pennsylvania
DEPARTMENT OF EDUCATION

PENNSYLVANIA
KEYSTONE EXAMS

Biology

Item and Scoring Sampler

2018

Pennsylvania Department of Education Bureau of Curriculum, Assessment and Instruction—September 2018

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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 2018 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.

This Item and Scoring Sampler is available in Braille format. For more information regarding Braille, call (717)-901-2238.

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 DOK is the cognitive expectation demanded by standards, curricular activities, and assessment tasks. Webb's DOK includes four levels, from the lowest (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 and is assigned a DOK level. For additional information about DOK, 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

Item Information	
Alignment	Assigned AAEC
Answer Key	Correct Answer
Depth of Knowledge	Assigned DOK
p-value A	Percentage of students who selected option A
p-value B	Percentage of students who selected option B
p-value C	Percentage of students who selected option C
p-value D	Percentage of students who selected option D
Option Annotations	Brief answer option analysis or rationale

Example Open-Ended 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

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 document.

In addition, a module 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 as 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.

Special Categories within zero reported separately:

Blank.....Blank, entirely erased, entirely crossed out, or consists entirely of whitespace

Refusal.....Refusal to respond to the task

Off Task.....Makes no reference to the item but is not an intentional refusal

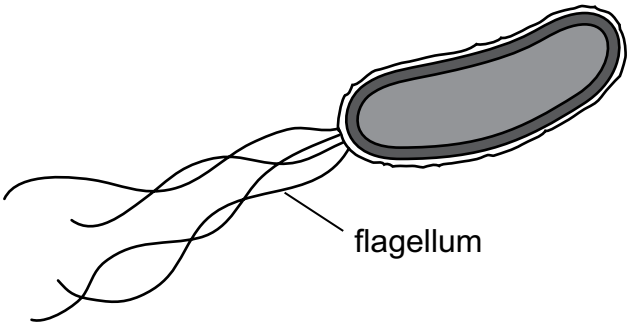
Foreign Language.....Written entirely in a language other than English

Illegible .....Illegible or incoherent

BIOLOGY MODULE 1
MULTIPLE-CHOICE QUESTIONS

1. Use the diagram below to answer the question.

Bacterial Cell



A scientist observes a single-celled organism with several long, whip-like tails. Which function do the whip-like tails **most likely** perform for the organism?

A. defense against predators

B. movement through an environment

C. detection of the location of a light source

D. measurement of atmospheric temperature changes

Item Information	
Alignment	BIO.A.1.2.2
Answer Key	B
Depth of Knowledge	2
p-value A	9%
p-value B	79% (correct answer)
p-value C	7%
p-value D	5%
Option Annotations	A. Flagella are used for movement, not for defense. B. Key: The cell uses flagella for movement. C. Flagella are not light sensitive; they are used for movement. D. Flagella are not temperature sensitive; they are used for movement.

2. Trees are typically able to transport water from their roots to their stems and leaves. Which statement describes the property of water that **most** supports the transportation of water to all parts of a tree?

A. Water forms a crystalline structure when it freezes.

B. Water dissolves fewer substances than any other liquid.

C. Water has strong attractions to itself and many other molecules.

D. Water can absorb large amounts of energy with minimal temperature changes.

Item Information	
Alignment	BIO.A.2.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	5%
p-value B	6%
p-value C	72% (correct answer)
p-value D	17%
Option Annotations	A. The crystalline structure forms when water freezes, making solid water less dense than liquid water. It does not affect the transportation of water within a tree. B. Water is considered the universal solvent because it can dissolve many substances. C. Key: The attraction allows water to adhere to the inside of tubes within the tree's tissues and move against the force of gravity to all parts of the tree. D. The high specific heat of water does not affect water's transport within the tree.

3. Which process **best** describes the assembly of proteins from amino acids?

A. Atoms are linked to form a compound.

B. Monomers are linked to form a polymer.

C. Atoms are added to a monomer until it becomes a polymer.

D. Molecules are added to a compound until it becomes a monomer.

Item Information	
Alignment	BIO.A.2.2.2
Answer Key	B
Depth of Knowledge	2
p-value A	16%
p-value B	61% (correct answer)
p-value C	13%
p-value D	10%
Option Annotations	A. Amino acids, not atoms, are complex molecules. B. Key: Amino acids are monomers linked together to form complex protein polymers. C. Adding atoms to a monomer does not make it a polymer. D. Proteins are polymers, not monomers.

4. Use the chart below to answer the question.

Biological Molecule Information

Molecule	Structure	Cellular Use
1	a molecule made mostly of carbon with two nonpolar chains and a polar head	is a component of plasma membranes
2	a polar molecule made of repeating units of sugar bonded to a phosphate and a nitrogenous base	stores genetic information

Which biological molecules are **most likely** represented by molecules 1 and 2?

A. molecule 1: lipid
molecule 2: nucleic acid

B. molecule 1: lipid
molecule 2: protein

C. molecule 1: carbohydrate
molecule 2: nucleic acid

D. molecule 1: carbohydrate
molecule 2: protein

Item Information	
Alignment	BIO.A.2.2.3
Answer Key	A
Depth of Knowledge	2
p-value A	48% (correct answer)
p-value B	17%
p-value C	23%
p-value D	12%
Option Annotations	A. Key: Lipids are key components of the plasma membrane, and a nucleic acid is characterized by its ability to store genetic information. B. Molecule 2 is not a protein because proteins are composed of amino acids. C. Membrane lipids, not carbohydrates, have polar and nonpolar ends. D. Molecule 1 is not a carbohydrate because carbohydrates are polar, and molecule 2 is not a protein because proteins are composed of amino acids.

5. Which statement **best** describes a relationship between enzymes and a simple biological reaction?

A. Enzymes will increase the amount of substrate formed during a biological reaction.

B. Enzymes will decrease the amount of substrate formed during a biological reaction.

C. A reaction rate can be increased when the specific enzyme for a biological reaction is present.

D. A reaction rate can be decreased when multiple enzymes for a biological reaction are present.

Item Information	
Alignment	BIO.A.2.3.1
Answer Key	C
Depth of Knowledge	2
p-value A	19%
p-value B	8%
p-value C	65% (correct answer)
p-value D	8%
Option Annotations	A. Substrate is not the product formed during a biological reaction. B. Substrate is not the product formed during a biological reaction. C. Key: An enzyme decreases the activation energy of a specific biological reaction, increasing the rate of reaction. D. Enzymes increase reaction rates rather than decrease them.

6. Microbes in the digestive system break down food, which allows nutrients to be absorbed by the body's cells. How will these body cells **most likely** be affected if an individual suffers from a high fever?

A. The body cells will swell because an increase in temperature promotes greater water absorption.

B. The body cells will stop absorbing nutrients because the heat melts the lipid bilayer of the plasma membrane.

C. The body cells will shrivel because the heat eliminates the chemical gradients on either side of the plasma membrane.

D. The body cells will bring in fewer nutrient molecules because the transport proteins lose their proper shape due to the high temperature.

Item Information	
Alignment	BIO.A.2.3.2
Answer Key	D
Depth of Knowledge	2
p-value A	20%
p-value B	11%
p-value C	13%
p-value D	56% (correct answer)
Option Annotations	A. A change in body temperature would not increase the amount of water that cells absorb. B. A fever would not increase body temperature enough to melt lipid bilayers. C. A change in body temperature would not change the chemical gradient across the plasma membrane. D. Key: High temperatures can cause proteins to denature and change shape.

7. Use the chart below to answer the question.

Student Classification of Main Energy Conversions

Student	Photosynthesis	Cellular Respiration
1	mechanical to thermal	solar to thermal
2	solar to mechanical	chemical to mechanical
3	thermal to solar	chemical to solar
4	solar to chemical	chemical to chemical

Four students classified the main energy conversions that occur during photosynthesis and cellular respiration. Which student **best** classified the energy conversions that occur in the two processes?

A. student 1

B. student 2

C. student 3

D. student 4

Item Information	
Alignment	BIO.A.3.2.1
Answer Key	D
Depth of Knowledge	2
p-value A	8%
p-value B	14%
p-value C	12%
p-value D	66% (correct answer)
Option Annotations	A. Photosynthesis converts solar energy to chemical energy, and cellular respiration converts one form of chemical energy to another form of chemical energy. B. Photosynthesis converts solar energy to chemical energy, and cellular respiration converts one form of chemical energy to another form of chemical energy. C. Photosynthesis converts solar energy to chemical energy, and cellular respiration converts one form of chemical energy to another form of chemical energy. D. Key: Photosynthesis converts solar energy to chemical energy, and cellular respiration converts one form of chemical energy to another form of chemical energy.

8. A scientist observed that during the course of a chemical reaction the number of ATP molecules was reduced. What did the scientist **most likely** learn from the observation?

A. The reaction produced water.

B. The reaction consumed water.

C. The reaction caused an output of energy.

D. The reaction required an input of energy.

Item Information	
Alignment	BIO.A.3.2.2
Answer Key	D
Depth of Knowledge	2
p-value A	7%
p-value B	10%
p-value C	39%
p-value D	44% (correct answer)
Option Annotations	A. The formation of ATP produces water. B. Many processes within a cell can release or consume water. C. Reactions that result in fewer ATP consume energy. D. Key: ATP is the energy currency of the cell and is used to fuel reactions.

9. Which of the following is **most** involved in providing structure for a plasma membrane?

A. the number of protein channels embedded in the membrane

B. the types of carbohydrates attached to proteins on the surface

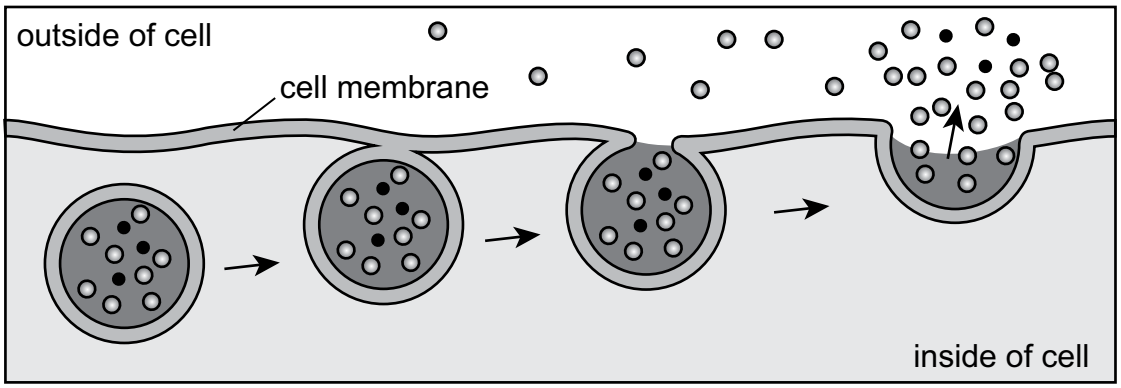
C. the types of proteins that are attached to the surface of the membrane

D. the arrangement of the hydrophobic and hydrophilic ends of the phospholipids

Item Information	
Alignment	BIO.A.4.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	18%
p-value B	13%
p-value C	24%
p-value D	45% (correct answer)
Option Annotations	A. Channel proteins allow molecules to diffuse into and out of the cell. B. Carbohydrates define a cell's characteristics and help it to identify chemical signals. C. The types of proteins embedded in the plasma membrane define which substances can enter and leave the cell. D. Key: The arrangement of the phospholipids makes the membrane thin and flexible and limits the substances that can pass into and out of the cell.

10. Use the diagram below to answer the question.

Cell Process



Which cell process is **best** modeled by the diagram?

A. osmosis

B. exocytosis

C. passive transport

D. facilitated diffusion

Item Information	
Alignment	BIO.A.4.1.2
Answer Key	B
Depth of Knowledge	2
p-value A	8%
p-value B	49% (correct answer)
p-value C	26%
p-value D	17%
Option Annotations	A. Osmosis is the movement of water across a cell membrane. B. Key: During exocytosis, a vacuole fuses with the cell membrane, releasing its contents outside of a cell. C. Passive transport is the movement of materials down a concentration gradient. D. Facilitated diffusion is the passive transport of materials across a cell membrane through channel proteins.

11. The shivering mechanism in bumblebees often serves the same purpose as it does in mammals. During which condition will the action of shivering **most** help a bumblebee to maintain homeostasis?

A. decrease in available oxygen

B. low environmental temperature

C. uncontrolled rise in core temperature

D. depletion of oxygen in muscle tissues

Item Information	
Alignment	BIO.A.4.2.1
Answer Key	B
Depth of Knowledge	2
p-value A	6%
p-value B	73% (correct answer)
p-value C	12%
p-value D	9%
Option Annotations	A. Shivering helps to return the body to an optimal temperature. It does not increase oxygen levels. B. Key: Shivering helps to return the body to an optimal temperature. C. Shivering helps to increase body temperature to an optimal range. It does not decrease body temperature. D. Shivering helps to return the body to an optimal temperature. It does not affect oxygen levels in tissues.

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

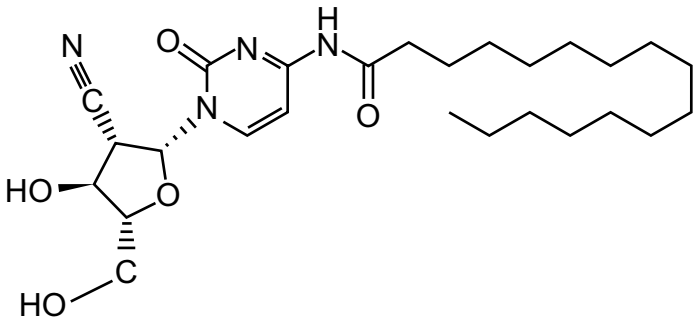
A New Type of Treatment

Some human diseases involve the unregulated growth of cells. Although some patients are not affected by these growths, many are harmed. Cells in harmful growths divide uncontrollably and can eventually invade other cells, tissues, and organs of the body.

