

Part C: Explain how altering the genome of a species has impacted the field of medicine.

Genome altering has allowed us to produce more life-saving plants used in medicines and in the future may be able to make things immune to certain diseases.

The response demonstrates a *thorough* understanding of how genetic engineering has impacted the fields of medicine, forensics, and agriculture by completing all **three** tasks. The response correctly describes how the altering of the plant's genome by the scientists is similar to naturally occurring genetic mutations (*"Naturally occuring genetic mutations will alter the plant's performance exactly like artificially modifying its genome"*) and correctly explains how this process could impact agriculture in the United States (*"cause the agriculture industry to explode and farmers could make money"*). The response also correctly explains how altering the genome of a species could impact the field of medicine (*"genome altering has allowed us to produce more life-saving plants used in medicines"*). The response is clear, complete, and correct.

STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS

15. New technologies can extract certain oils from plants to make renewable biodiesel fuel. Scientists have altered the genome of a species of plant to increase the amount of this oil that each plant produces. To do this, scientists activated a gene that directs cells to store plant oils. To further increase the amount of plant oil produced, scientists are planning to duplicate the gene that codes for oil production.

Part A: Describe how the altering of the plant's genome by the scientists is similar to naturally occurring genetic mutations.

The plant could have experienced this alteration in its natural environment from some sort of drastic change.

Part B: Explain how this process could impact agriculture in the United States.

This could produce more farming jobs and let us not have to buy our oil from Iraq.

Go to the next page to finish question 15.

15. ***Continued.*** Please refer to the previous page for task explanation.

Part C: Explain how altering the genome of a species has impacted the field of medicine.

If there is a plant that produces a specific chemical that is beneficial to the medical field, it's genes could be altered to make it produce more of that specific chemical.

The response demonstrates a *partial* understanding of how genetic engineering has impacted the fields of medicine, forensics, and agriculture by completing **two** of the tasks. The response (*"the plant could have experienced this alteration in its natural environment from some sort of drastic change"*) does not completely describe how the altering of the plant's genome by the scientists is similar to naturally occurring genetic mutations. The response correctly explains how the process could impact agriculture in the United States (*"produce more farming jobs"*) and correctly explains how altering the genome of a species could impact the field of medicine (*"plant that produces a specific chemical . . . altered to make it produce more of that specific chemical"*). The response contains some work that is incomplete or unclear.

STUDENT RESPONSE

RESPONSE SCORE: 1 POINT

15. New technologies can extract certain oils from plants to make renewable biodiesel fuel. Scientists have altered the genome of a species of plant to increase the amount of this oil that each plant produces. To do this, scientists activated a gene that directs cells to store plant oils. To further increase the amount of plant oil produced, scientists are planning to duplicate the gene that codes for oil production.

Part A: Describe how the altering of the plant's genome by the scientists is similar to naturally occurring genetic mutations.

if you alter a plant's genome your not directly altering their chromosomes it does it naturally and a genetic mutation alter's the chromosome naturally.

Part B: Explain how this process could impact agriculture in the United States.

More plants would be going for the creation of biodiesel fuel to make more money from that.

Go to the next page to finish question 15.

15. ***Continued.*** Please refer to the previous page for task explanation.

Part C: Explain how altering the genome of a species has impacted the field of medicine.

Altering the genome of a species can change it's life they could be born with brown eyes instead of the genetic codon of blue or Hazel and a downs baby could be born normal.

The response demonstrates a *minimal* understanding of how genetic engineering has impacted the fields of medicine, forensics, and agriculture by completing **one** of the tasks. The description of altering the plant's chromosomes in Part A does not correctly describe how the altering of the plant's genome by the scientists is similar to naturally occurring genetic mutations. The response (*"more plants . . . make more money from that"*) in Part B correctly explains how the process could impact agriculture in the United States, but the response in Part C (*"could be born with brown eyes instead of . . . blue or Hazel"*) does not correctly explain how altering the genome of a species could impact the field of medicine. The response contains work that is incomplete or unclear.

STUDENT RESPONSE

RESPONSE SCORE: 0 POINTS

15. New technologies can extract certain oils from plants to make renewable biodiesel fuel. Scientists have altered the genome of a species of plant to increase the amount of this oil that each plant produces. To do this, scientists activated a gene that directs cells to store plant oils. To further increase the amount of plant oil produced, scientists are planning to duplicate the gene that codes for oil production.

Part A: Describe how the altering of the plant's genome by the scientists is similar to naturally occurring genetic mutations.

It is similar because they both require a gene that will duplicate to form biodiesel fuel.

Part B: Explain how this process could impact agriculture in the United States.

it could impact farmers because their crops could die due to too much air pollution for the Biodiesel fuel.

Go to the next page to finish question 15.

15. ***Continued.*** Please refer to the previous page for task explanation.

Part C: Explain how altering the genome of a species has impacted the field of medicine.

because of how medicine is being used in our daily life. Doctors are writing more and more prescriptions.

The response provides *insufficient* evidence to demonstrate any understanding of how genetic engineering has impacted the fields of medicine, forensics, and agriculture. The response (*"they both require a gene that will duplicate to form biodiesel fuel"*) does not correctly describe how the altering of the plant's genome by the scientists is similar to naturally occurring genetic mutations. The response (*"crops could die due to too much air pollution"*) in Part B does not clearly explain how the process could impact agriculture in the United States, and the response in Part C (*"doctors are writing more and more prescriptions"*) does not completely explain how altering the genome of a species could impact the field of medicine.

BIOLOGY MODULE 2—SUMMARY DATA

MULTIPLE-CHOICE

Sample Number	Alignment	Answer Key	Depth of Knowledge	*p*-values			
				A	B	C	D
1	BIO.B.1.1.2	D	2	19%	15%	19%	46%
2	BIO.B.1.2.1	A	2	60%	12%	23%	5%
3	BIO.B.1.2.2	B	2	24%	54%	17%	5%
4	BIO.B.2.1.2	A	2	61%	18%	11%	9%
5	BIO.B.2.2.1	B	2	14%	41%	31%	14%
6	BIO.B.2.3.1	B	3	12%	47%	22%	19%
7	BIO.B.3.1.1	B	2	25%	53%	11%	11%
8	BIO.B.3.1.2	D	2	17%	12%	15%	55%
9	BIO.B.3.1.3	A	2	50%	17%	16%	17%
10	BIO.B.4.1.1	A	2	36%	27%	29%	8%
11	BIO.B.4.2.3	B	2	13%	57%	23%	6%
12	BIO.B.3.1.1	D	2	5%	8%	7%	79%
13	BIO.B.4.2.2	C	2	11%	17%	64%	8%

CONSTRUCTED-RESPONSE

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
14	BIO.B.4.2.4	3	3	1.89
15	BIO.B.2.4.1	3	3	1.26

Keystone Exams
Biology

Item and Scoring Sampler 2016