Some patients carry a mutation on one or more growth-suppressor genes (GSGs). GSGs help to repair damage to DNA. This mutation decreases the individual's ability to fight these harmful growths. Recently, researchers reported on the results of using a combination of two types of medicine to treat patients with unregulated growths caused by a lack of functioning GSGs.

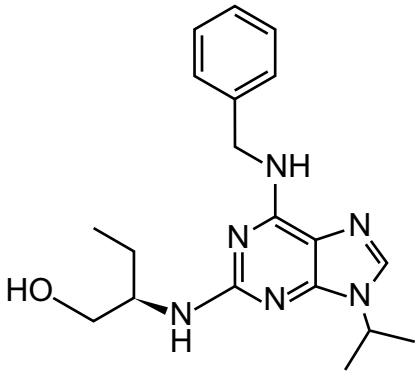
Characteristics of Medicine X

- large molecule
- damages DNA



Characteristics of Medicine Y

- large molecule
- decreases enzyme activity



When medicine X and medicine Y are used together, they cause the cell processes in the targeted cells to fail.

12. In order for medicine X to produce the effects that the researchers observed, it must have entered into which part of the targeted cells?

A. nucleus

B. ribosomes

C. Golgi apparatus

D. rough endoplasmic reticulum

Item Information	
Alignment	BIO.A.1.2.1
Answer Key	A
Depth of Knowledge	2
p-value A	73% (correct answer)
p-value B	11%
p-value C	10%
p-value D	6%
Option Annotations	A. Key: A medicine that damages DNA would need to enter a cell's nucleus. B. Medicine Y might enter ribosomes since it affects enzyme activity. C. The Golgi apparatus packages proteins; it does not interact with DNA. D. Medicine Y might enter the rough endoplasmic reticulum since the rough endoplasmic reticulum houses enzyme-manufacturing ribosomes.

13. Given the properties of the medicine Y molecule, which mechanism is **most likely** responsible for medicine Y's entry into cells?

A. osmosis

B. exocytosis

C. active transport

D. simple diffusion

Item Information	
Alignment	BIO.A.4.1.2
Answer Key	C
Depth of Knowledge	2
p-value A	11%
p-value B	11%
p-value C	60% (correct answer)
p-value D	18%
Option Annotations	A. Osmosis is the movement of water across a cell membrane. B. Exocytosis moves materials out of a cell. C. Key: The movement of large molecules, like medicine Y, into a cell requires energy and is therefore active transport. D. Simple diffusion is the flow of small molecules across a cell membrane.

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CONSTRUCTED-RESPONSE ITEM

14. Use the list below to answer the question.

Cell Structures

- plasma membrane
- endoplasmic reticulum
- Golgi apparatus
- mitochondria
- nucleus
- ribosomes

A scientist identifies several structures in a cell and organizes them in a list.

Part A: Describe how the cell structures in this list can be used to classify the cell as either prokaryotic or eukaryotic. Use examples of the structures that would help identify the cell in your answer.

Go to the next page to finish question 14.

GO ON

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

Part B: Compare how **both** prokaryotes and eukaryotes use two of the cell structures listed and describe the common functions of these structures.

Structure 1: _____

Common function: _____

_____

_____

_____

_____

Structure 2: _____

Common function: _____

_____

_____

_____

_____

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

SCORING GUIDE

#14 Item Information

Alignment	BIO.A.1.2.1	**Depth of Knowledge**	3	**Mean Score**	1.12

Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a *thorough* understanding of comparing and contrasting cellular structures and their functions in prokaryotic and eukaryotic cells by • Describing how the list of cell structures can be used to classify a cell as prokaryotic or eukaryotic and providing example(s) of structures that allowed that classification • Identifying two of the cell structures found in both prokaryotic and eukaryotic cells and describing the function of each common to both cell types. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of comparing and contrasting cellular structures and their functions in prokaryotic and eukaryotic cells by • Using the list of structures in a cell to classify whether the cell is prokaryotic or eukaryotic and providing example(s) of structures that allowed that classification **and** identifying one cell structure found in both prokaryotic and eukaryotic cells and describing the function **OR** • Identifying two of the cell structures found in both prokaryotic and eukaryotic cells **and** describing the function of each common to both cell types. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of comparing and contrasting cellular structures and their functions in prokaryotic and eukaryotic cells by • Using the list of structures in a cell to classify whether the cell is prokaryotic or eukaryotic and providing example(s) of structures that allowed that classification **OR** • Identifying one of the cell structures found in both prokaryotic and eukaryotic cells and describing its function common to both cell types. 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 cell is eukaryotic because it has a nucleus
  OR
- The cell is eukaryotic because it has mitochondria
  OR
- The cell is eukaryotic because it has Golgi apparatus
  OR
- The cell is eukaryotic because it has endoplasmic reticulum

Part B (2 points; 1 point each response):

- Plasma membrane – controls what moves in and out of the cell **or** provides a barrier around the cell **or** gives structural support to the cell
  AND
- Ribosomes – synthesize proteins **or** perform translation

Background Information:

- For Part A, it should be apparent that the student understands that prokaryotic cells do not have a nucleus or any of the membrane-bound organelles, so this must be a eukaryotic cell.
- For Part B, a student will not receive a point for identifying both structures without any description of function.

STUDENT RESPONSE

Response Score: 3 points

14. Use the list below to answer the question.

Cell Structures

- plasma membrane
- endoplasmic reticulum
- Golgi apparatus
- mitochondria
- nucleus
- ribosomes

A scientist identifies several structures in a cell and organizes them in a list.

Part A: Describe how the cell structures in this list can be used to classify the cell as either prokaryotic or eukaryotic. Use examples of the structures that would help identify the cell in your answer.

The cell structures would be used to identify the cell as prokaryotic or eukaryotic by the different cell structures present. Prokaryotic cells have no nucleus or mitochondria, but eukaryotes do.

Go to the next page to finish question 14.

GO ON

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

Part B: Compare how **both** prokaryotes and eukaryotes use two of the cell structures listed and describe the common functions of these structures.

Structure 1: Plasma membrane

Common function: Both prokaryotes and eukaryotes use the plasma membrane to seperate themselves from their environment and help maintain homeostasis.

Structure 2: ribosomes

Common function: Both prokaryotes and eukaryotes use ribosomes to aid in protien manufacturing.

The response demonstrates a thorough understanding of comparing and contrasting cellular structures and their functions in prokaryotic and eukaryotic cells. In Part A, the response describes how the list of cell structures can be used to classify a cell as prokaryotic or eukaryotic and provides examples of structures that allowed that classification (*"Prokaryotic cells have no nucleus or mitochondria, but eukaryotes do"*). In Part B, the response identifies two of the cell structures found in both prokaryotic and eukaryotic cells and describes the function of each (*"Plasma membrane. . . Both prokaryotes and eukaryotes use the plasma membrane to sepertate themselves from their environment and help maintain homeostasis; ribosomes . . . Both prokaryotes and eukaryotes use ribosomes to aid in protien manufacturing"*). The response is clear, complete, and correct.

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

STUDENT RESPONSE

Response Score: 2 points

14. Use the list below to answer the question.

Cell Structures

- plasma membrane
- endoplasmic reticulum
- Golgi apparatus
- mitochondria
- nucleus
- ribosomes

A scientist identifies several structures in a cell and organizes them in a list.

Part A: Describe how the cell structures in this list can be used to classify the cell as either prokaryotic or eukaryotic. Use examples of the structures that would help identify the cell in your answer.

The cell would be classified as eukaryotic since one of the structures is a nucleus. Only eukaryotic cells have this structure.

Go to the next page to finish question 14.

GO ON

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

Part B: Compare how **both** prokaryotes and eukaryotes use two of the cell structures listed and describe the common functions of these structures.

Structure 1: nucleus

Common function: contains DNA for cell reproduction

Structure 2: ribosomes

Common function: make proteins

The response demonstrates a partial understanding of comparing and contrasting cellular structures and their functions in prokaryotic and eukaryotic cells. In Part A, the response describes how the list of cell structures can be used to classify a cell as prokaryotic or eukaryotic and provides an example of a structure that allowed that classification (*"The cell would be classified as eukaryotic since one of the structures is a nucleus. Only eukaryotic cells have this structure"*). In Part B, the response identifies only one cell structure found in both prokaryotic and eukaryotic cells (*"ribosomes"*) and describes its function common to both cell types (*"make proteins"*). The other structure identified (*"nucleus"*) is not found in prokaryotic cells.

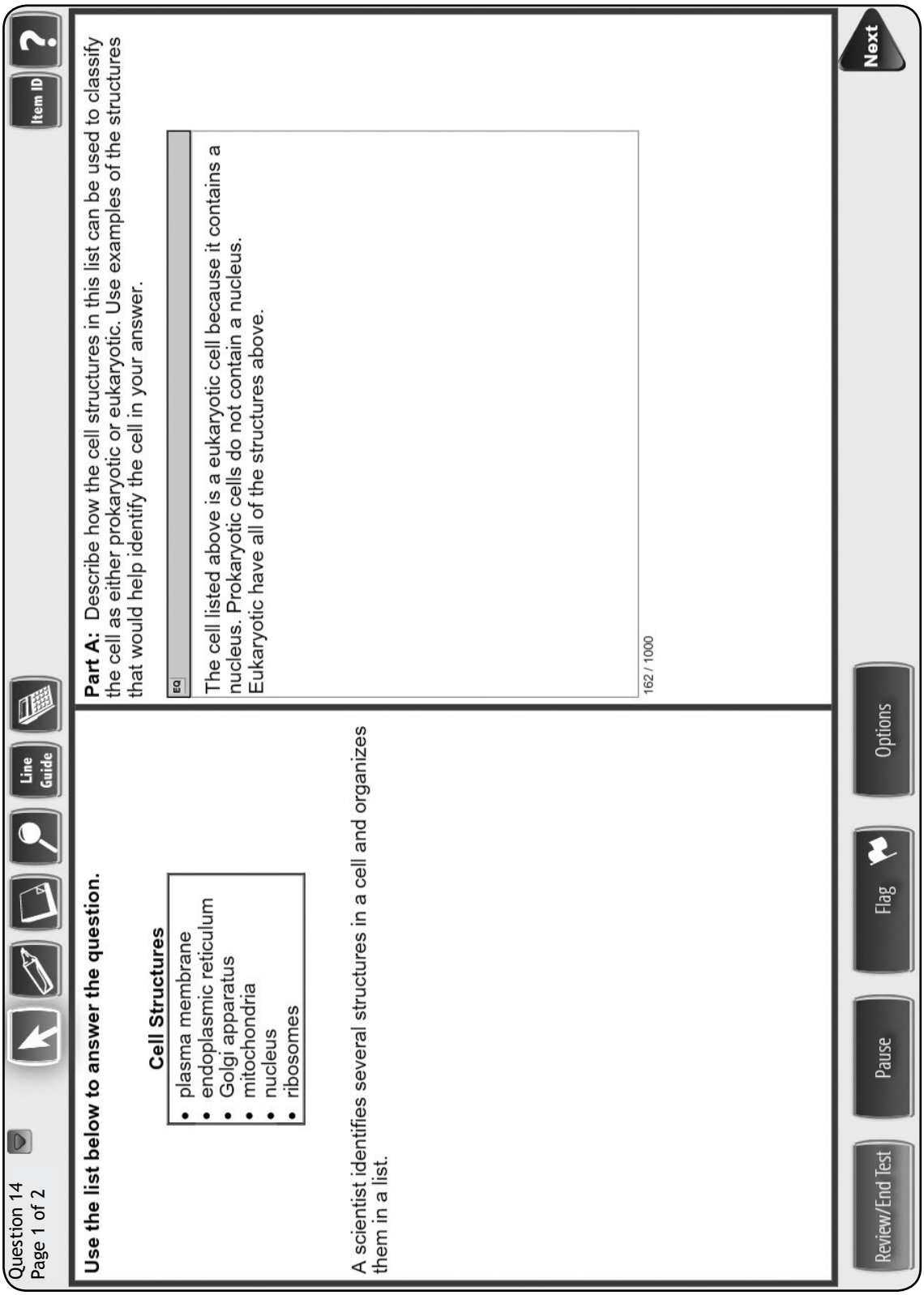
AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

STUDENT RESPONSE

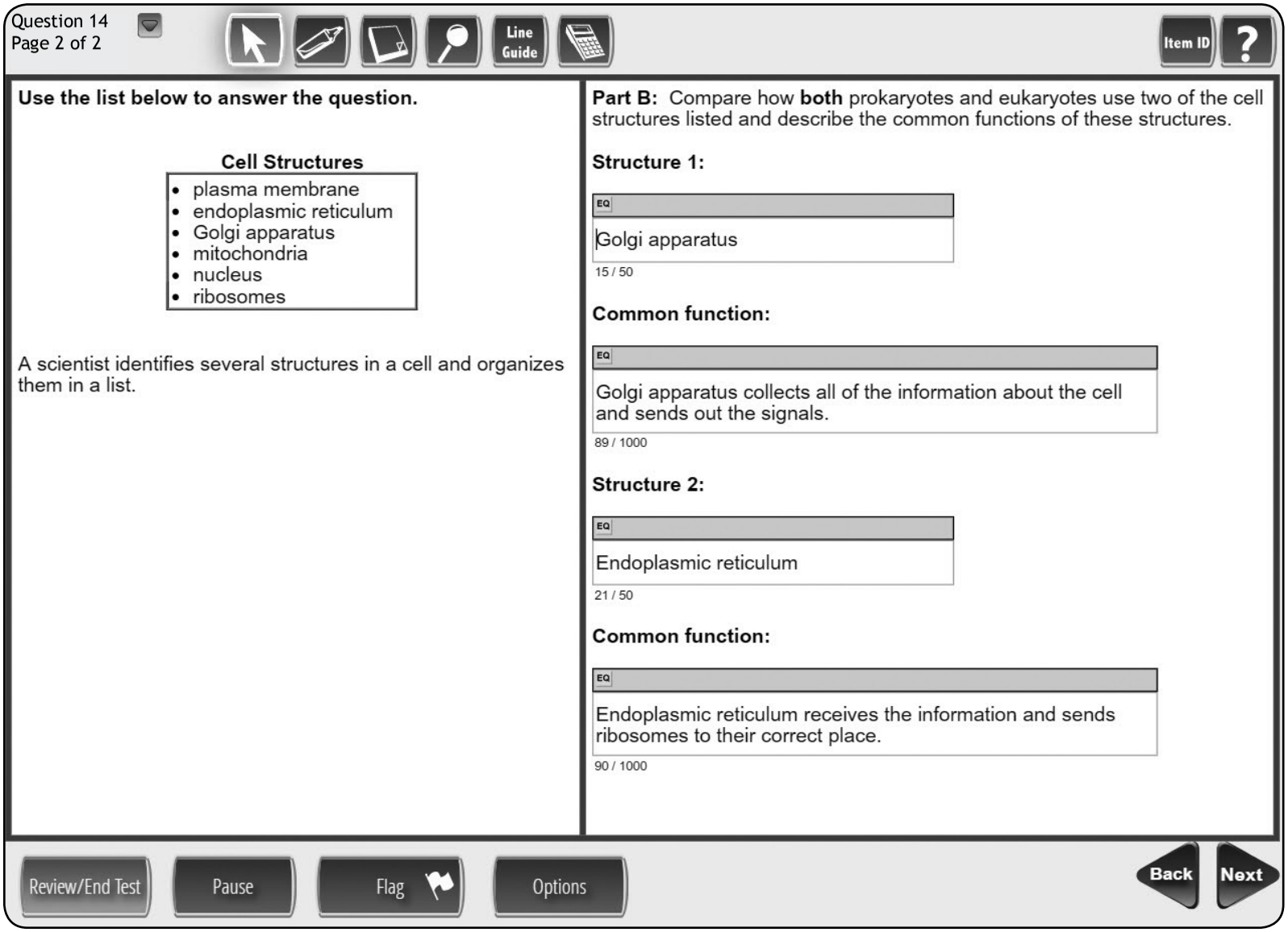
Response Score: 1 point

Part A



STUDENT RESPONSE

Part B

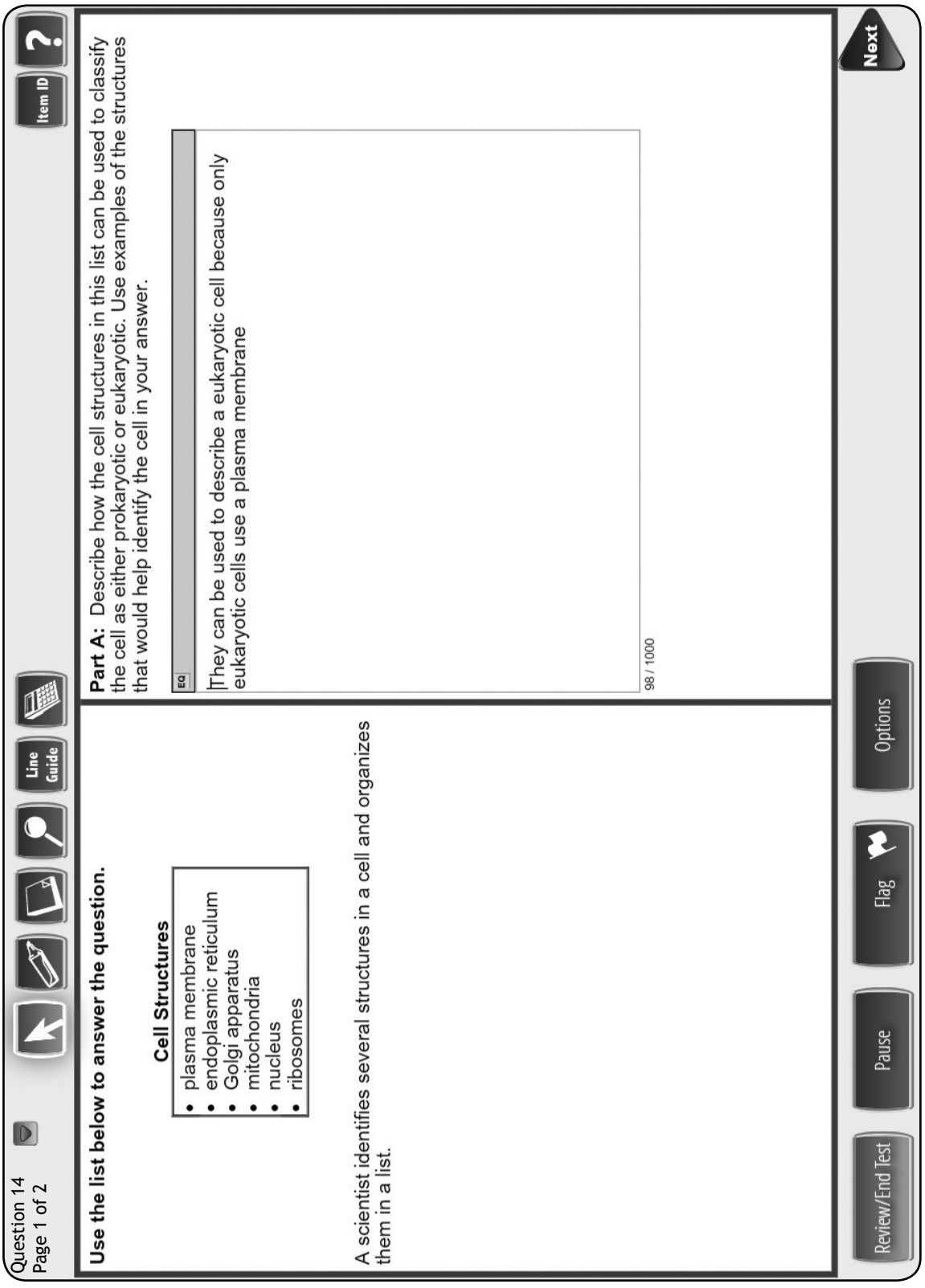


The response demonstrates a minimal understanding of comparing and contrasting cellular structures and their functions in prokaryotic and eukaryotic cells. In Part A, the response describes how the list of cell structures can be used to classify a cell as prokaryotic or eukaryotic and provides an example of a structure that allowed that classification (*"The cell listed above is a eukaryotic cell because it contains a nucleus. Prokaryotic cells do not contain a nucleus"*). In Part B, both structures identified are incorrect (*"Golgi apparatus and Endoplasmic reticulum"*) as these structures are found in eukaryotic cells only.

STUDENT RESPONSE

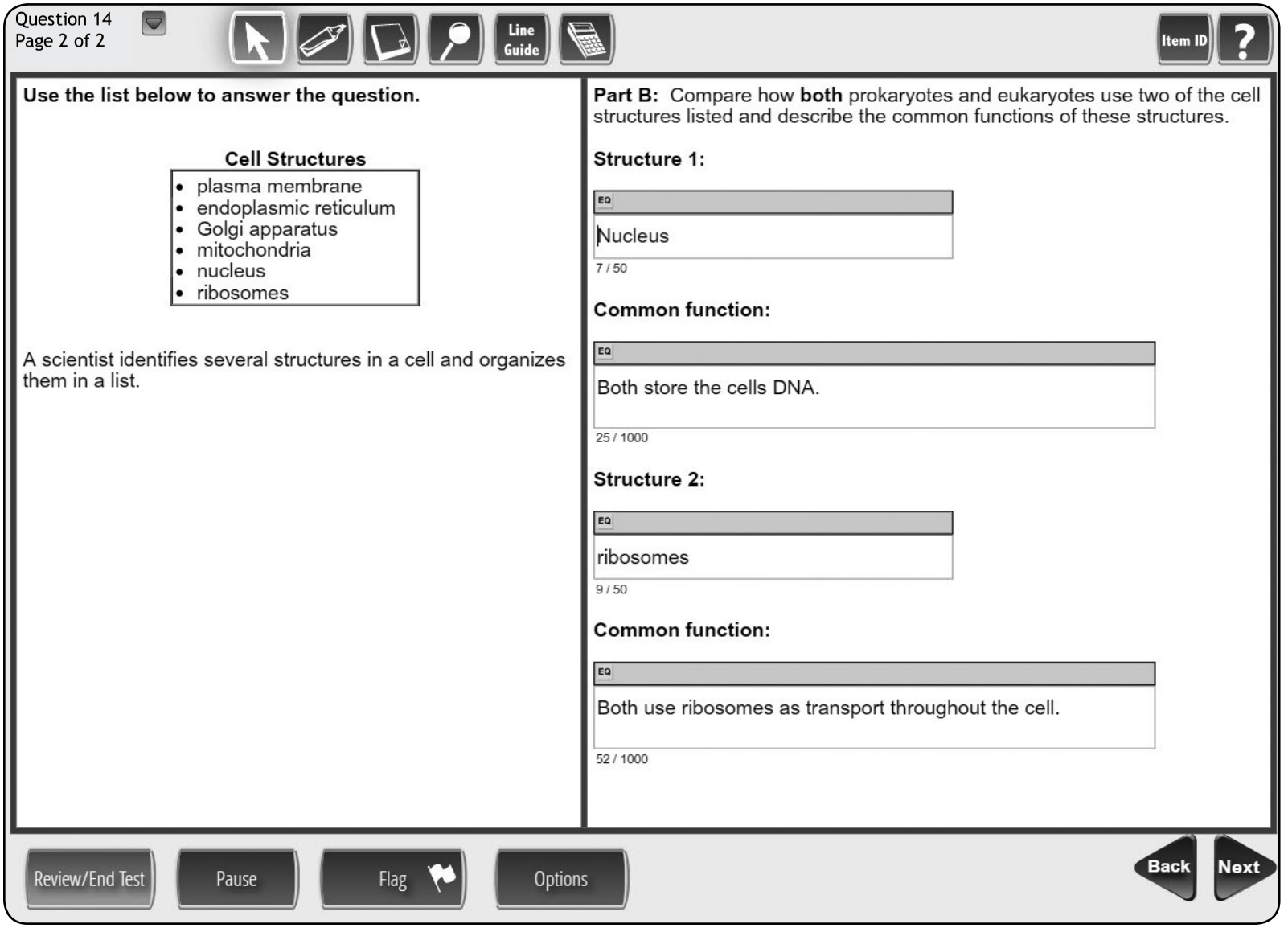
Response Score: 0 points

Part A



STUDENT RESPONSE

Part B



The response provides insufficient evidence to demonstrate any understanding of the concept being tested. In Part A, the response incorrectly describes how the cell structures in the list can be used to classify a cell as either prokaryotic or eukaryotic (*"They can be used to describe a eukaryotic cell because only eukaryotic cells use a plasma membrane"*). In Part B, the first structure identified (*"nucleus"*) is not found in both eukaryotic and prokaryotic cells. While the second structure identified (*"ribosomes"*) is found in both prokaryotic and eukaryotic cells, the common function (*"Both use ribosomes as transport throughout the cell"*) is incorrect.

CONSTRUCTED-RESPONSE ITEM

15. During physical education class, some students ran one mile. After their run, the students recorded changes they experienced.

Changes Experienced

- sweating
- muscle cramps
- decreased energy
- increased heart rate
- increased breathing rate
- increased thirst
- increased body temperature

Select three changes experienced by the students and explain how each change can represent a homeostatic mechanism.

Change 1: _____

Go to the next page to finish question 15.

GO ON

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

Change 2: _____

Change 3: _____

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

SCORING GUIDE

#15 Item Information

Alignment	BIO.A.4.2.1	**Depth of Knowledge**	3	**Mean Score**	0.96

Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a *thorough* understanding of how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation) by explaining how three changes experienced by the students represent homeostatic mechanisms. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation) by explaining how two changes experienced by the students represent homeostatic mechanisms. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation) by explaining how one change experienced by the students represents a homeostatic mechanism. 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 (1 point each):

- Sweating is a response to increased temperature. The evaporation of sweat cools the body (lowers the temperature).
- Muscle cramps are a response to depleted electrolytes, dehydration, depletion of ATP, or build-up of lactic acid. The cramps will cause the person to slow down or stop, thus reducing the depletion of electrolytes, water, and ATP.
- Decreased energy is a response to insufficient oxygenation of tissues, or depletion of fuel (glucose) or water. Fatigue will cause the person to slow down or stop, allowing time for the body to stabilize.
- Increased heart rate is a response to the tissues (especially muscles) needing more oxygen. The heart pumps faster in order to supply the muscles with oxygen faster. (This also helps the body get rid of carbon dioxide more quickly.)
- Increased breathing rate is a response to the need for more oxygen and the need to rid the body of carbon dioxide. The faster breathing rate will help supply oxygen to muscles more quickly and also eliminate carbon dioxide more quickly.
- Increased thirst is a response to dehydration caused by sweating and increased breathing rate. Thirst will cause the person to seek water to drink to achieve homeostasis.
- Increased temperature is caused when some of the energy that powers muscles is lost as heat. The rise in temperature stimulates sweating, which helps cool the body and bring the temperature back to normal. Increased temperature also contributes to increased heart rate and breathing rate. “Feeling hot” may cause a person to seek shade or air conditioning, or to slow down or stop, allowing the body to achieve homeostasis.

Background information: Homeostasis is the maintenance of relatively stable internal and chemical conditions despite changes in the external environment.

STUDENT RESPONSE

Response Score: 3 points

15. During physical education class, some students ran one mile. After their run, the students recorded changes they experienced.

Changes Experienced

- sweating
- muscle cramps
- decreased energy
- increased heart rate
- increased breathing rate
- increased thirst
- increased body temperature

Select three changes experienced by the students and explain how each change can represent a homeostatic mechanism.

Change 1: Sweating can represent a homeostatic mechanism because when your body is hot it cools itself by activating the sweat glands which cool you by evaporation.

Go to the next page to finish question 15.

GO ON

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

Change 2: Increased heart rate can represent a homeostatic mechanism because when you run your muscles need more oxygen and blood so your heart pumps faster to abide to those needs.

Change 3: Increased thirst represents a homeostatic mechanism because it is caused by sweating out moisture which your body then wants to replenish causing your body to tell you to get a drink.

This response demonstrates a thorough understanding of how organisms maintain homeostasis by explaining how three of the changes experienced represent a homeostatic mechanism. The student correctly describes how sweating is a response to your body being hot, activating sweat glands to cool you by evaporation. The student states that an increased heart rate represents a homeostatic mechanism because your heart must pump faster to keep up with your muscles' need for more oxygen. Lastly, the student describes how increased thirst represents a homeostatic mechanism by signaling to your body the need to replenish fluids. This response is clear, complete, and correct.

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

STUDENT RESPONSE

Response Score: 2 points

15. During physical education class, some students ran one mile. After their run, the students recorded changes they experienced.

Changes Experienced

- sweating
- muscle cramps
- decreased energy
- increased heart rate
- increased breathing rate
- increased thirst
- increased body temperature

Select three changes experienced by the students and explain how each change can represent a homeostatic mechanism.

Change 1: Sweating, because as your body heats up you need to cool down so you start to sweat.

Go to the next page to finish question 15.

GO ON

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

Change 2: Cramps, because your muscles loosen up as you excersise and then when you stop your muscles tighten up giving you the feeling of cramps.

Change 3: decreased energy, because when you excersise your body uses all of its energy to do so, so you loose your energy and become tired until your body regains its

This response demonstrates a partial understanding of how organisms maintain homeostasis by explaining how two changes experienced represent a homeostatic mechanism. The student correctly describes how sweating represents a homeostatic mechanism. (*"As your body heats up you need to cool down so you start to sweat"*). The student also describes how decreased energy represents a homeostatic mechanism. (*"As your body heats up you need to cool down so you start to sweat"*). The response describing how muscle cramps represent a homeostatic mechanism is incomplete.

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

STUDENT RESPONSE

Response Score: 1 point

15. During physical education class, some students ran one mile. After their run, the students recorded changes they experienced.

Changes Experienced

- sweating
- muscle cramps
- decreased energy
- increased heart rate
- increased breathing rate
- increased thirst
- increased body temperature

Select three changes experienced by the students and explain how each change can represent a homeostatic mechanism.

Change 1: THE FIRST CHANGE IS WHEN YOUR BODY CHANGES FROM NOT SWEATING TO SWEATING. THIS REPRESENT A HOMEOSTATIC MECHANISM BECAUSE YOUR BODY REALIZES THAT YOUR GETTING VERY HOT, SO THEN IT CREATES SWEAT TO TRY AND COOL ITSELF OFF. SO BY SWEATING, THE SWEAT SHOULD COOL OFF YOUR BODY.

Go to the next page to finish question 15.

GO ON

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

Change 2: THE SECOND CHANGE IS DECREASED ENERGY. THIS REPRESENTS HOMEOSTATIC MECHANISM BECAUSE AFTER YOU RUN A MILE YOUR GOING TO BE TIRED. YOUR BODY HAD A HIGH AMOUNT OF ENERGY BEFORE YOU RUN, BUT WHEN YOU RUN, YOU ARE USING UP YOUR ENERGY. SO WHENEVER YOUR DONE RUNNING YOUR ENERGY HAS DECREASED MAKING YOUR ENERGY LEVEL LOW.

Change 3: THE LAST CHANGE IS INCREASED TEMPERATURE. THIS REPRESENT HOMEOSTATIC MECHANISM BECAUSE BEFORE YOU RUN YOUR BODY IS AT ITS RESTING TEMPERATURE. WHEN YOUR NOT DOING EXCESSIVE ACTIVITIES YOUR TEMPERATURE IS NORMAL. WHENER YOU BEGIN TO DO THINGS LIKE RUNNING YOUR TEMPERATURE BEGINS TO RISE BECAUSE YOU ARE USING ALOT OF ENERGY AND MAKING THE BODY WORK HARDER.

This response demonstrates a minimal understanding how organisms maintain homeostasis by describing how one change experienced represents a homeostatic mechanism. The student correctly describes how the body sweats in response to getting hot as an attempt to cool itself off. The additional changes describe why the body experiences the changes without describing how each represents a homeostatic mechanism.

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STUDENT RESPONSE

Response Score: 0 points

15. During physical education class, some students ran one mile. After their run, the students recorded changes they experienced.

Changes Experienced

- sweating
- muscle cramps
- decreased energy
- increased heart rate
- increased breathing rate
- increased thirst
- increased body temperature

Select three changes experienced by the students and explain how each change can represent a homeostatic mechanism.

Change 1: Muscle cramps are from not stretching. The muscle wants to expand but the cells don't want to yet.

Go to the next page to finish question 15.

GO ON

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

Change 2: Sweating is caused because it is making new cells.

Change 3: Increased heart rate is your heart working harder than normal.

This response provides insufficient evidence to demonstrate any understanding of the concept being tested. The student attempts to describe the changes experienced but does not explain how each represents a homeostatic mechanism.

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

BIOLOGY MODULE 1—SUMMARY DATA

MULTIPLE-CHOICE

Sample Number	Alignment	Answer Key	Depth of Knowledge	*p*-value A	*p*-value B	*p*-value C	*p*-value D
1	BIO.A.1.2.2	B	2	9%	79%	7%	5%
2	BIO.A.2.2.1	C	2	5%	6%	72%	17%
3	BIO.A.2.2.2	B	2	16%	61%	13%	10%
4	BIO.A.2.2.3	A	2	48%	17%	23%	12%
5	BIO.A.2.3.1	C	2	19%	8%	65%	8%
6	BIO.A.2.3.2	D	2	20%	11%	13%	56%
7	BIO.A.3.2.1	D	2	8%	14%	12%	66%
8	BIO.A.3.2.2	D	2	7%	10%	39%	44%
9	BIO.A.4.1.1	D	2	18%	13%	24%	45%
10	BIO.A.4.1.2	B	2	8%	49%	26%	17%
11	BIO.A.4.2.1	B	2	6%	73%	12%	9%
12 (P)	BIO.A.1.2.1	A	2	73%	11%	10%	6%
13 (P)	BIO.A.4.1.2	C	2	11%	11%	60%	18%

CONSTRUCTED-RESPONSE

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
14	BIO.A.1.2.1	3	3	1.12
15	BIO.A.4.2.1	3	3	0.96

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BIOLOGY MODULE 2
MULTIPLE-CHOICE QUESTIONS

1. At a point in the cell cycle, chromosomes have aligned near the middle of a cell. Which sequence of events will the cell need to complete to produce two identical daughter cells?

A. anaphase ⟶ telophase ⟶ cytokinesis

B. anaphase II ⟶ telophase II ⟶ cytokinesis II

C. prophase ⟶ metaphase ⟶ anaphase

D. metaphase II ⟶ anaphase II ⟶ telophase II

Item Information	
Alignment	BIO.B.1.1.1
Answer Key	A
Depth of Knowledge	2
p-value A	48% (correct answer)
p-value B	13%
p-value C	25%
p-value D	14%
Option Annotations	A. Key: Chromosomes align during metaphase, which is followed by anaphase. B. This sequence describes meiosis, which produces four unique daughter cells. C. Chromosomes align during metaphase, which occurs after prophase. D. This sequence describes meiosis, which produces four unique daughter cells.

2. Use the chart below to answer the question.

Student Comparisons of Meiosis and Mitosis

Student	Outcome of Meiosis	Outcome of Mitosis
1	two haploid cells	two diploid cells
2	two diploid cells	four haploid cells
3	four haploid cells	two diploid cells
4	four diploid cells	four haploid cells

Which student correctly compared the outcomes of meiosis and mitosis?

A. student 1

B. student 2

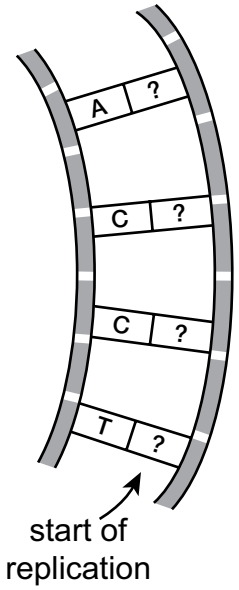
C. student 3

D. student 4

Item Information	
Alignment	BIO.B.1.1.2
Answer Key	C
Depth of Knowledge	2
p-value A	12%
p-value B	17%
p-value C	10% (correct answer)
p-value D	61%
Option Annotations	A. Meiosis produces four, not just two, haploid cells. B. Meiosis produces haploid cells, and mitosis produces diploid cells. C. Key: Meiosis produces four haploid daughter cells, and mitosis produces two diploid daughter cells. D. Meiosis produces haploid cells, and mitosis produces diploid cells.

3. Use the diagram below to answer the question.

DNA Replication



The DNA Replication diagram is incomplete. Which nucleotide sequence accurately shows the DNA strand that would be produced during DNA replication?

A. TCCA

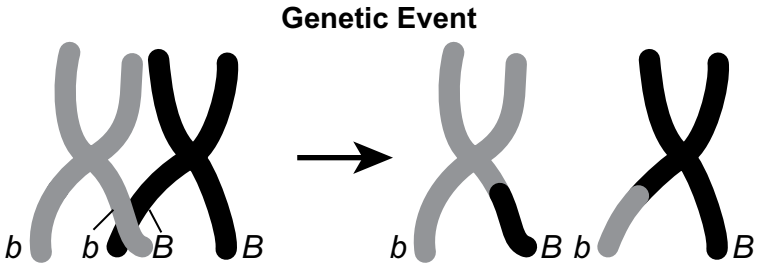
B. AGGT

C. UCCU

D. AGGU

Item Information	
Alignment	BIO.B.1.2.1
Answer Key	B
Depth of Knowledge	2
p-value A	14%
p-value B	61% (correct answer)
p-value C	4%
p-value D	21%
Option Annotations	A. During DNA replication, T is not complementary to T, C is not complementary to C, and A is not complementary to A. B. Key: A pairs with T, G pairs with C twice, and T pairs with A. C. During DNA replication, U is not complementary to T, C is not complementary to C, and U is not complementary to A. D. During DNA replication, U is not complementary to A. U is complementary to A during RNA transcription.

4. Use the diagram below to answer the question.



The genetic event shown in the diagram can occur during meiosis. Which statement **best** describes this type of event?

A. Gene sequences that are identical are replicated and added to the homologous chromosome.

B. Sections of DNA between nonhomologous chromosomes are exchanged, decreasing genetic diversity.

C. Segments of homologous chromosomes are exchanged, resulting in cells that will be genetically different.

D. The traits from two sections of the same DNA strand are altered, resulting in the production of a new species.

Item Information	
Alignment	BIO.B.2.1.2
Answer Key	C
Depth of Knowledge	2
p-value A	9%
p-value B	13%
p-value C	66% (correct answer)
p-value D	12%
Option Annotations	A. The two homologous chromosomes are breaking at different end pieces and exchange unique information. B. These are homologous chromosomes that exchange genetic material during a chromosomal crossover event. This takes place during sexual reproduction, which helps increase genetic diversity. C. Key: The chromosomes exchange segments during crossing-over, which results in recombinant chromosomes. D. These are homologous chromosomes from the same species.

5. Which activity would a cell be unable to perform if a mutation occurred that caused the Golgi apparatus to stop functioning?

A. packaging proteins for transport out of the cell

B. processing mRNA as it is transcribed from DNA strands

C. providing the location for the delivery of amino acids by tRNA

D. producing a template to guide the sequencing of amino acid chains

Item Information	
Alignment	BIO.B.2.2.2
Answer Key	A
Depth of Knowledge	2
p-value A	67% (correct answer)
p-value B	13%
p-value C	12%
p-value D	8%
Option Annotations	A. Key: A function of the Golgi apparatus is to package and process proteins. B. The process of transcription occurs in the nucleus. C. The ribosome provides the location for the delivery of amino acids. D. DNA in the nucleus provides the template.

6. Which statement describes how cloning is different from selective breeding?

A. Cloning eliminates recessive alleles from a genome.

B. Cloning transforms harmful traits into beneficial traits.

C. Cloning corrects or replaces mutated gene sequences.

D. Cloning results in offspring genetically identical to the parents.

Item Information	
Alignment	BIO.B.2.4.1
Answer Key	D
Depth of Knowledge	2
p-value A	10%
p-value B	7%
p-value C	9%
p-value D	74% (correct answer)
Option Annotations	A. Cloning is not the removal of alleles from a genome. B. Cloning involves making exact genetic copies; therefore, it does not transform harmful traits into beneficial traits. C. Cloning may make only an exact copy of a mutated gene sequence. It cannot correct or replace a gene sequence. D. Key: Cloning results in exact copies of genetic material, including offspring that are identical to their parents.

7. Which statement **best** describes how geographic isolation can contribute to land animal speciation?

A. Geographic isolation physically separates populations but allows them to interact.

B. Geographic isolation physically separates populations and prevents them from interacting.

C. Geographic isolation causes genetic changes in individual organisms but allows them to interact.

D. Geographic isolation causes genetic changes in individual organisms and prevents them from interacting.

Item Information	
Alignment	BIO.B.3.1.2
Answer Key	B
Depth of Knowledge	2
p-value A	11%
p-value B	59% (correct answer)
p-value C	12%
p-value D	18%
Option Annotations	A. Geographic isolation prevents populations from interacting. B. Key: Geographic isolation involves a physical separation of populations that prevents their interaction. C. Geographic isolation prevents populations from interacting. D. Geographic isolation is caused by physical separation of populations.

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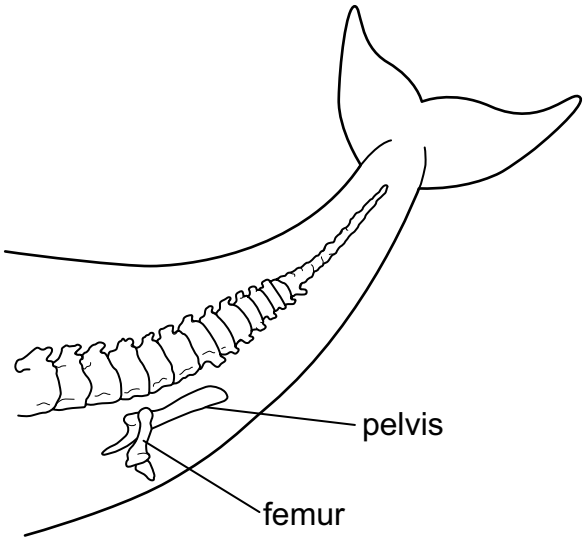
8. Use the diagram below to answer the question.

Vestigial Bones in a Whale



Whales have vestigial femurs and pelvic bones. Which statement explains why the vestigial structures are **most likely** present in whales?

A. Whales evolved over time from ancestors that lived on land.

B. Whales evolved over time from fish species that once lived on land.

C. Hind legs are an adaptation in whales that is selected for as they evolve into land mammals.

D. Hind legs are an evolutionary adaptation observed in whales that walk along the ocean floor.

Item Information	
Alignment	BIO.B.3.2.1
Answer Key	A
Depth of Knowledge	2
p-value A	66% (correct answer)
p-value B	17%
p-value C	8%
p-value D	9%
Option Annotations	A. Key: A pelvis and a femur are evolutionary remnants that indicate whales likely once walked on land. B. A pelvis and a femur indicate a land-dwelling animal rather than a water-dwelling animal like a fish. C. Since the bones are not needed by whales in their current environment, there is no selection pressure to evolve into land mammals. D. Whales do not walk on the ocean floor.

9. A student listed characteristics of a classroom aquarium ecosystem. Which characteristic is a biotic component of the aquarium ecosystem?

A. The water temperature is 23°C.

B. The pH of the water is usually between 6.5 and 6.8.

C. The ammonia is controlled with a filter that uses two types of bacteria.

D. The lighting is supplied by natural sunlight and a fluorescent light bulb.

Item Information	
Alignment	BIO.B.4.1.2
Answer Key	C
Depth of Knowledge	2
p-value A	11%
p-value B	16%
p-value C	62% (correct answer)
p-value D	11%
Option Annotations	A. Water temperature is an abiotic component of the ecosystem. B. The pH of the water is an abiotic component of the ecosystem. C. Key: The bacteria in the filter are a biotic component of the ecosystem. D. Lighting is an abiotic component of the ecosystem.

10. Tadpoles grown in ponds with high densities of tadpoles have lower survival and growth rates than tadpoles grown in ponds with lower densities of tadpoles. Which interaction between tadpoles grown in high-tadpole-density ponds would **most likely** cause the decreased survival and growth rates?

A. symbiosis

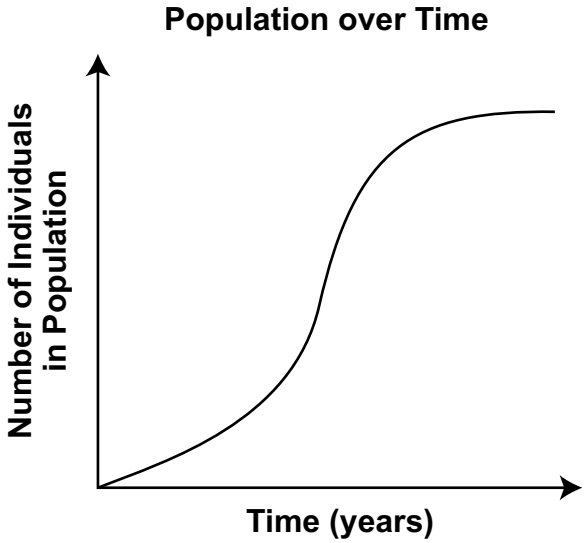
B. mutualism

C. competition

D. commensalism

Item Information	
Alignment	BIO.B.4.2.2
Answer Key	C
Depth of Knowledge	2
p-value A	9%
p-value B	12%
p-value C	72% (correct answer)
p-value D	7%
Option Annotations	A. Symbiosis describes either a beneficial or harmful relationship. B. Mutualism is a type of symbiosis in which both organisms benefit. C. Key: Tadpoles in low-density ponds have less competition for resources. D. Commensalism is a type of symbiosis in which one organism benefits, and the other is unaffected.

11. Use the graph below to answer the question.



Which population description is **most likely** represented by the graph?

A. A population of birds quickly increases but then becomes stable due to limiting factors in the environment.

B. A population of mice slowly increases but then fluctuates seasonally as predators raise their young and limit prey populations.

C. A population of fish quickly increases in the spring when there is plenty of food but then decreases quickly in the fall when food is limited.

D. A population of wolves slowly increases because of limiting factors in the environment but then increases constantly when additional prey migrate into the environment.

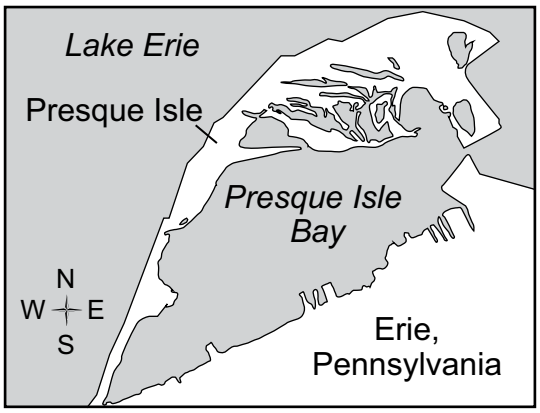
Item Information	
Alignment	BIO.B.4.2.5
Answer Key	A
Depth of Knowledge	2
p-value A	69% (correct answer)
p-value B	8%
p-value C	6%
p-value D	17%
Option Annotations	A. Key: The trend line on the graph shows that the population increases slowly at first, then rapidly increases, and then levels off. B. The trend line on the graph does not show a seasonal fluctuation in population. C. The trend line on the graph does not show a decrease. D. The trend line on the graph shows that the population levels off after a certain amount of time.

Directions: Use the information presented on page 64 to answer questions 12 and 13.

An Erie Ecosystem

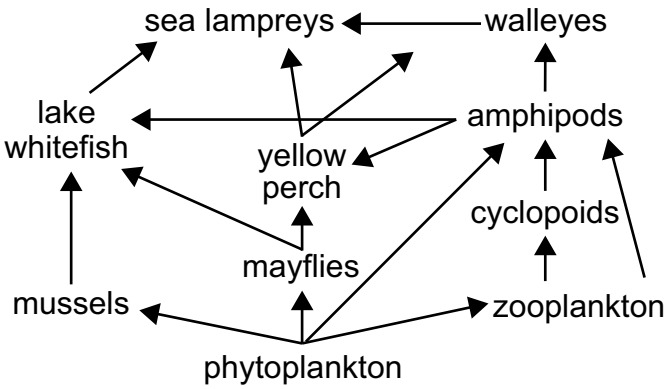
Presque Isle is located along the short stretch of Pennsylvania coastline on Lake Erie.

Presque Isle and Vicinity



Many different species of plants and animals live in the waters near Presque Isle. An environmental scientist decided to investigate the impact of human activity on the environment surrounding Presque Isle. The scientist used a net to catch several different fish species in the waters off the west shore of the isle. The scientist also took water samples and scrapings from the bottom of Lake Erie to analyze. The scientist was able to identify several different organisms. The food web shows the relationship of some of the organisms within the Presque Isle coastal ecosystem.

Food Web



The scientist observed that very few amphipods were present in the water samples that were collected. The scientist thought that the reduced number of amphipods might indicate an endangered ecosystem. In a preliminary report, the scientist hypothesized that the absence of amphipods was due to pesticides being released into Lake Erie that were especially toxic to aquatic invertebrates.

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12. Use the table below to answer the question.

Step	Action
1	Analyze the water for the presence of different pesticides.
2	Communicate the data and results of the investigation to a peer-reviewed scientific journal.
3	Allow many other scientists to perform experiments, review the data, and agree with the hypothesis.
4	Draw a conclusion about any pesticides found in the water that could be causing the extinction of water fleas.
5	Collect additional samples from Presque Isle Bay and the waters north and east of Presque Isle.

Which sequence of steps is needed for the scientist's hypothesis about the absence of amphipods to eventually become a theory?

A. 3, 2, 4, 1, 5

B. 4, 3, 5, 1, 2

C. 5, 1, 4, 2, 3

D. 5, 4, 3, 2, 1

Item Information	
Alignment	BIO.B.3.3.1
Answer Key	C
Depth of Knowledge	2
p-value A	11%
p-value B	14%
p-value C	68% (correct answer)
p-value D	7%
Option Annotations	A. Experiments must first be conducted before they can be repeated. B. Conclusions cannot be drawn before the samples are collected and tested. C. Key: The correct order of the steps in the scientific process is to collect additional samples, analyze the samples, draw conclusions, communicate the data and results, and allow other scientists to repeat the experiments. D. Conclusions cannot be drawn before the samples are tested.

13. Asian carp are an invasive species of fish. These large fish eat up to 40% of their body weight per day by feeding on phytoplankton. The carp also reproduce quickly. If these fish were to enter Lake Erie, how would the Presque Isle coastal ecosystem **most likely** be affected?

A. Producers in the ecosystem would grow at a faster rate, and smaller fish such as yellow perch would thrive.

B. The invasive fish would prey on mollusks such as mussels, but native fish species would quickly eat the invasive fish.

C. Consumers in the higher trophic levels would suffer stress, but crustaceans such as amphipods would be unaffected.

D. Most consumers in the ecosystem would face a shortage of food, and larger fish, such as walleye, would be unable to thrive.

Item Information	
Alignment	BIO.B.4.2.4
Answer Key	D
Depth of Knowledge	2
p-value A	9%
p-value B	10%
p-value C	8%
p-value D	73% (correct answer)
Option Annotations	A. Phytoplankton (producers) are the main food source for Asian carp. As the Asian carp population increased, producer populations would decrease. B. Asian carp would rely on phytoplankton, not mollusks, for food. The native fish primarily feed on mayflies and mussels, not on other fish. C. Amphipods would experience increased competition for food resources. D. Key: Asian carp would reduce the amount of phytoplankton available to primary consumers, causing secondary and tertiary consumers to have fewer available food resources.

CONSTRUCTED-RESPONSE ITEM

14. In the 1800s Gregor Mendel published a scientific paper based on pea plant experiments. In the paper he made the following conclusion:

Traits have two possible forms, which are determined by the inheritance of two factors. One factor is inherited from each parent. One form of the trait is dominant and the other recessive. When the offspring inherit one or more dominant factors, they will display that form of the trait.

Part A: Describe how one part of Mendel's conclusion is consistent with current scientific knowledge of inheritance.

Go to the next page to finish question 14.

GO ON

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

Part B: Since Mendel's paper was published, other forms of inheritance have been discovered. Describe two examples of how Mendel's conclusion does not fully explain the current scientific understanding of inheritance.

Example 1: _____

Example 2: _____

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

SCORING GUIDE

#14 Item Information

Alignment	BIO.B.2.1.1	**Depth of Knowledge**	3	**Mean Score**	1.26

Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a *thorough* understanding of describing and/or predicting observed patterns of inheritance by • Describing how one part of Mendel's conclusions is consistent with current scientific knowledge of inheritance **AND** • Describing an example of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered **AND** • Describing a second example of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of describing and/or predicting observed patterns of inheritance by fulfilling **two** of the bullets. The response may contain some work that is incomplete or unclear. • Describing how one part of Mendel's conclusions is consistent with current scientific knowledge of inheritance **OR** • Describing an example of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered **OR** • Describing a second example of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered.
1	The response demonstrates a *minimal* understanding of describing and/or predicting observed patterns of inheritance by fulfilling **one** of the bullets. The response may contain some work that is incomplete or unclear. • Describing how one part of Mendel's conclusions is consistent with current scientific knowledge of inheritance **OR** • Describing an example of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered **OR** • Describing a second example of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered.
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.

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Responses that will receive credit:

Part A (1 point):

- Mendel's "factors" are what we now call "alleles." We now know that alleles are found on chromosomes and that, in each cell of an individual, one set of chromosomes is from the mother and one set is from the father. So for each trait, an individual inherits one allele for that trait from the mother and one from the father.
- We now know that meiosis occurs to make sex cells that have one set of chromosomes, and therefore one allele (or factor) for each trait. When the sex cells fuse in sexual reproduction, the offspring has inherited one set of chromosomes from each parent, and therefore one allele for each trait from each parent.
- We know that a dominant trait is often caused by having an allele that codes for a protein that is functional, and a recessive trait is caused by having only recessive alleles that code for a non-functional protein (or that are not transcribed).

Part B (2 points, 1 point for each of two examples):

- Traits that show incomplete dominance are not explained by Mendel's conclusions. In incomplete dominance, heterozygotes have a phenotype that is like a blend of the "recessive" and "dominant" phenotypes (e.g., displays an intermediate coloration between the dominant color and recessive color, such as red flower color, pink flower color, and white flower color for a species of plant).
- Traits that show co-dominance are not explained by Mendel's conclusions. In co-dominance, heterozygotes have a phenotype that displays both the "recessive" and "dominant" phenotypes (e.g., a black rooster and white hen have "checkered" offspring).
- In males, sex-linked traits are not determined by the inheritance of two factors, since they have only one X chromosome, which they inherit from their mother.
- Some traits have more than two possible forms because there are more than two possible alleles that affect that trait. This is "multiple allele" inheritance and examples are ABO blood types and feather color in pigeons.
- Some traits are caused by more than one gene and have several possible phenotypes. These are polygenic traits (or quantitative characters). Examples are eye color, hair color, skin color, height, etc.
- Some traits are primarily determined by one gene, but can be affected by a second gene. So the phenotype is determined by the genotypes of both genes. This is called epistasis. For example, B_C_ mice are gray, bbC_ mice are brown, and B_cc and bbcc mice are white.
- Some traits are caused by a chromosomal abnormality or chromosomal mutation, in which a chromosome or section of a chromosome is either missing or there is an extra copy. These traits are not caused by only two alleles.
- Some traits are affected by environment and genes, so the phenotype is not solely dependent on the genotype. In these cases, the phenotype is affected by diet or exposure to sunlight or soil pH, etc.

Background Information:

- Mendel's "factors" are the same as alleles, which are the possible forms of a gene.
- A "phenotype" is effectively a trait or characteristic.
- The genotype is the alleles an individual has for a gene.
- Heterozygotes have one dominant allele and one recessive allele, or two different alleles for a trait. Homozygotes have two of the same alleles.
- To receive credit in Part B, students do not need to provide real-world examples of the described differences between Mendel's conclusion and current scientific understandings of inheritance.

STUDENT RESPONSE

Response Score: 3 points

14. In the 1800s Gregor Mendel published a scientific paper based on pea plant experiments. In the paper he made the following conclusion:

Traits have two possible forms, which are determined by the inheritance of two factors. One factor is inherited from each parent. One form of the trait is dominant and the other recessive. When the offspring inherit one or more dominant factors, they will display that form of the trait.

Part A: Describe how one part of Mendel's conclusion is consistent with current scientific knowledge of inheritance.

It is currently known that many traits are determined by alleles, and that one allele is inherited from each parent. Also, it has been discovered that there are dominant and recessive alleles.

Go to the next page to finish question 14.

GO ON

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

Part B: Since Mendel's paper was published, other forms of inheritance have been discovered. Describe two examples of how Mendel's conclusion does not fully explain the current scientific understanding of inheritance.

Example 1: One way it does not fully explain current scientific knowledge is because of codominance. Mendel thought that no matter what, each trait was either dominant or recessive. It has been discovered that certain traits are codominant, meaning that neither is dominant or recessive.

Example 2: Another way in which Mendel's conclusion is not fully supported by modern science is multi allele traits. Some traits are not determined entirely by one allele, and are instead made up of a combination of several alleles.

The response demonstrates a *thorough* understanding of describing and/or predicting observed patterns of inheritance. In Part A, the response correctly describes how one part of Mendel's conclusions is consistent with current scientific knowledge of inheritance: *"... many traits are determined by alleles ..."* In Part B, the response correctly describes two examples of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered. Example 1: *"... certain traits are codominant, meaning that neither is dominant or recessive."* Example 2: *"... multi allele traits. Some traits are not determined entirely by one allele, and are instead made up of a combination of several alleles."* The response is clear, complete, and correct.

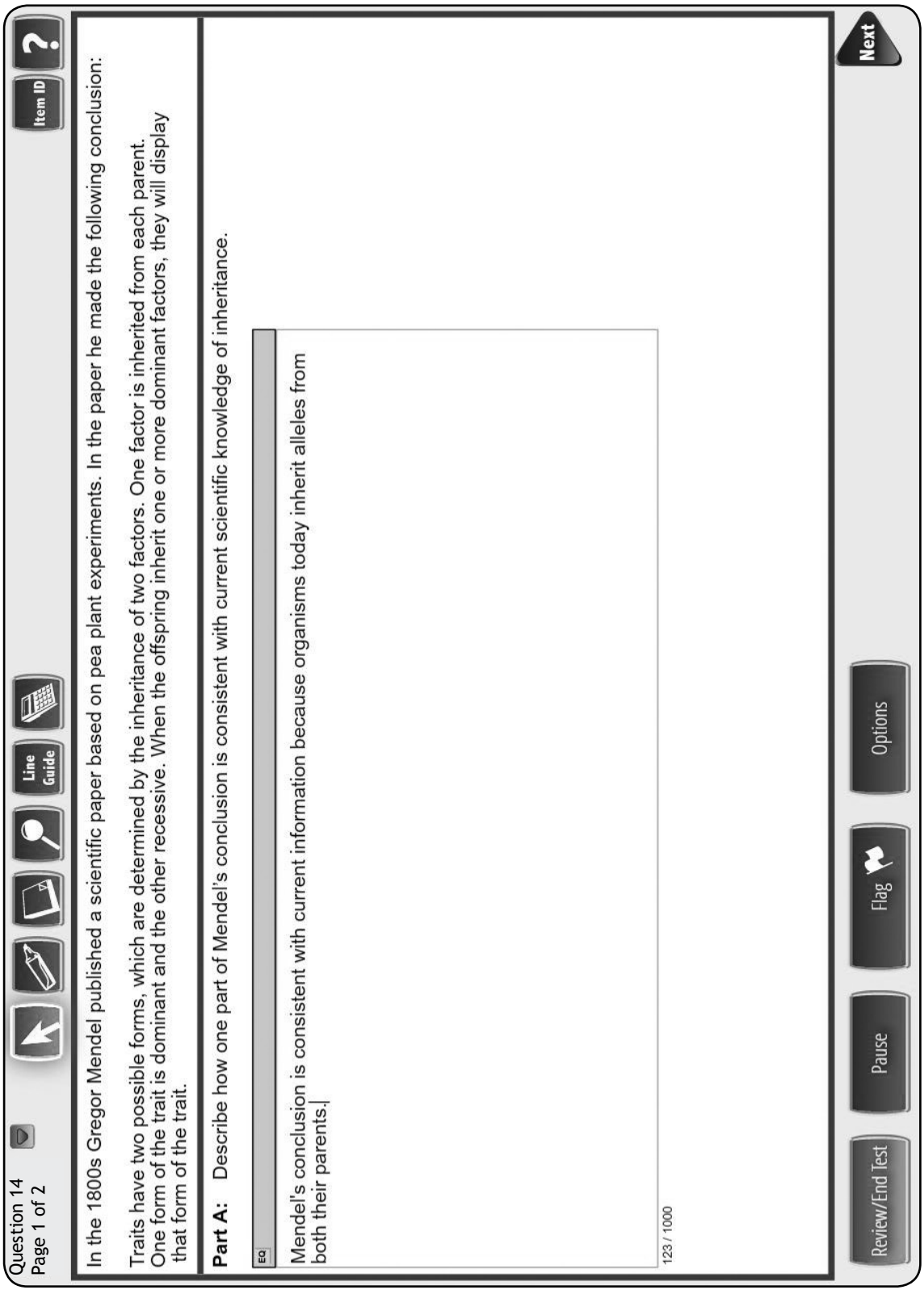
AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

STUDENT RESPONSE

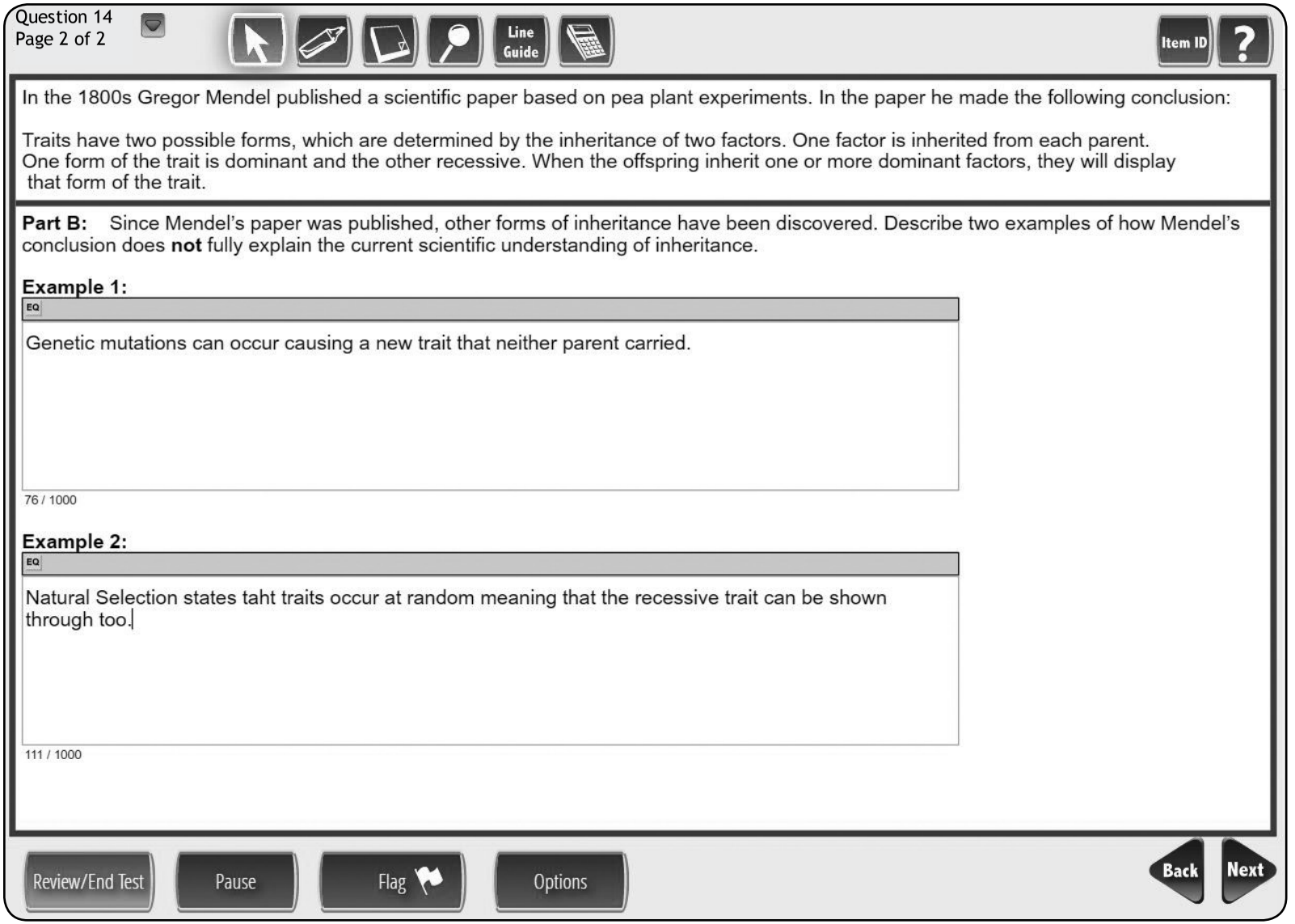
Response Score: 2 points

Part A



STUDENT RESPONSE

Part B



The response demonstrates a *partial* understanding of describing and/or predicting observed patterns of inheritance. In Part A, the response correctly describes how one part of Mendel's conclusions is consistent with current scientific knowledge of inheritance: *". . . organisms today inherit alleles from both their parents."* In Part B, the response correctly describes only one example of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered. Example 1: *"Genetic mutations can occur causing a new trait that neither parent carried."* Example 2 for Part B is not acceptable and does not receive any credit. The response contains some work that is incomplete or unclear.

STUDENT RESPONSE

Response Score: 1 point

14. In the 1800s Gregor Mendel published a scientific paper based on pea plant experiments. In the paper he made the following conclusion:

Traits have two possible forms, which are determined by the inheritance of two factors. One factor is inherited from each parent. One form of the trait is dominant and the other recessive. When the offspring inherit one or more dominant factors, they will display that form of the trait.

Part A: Describe how one part of Mendel's conclusion is consistent with current scientific knowledge of inheritance.

When we are born we inherit two factors, one from each parent. When we get the dominant factors, we will display that trait.

Go to the next page to finish question 14.

GO ON

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

Part B: Since Mendel's paper was published, other forms of inheritance have been discovered. Describe two examples of how Mendel's conclusion does not fully explain the current scientific understanding of inheritance.

Example 1: We could inherit a recessive trait

Example 2: Don't always display that trait

The response demonstrates a *minimal* understanding of describing and/or predicting observed patterns of inheritance. In Part A, the response correctly describes how one part of Mendel's conclusions is consistent with current scientific knowledge of inheritance: *"When we are born we inherit two factors, one from each parent."* OR *"When we get the dominant factors, we will display that trait."* Either is correct for credit in Part A. In Part B, the response does not describe any correct examples of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered. Example 2 *"Don't always display that trait"* needs more description for credit. Neither example receives any credit. The response contains some work that is incomplete or unclear.

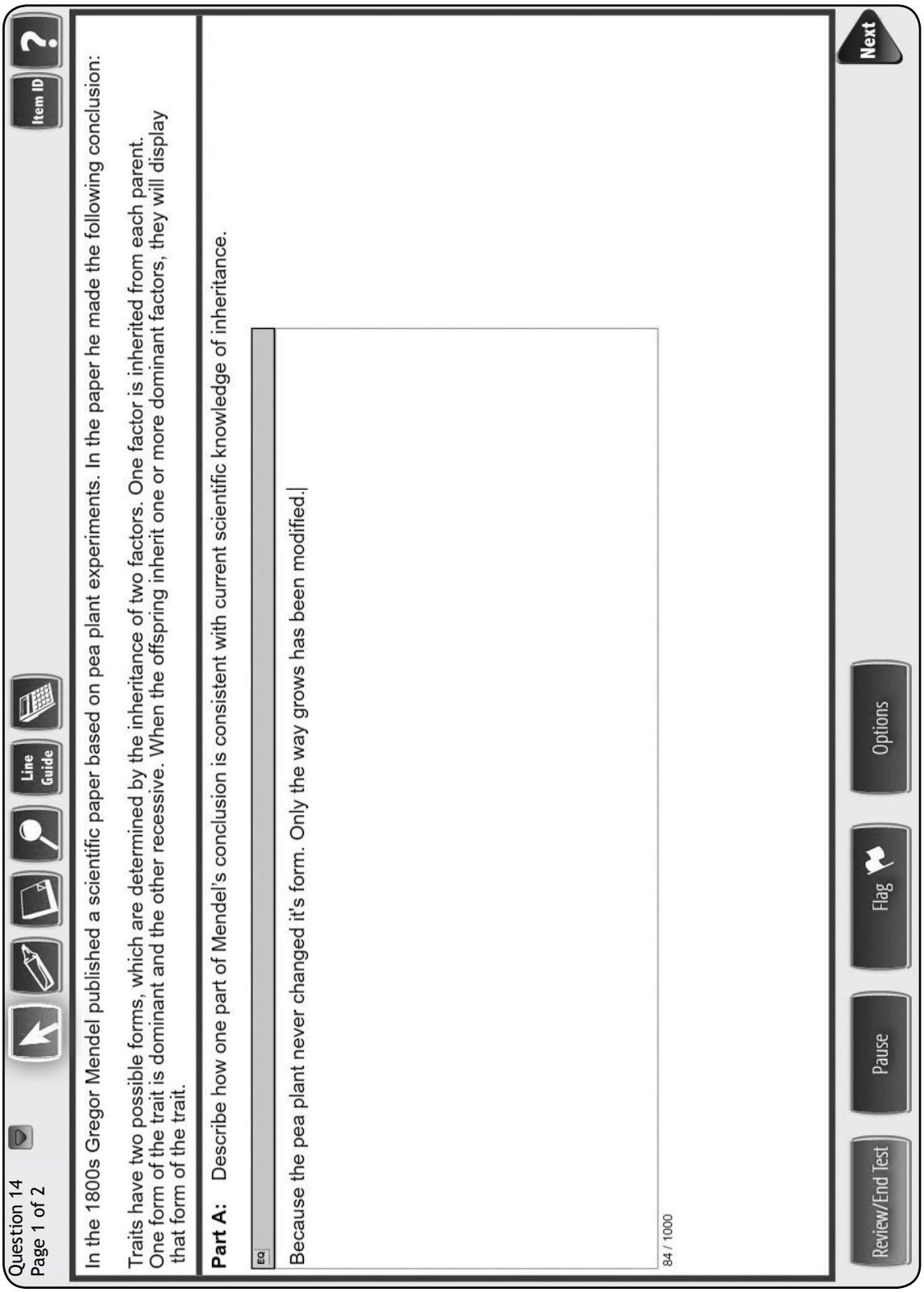
AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

STUDENT RESPONSE

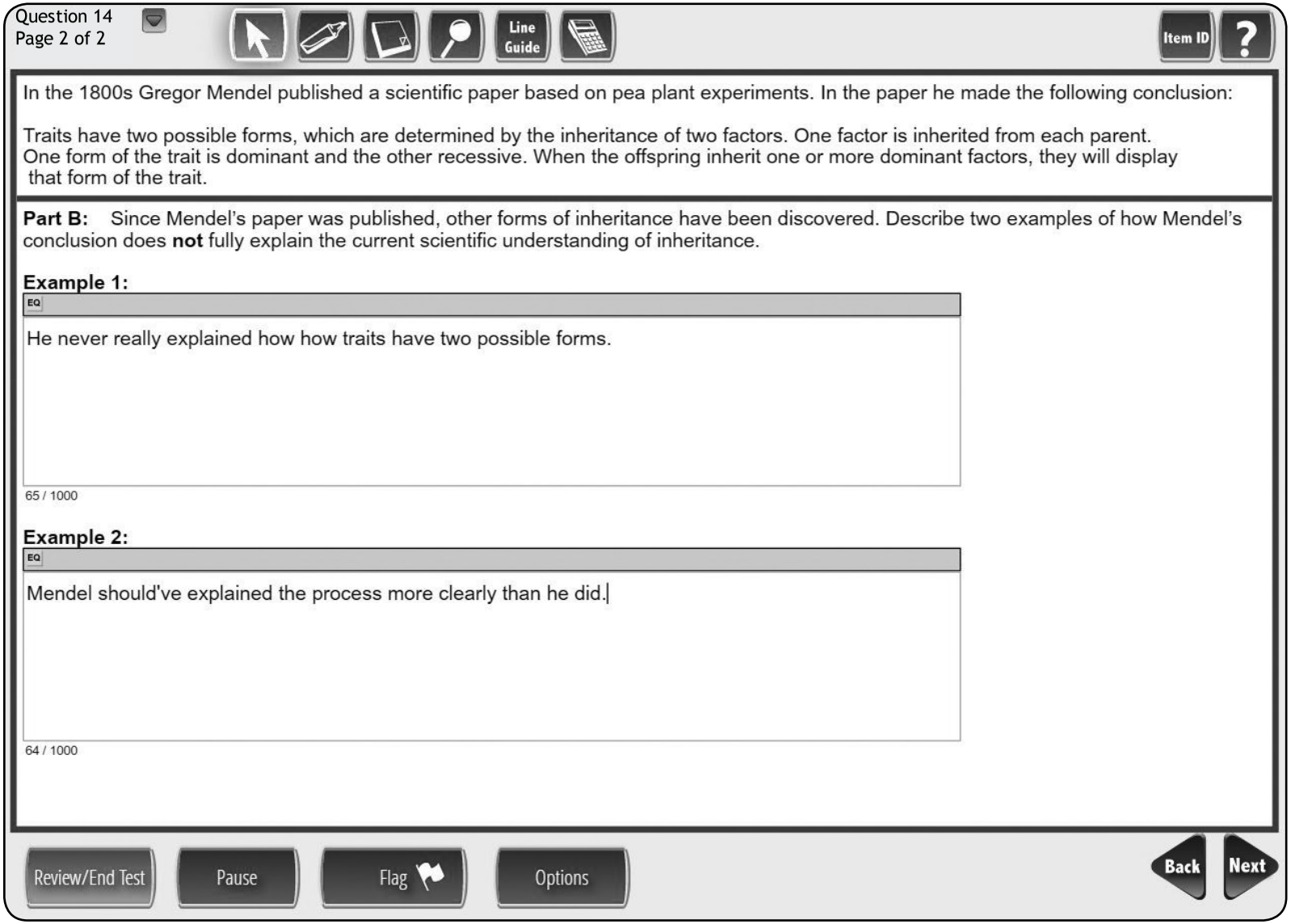
Response Score: 0 points

Part A



STUDENT RESPONSE

Part B

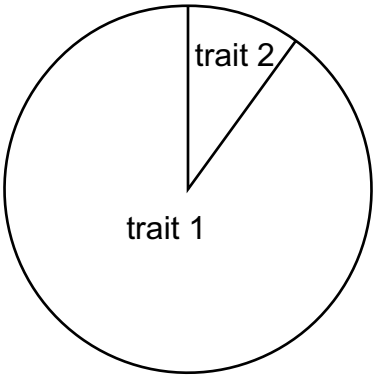


The response provides *insufficient* evidence to demonstrate any understanding of describing and/or predicting observed patterns of inheritance. In Part A, the response does not correctly describe how one part of Mendel's conclusions is consistent with current scientific knowledge of inheritance and does not receive any credit. In Part B, the response does not describe any correct examples of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered. Both examples provided are incorrect and do not receive any credit. The response contains work that is incomplete or unclear.

CONSTRUCTED-RESPONSE ITEM

15. Use the circle graph below to answer the question.

Occurrence of Two Traits in a Population



The graph shows the frequency of two traits, 1 and 2, in a population.

Part A: Use information from the circle graph to infer which trait is **most likely** favored by natural selection.

Part B: Explain how natural selection could lead to the trait distribution shown in the circle graph.

Go to the next page to finish question 15.

GO ON

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

Part C: Scientists predict that over time 0% of the population will have trait 2. Explain why this change in trait distribution could result in negative consequences for the population.

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

SCORING GUIDE

#15 Item Information

Alignment	BIO.B.3.1.1	**Depth of Knowledge**	3	**Mean Score**	1.63

Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a *thorough* understanding of how natural selection can impact allele frequencies of a population by • Using information from a circle graph to infer which of two traits is most likely favored by natural selection • Explaining how natural selection could lead to the trait distribution shown in the graph • Explaining why losing a trait from a population could result in negative consequences for the population. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of how natural selection can impact allele frequencies of a population by fulfilling **two** of the bullets under the 3-point response. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of how natural selection can impact allele frequencies of a population by fulfilling **one** of the 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 (1 point):

- Trait 1 is most likely favored by natural selection, since it is the more common trait.

Part B (1 point):

- Natural selection causes desirable traits to increase in frequency in the population, so trait 1 is likely the trait most favored by natural selection because individuals with this trait are more likely to survive and reproduce.
  OR
- Trait 1 offers some advantage in the environment, so individuals with trait 1 are more likely to survive and reproduce successfully than individuals with trait 2. So over time the percentage of the population that has trait 1 increases gradually.
  OR
- Perhaps in the past all members of this population had trait 2. Then one individual was born with trait 1 (due to a mutation in a germ cell probably). This individual was better suited to its environment than the individuals with trait 2, so it lived longer and had more offspring. Many of its offspring also had trait 1 and they were well-suited to the environment and had more offspring than average. The percentage of the population with trait 1 increased slightly with each generation, until it reached the percentage shown in the graph.

Part C (1 point):

- Having no individuals with trait 2 could have negative consequences for the population because genetic diversity is beneficial. If the environment changes in some way, it is possible that trait 2 would be the better trait to have in that new environment.
  OR
- It is important to have genetic diversity in a population, so they can meet various challenges in a changing environment. If no individuals in the population have trait 2, then some genetic diversity is lost and that is potentially harmful for the population.
  OR
- Perhaps trait 2 would be the better trait in a slightly different environment. If the environment changes and there are no individuals with trait 2, then it might be possible that the population will all die off.

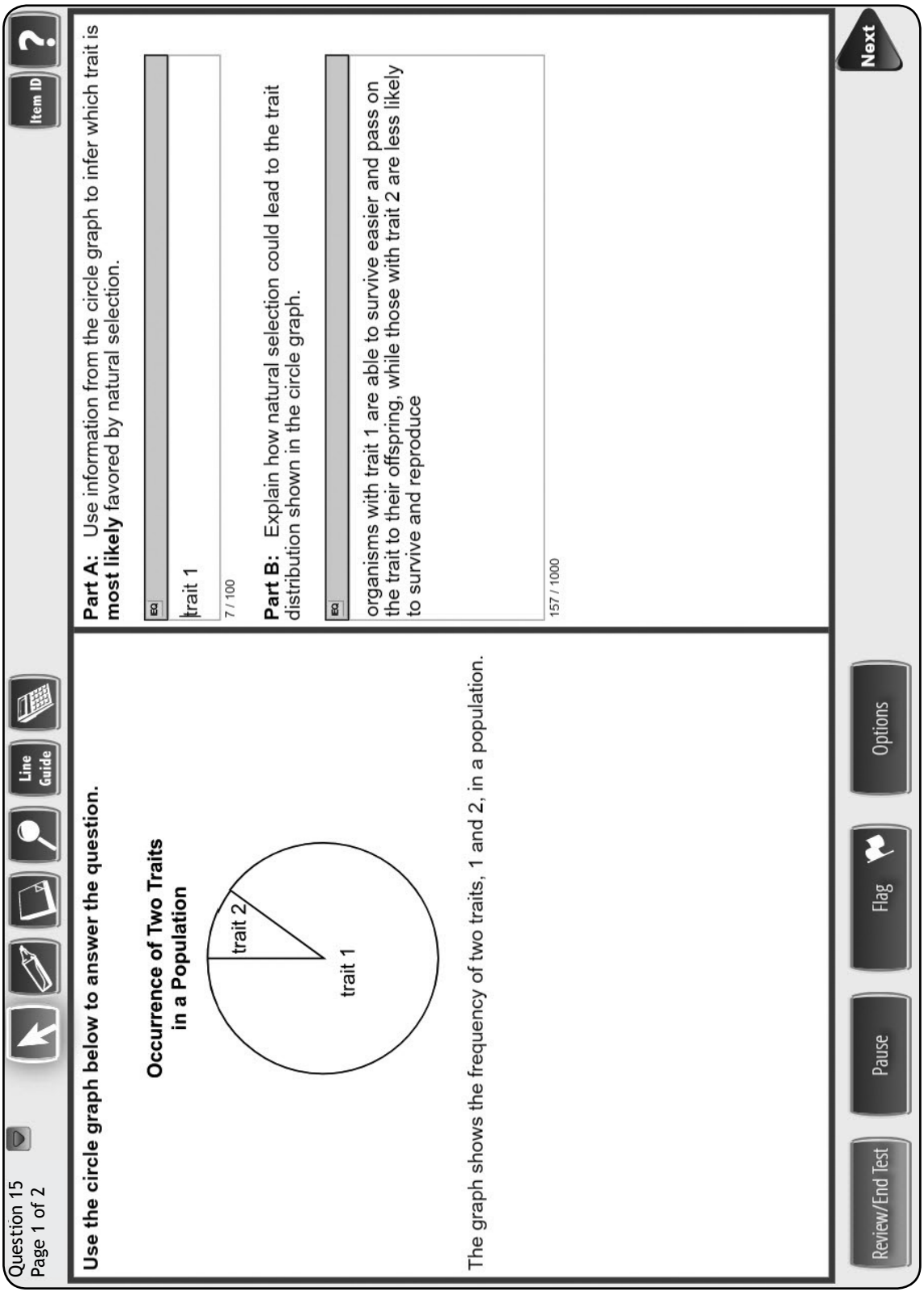
Background Information:

- Note for Part A and B: It is possible that trait 2 is the trait most favored by natural selection. Since the circle graph can only show the occurrence of the two traits for one given time, we do not know what the trend is. Perhaps trait 2 is fairly new to the population and is in the process of increasing in frequency. A student should receive credit in Part A if they respond with Trait 2 and in Part B they provide the given explanation.

STUDENT RESPONSE

Response Score: 3 points

Parts A and B



STUDENT RESPONSE

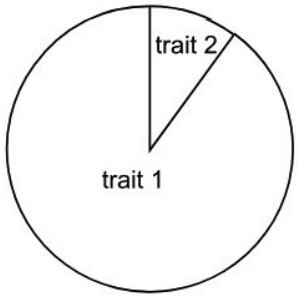
Part C

Question 15
Page 2 of 2

Line Guide | Item ID | ?

Use the circle graph below to answer the question.

Occurrence of Two Traits in a Population



The graph shows the frequency of two traits, 1 and 2, in a population.

Part C: Scientists predict that over time 0% of the population will have trait 2. Explain why this change in trait distribution could result in negative consequences for the population.

EQ

a change may occur in the environment making trait 1 undesirable

64 / 1000

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

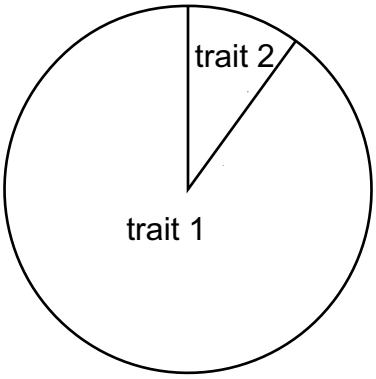
This response demonstrates a thorough understanding of how natural selection can impact allele frequencies of a population. In Part A, which of the two traits is most likely favored by natural selection is correctly inferred (*"trait 1"*). In Part B, the response correctly explains how natural selection could lead to the trait distribution shown in the graph (*"organisms with trait 1 are able to survive easier and pass on the trait to their offspring, while those with trait 2 are less likely to survive and reproduce"*). In Part C, the response correctly explains why losing a trait from a population could result in negative consequences for the population (*"a change may occur in the environment making trait 1 undesirable"*). The response is clear, complete and correct.

STUDENT RESPONSE

Response Score: 2 points

15. Use the circle graph below to answer the question.

Occurrence of Two Traits in a Population



The graph shows the frequency of two traits, 1 and 2, in a population.

Part A: Use information from the circle graph to infer which trait is **most likely** favored by natural selection.

The trait that is favored by natural selection is trait 1.

Part B: Explain how natural selection could lead to the trait distribution shown in the circle graph.

Natural selection could lead to the trait distribution shown because in natural selection is a random select of which trait should go into or out or moved in the gene pool. Natural selection is randomly selected from the gene pool and trait 1 was most likey selected as the main trait.

Go to the next page to finish question 15.

GO ON

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

Part C: Scientists predict that over time 0% of the population will have trait 2. Explain why this change in trait distribution could result in negative consequences for the population.

This change in distibution could result negatively for the popnlatron because that trait will no longer be there and if there are environmental changes the trait that is needed will no longer be there for them to survive and the popultion will decrease and could come to extinction.

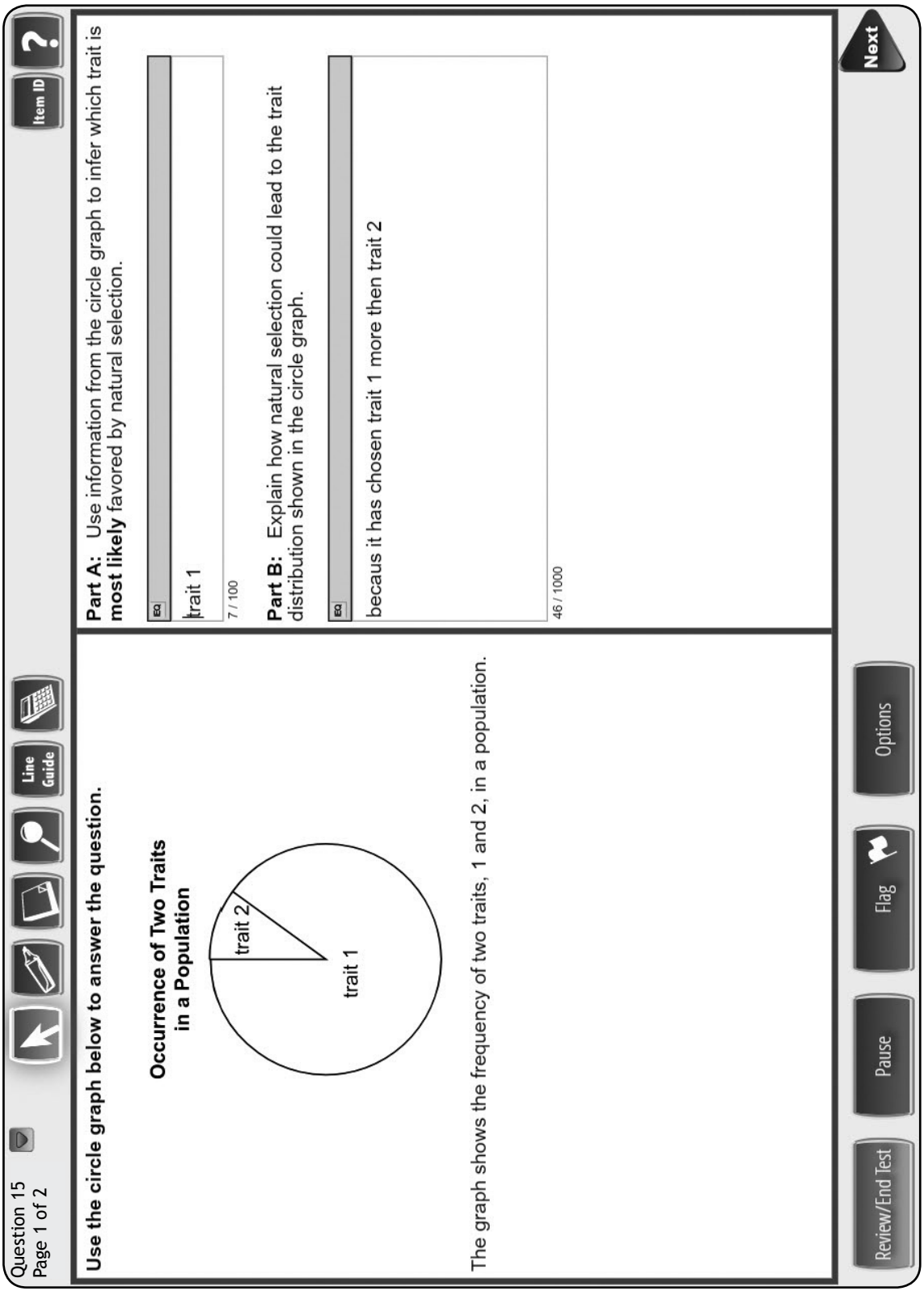
The response demonstrates a partial understanding of how natural selection can impact allele frequencies of a population. In Part A, which of the two traits is most likely favored by natural selection is correctly inferred (*"trait 1"*). In Part B, the response incorrectly explains how natural selection could lead to the trait distribution shown in the graph (*"natural selection is a random select of which trait should go into or out or moved in the gene pool. Natural selection is randomly selected from the gene pool and trait 1 was most likely selected as the main trait"*). In Part C, the response correctly explains why losing a trait from a population could result in negative consequences for the population (*"if there are environmental changes the trait that is needed will no longer be there for them to survive"*).

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STUDENT RESPONSE

Response Score: 1 point

Parts A and B



STUDENT RESPONSE

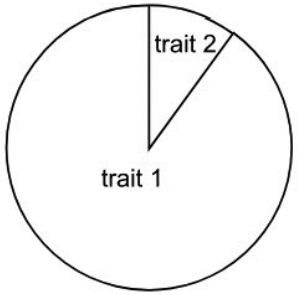
Part C

Question 15
Page 2 of 2

Line Guide | Item ID | ?

Use the circle graph below to answer the question.

Occurrence of Two Traits in a Population



The graph shows the frequency of two traits, 1 and 2, in a population.

Part C: Scientists predict that over time 0% of the population will have trait 2. Explain why this change in trait distribution could result in negative consequences for the population.

because trait 1's percentage will keep on getting high as we go

63 / 1000

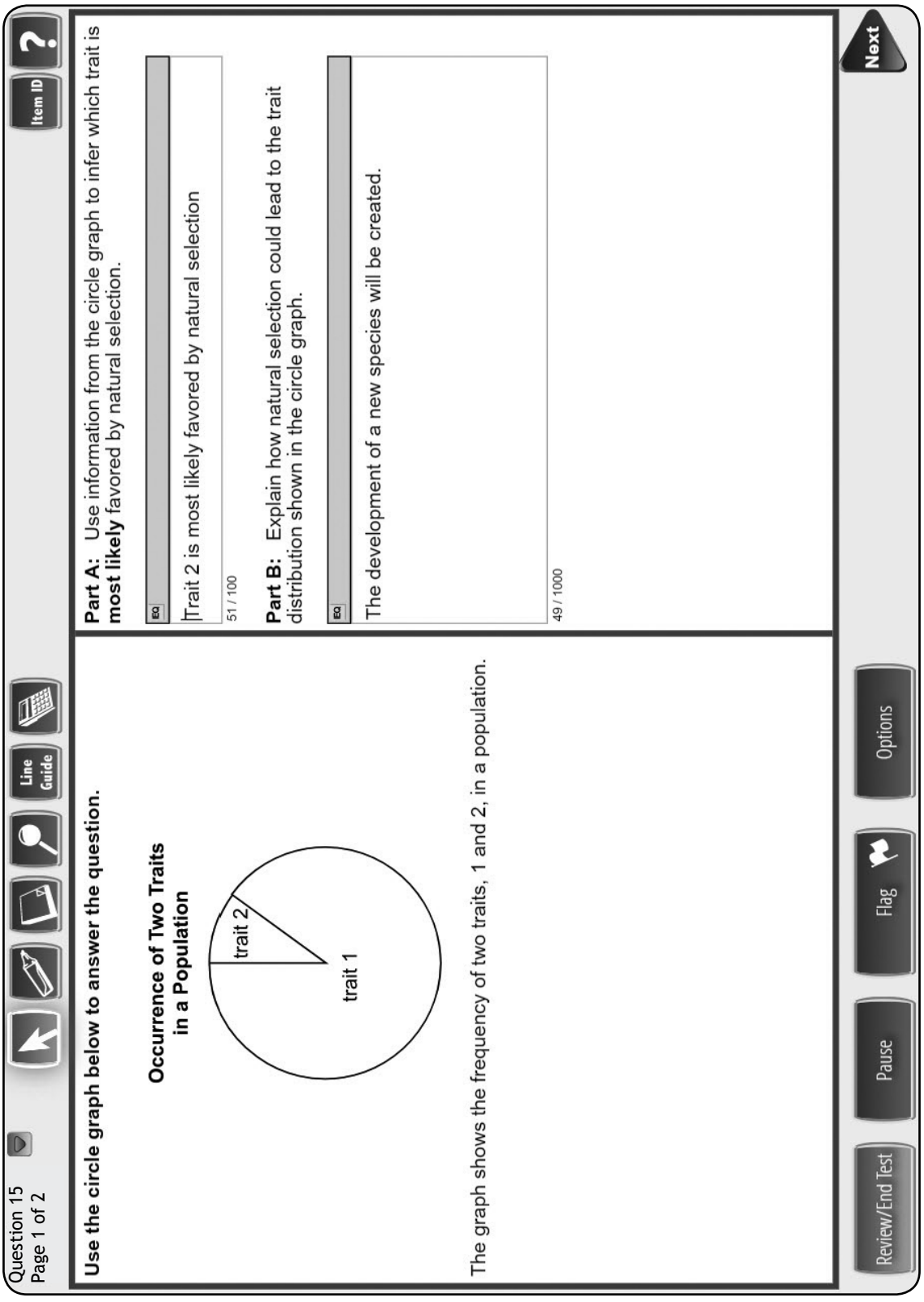
Review/End Test | Pause | Flag | Options | Back | Next

The response demonstrates a minimal understanding of how natural selection can impact allele frequencies of a population. In Part A, which of the two traits is most likely favored by natural selection is correctly inferred (*"trait 1"*). In Part B, the response does not explain how natural selection could lead to the trait distribution shown in the graph (*"becaus it has chosen trait 1 more then trait 2"*). In Part C, the response incorrectly explains why losing a trait from a population could result in negative consequences for the population (*"because trait 1's percentage will keep on getting high as we go"*).

STUDENT RESPONSE

Response Score: 0 points

Parts A and B



STUDENT RESPONSE

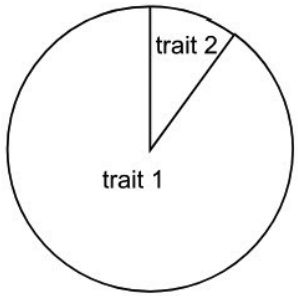
Part C

Question 15
Page 2 of 2

Line Guide | Item ID | ?

Use the circle graph below to answer the question.

Occurrence of Two Traits in a Population



The graph shows the frequency of two traits, 1 and 2, in a population.

Part C: Scientists predict that over time 0% of the population will have trait 2. Explain why this change in trait distribution could result in negative consequences for the population.

With the increase in offspring from the animals in the populuation, natural selection will result in negative consequences.

123 / 1000

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

The response provides insufficient evidence to demonstrate understanding of how natural selection can impact allele frequencies of a population. In Part A, which of the two traits is most likely favored by natural selection is incorrectly inferred (*"Trait 2"*). In Part B, the response does not explain how natural selection could lead to the trait distribution shown in the graph (*"The development of a new species will be created"*). In Part C, the response incorrectly explains why losing a trait from a population could result in negative consequences for the population (*"With the increase of offspring from the animals in the population, natural selection will result in negative consequences"*).

Biology Module 2—Summary Data

MULTIPLE-CHOICE

Sample Number	Alignment	Answer Key	Depth of Knowledge	*p*-value A	*p*-value B	*p*-value C	*p*-value D
1	BIO.B.1.1.1	A	2	48%	13%	25%	14%
2	BIO.B.1.1.2	C	2	12%	17%	10%	61%
3	BIO.B.1.2.1	B	2	14%	61%	4%	21%
4	BIO.B.2.1.2	C	2	9%	13%	66%	12%
5	BIO.B.2.2.2	A	2	67%	13%	12%	8%
6	BIO.B.2.4.1	D	2	10%	7%	9%	74%
7	BIO.B.3.1.2	B	2	11%	59%	12%	18%
8	BIO.B.3.2.1	A	2	66%	17%	8%	9%
9	BIO.B.4.1.2	C	2	11%	16%	62%	11%
10	BIO.B.4.2.2	C	2	9%	12%	72%	7%
11	BIO.B.4.2.5	A	2	69%	8%	6%	17%
12 (P)	BIO.B.3.3.1	C	2	11%	14%	68%	7%
13 (P)	BIO.B.4.2.4	D	2	9%	10%	8%	73%

CONSTRUCTED-RESPONSE

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
14	BIO.B.2.1.1	3	3	1.26
15	BIO.B.3.1.1	3	3	1.63

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Keystone Exams
Biology

Item and Scoring Sampler 2018

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