pennsylvania
DEPARTMENT OF EDUCATION

PENNSYLVANIA
KEYSTONE EXAMS

Biology
Item and Scoring Sampler

2024–2025

Pennsylvania Department of Education Bureau of Curriculum, Assessment and Instruction—August 2024

TABLE OF CONTENTS

INFORMATION ABOUT BIOLOGY

Introduction

General Introduction

The Pennsylvania Department of Education (PDE) provides districts and schools with tools to assist in delivering focused instructional programs aligned with the Pennsylvania Standards. These tools include STEELS Standards, STEELS Foundation Boxes, Keystone Exams Test Definition, Classroom Diagnostic Tool, Standards Aligned System, and content-based Item and Scoring Samplers. This 2024 Biology Item and Scoring Sampler is a useful tool for Pennsylvania educators in preparing students for the Keystone Exams by providing samples of test item types and scored student responses. This Item and Scoring Sampler is not designed to be used as a pretest, a curriculum, or any other benchmark for operational testing.

The items in this Item and Scoring Sampler may be used[1] as samples of item types that students will encounter in operational testing. Classroom teachers may find it beneficial to have students respond to the constructed-response items in this Item and Scoring Sampler. Educators may then use this Item and Scoring Sampler as a guide to score the responses either independently or together with colleagues within a school or district.

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

Pennsylvania STEELS Standards

This Item and Scoring Sampler contains examples of test questions designed to assess the STEELS standards. The sample test questions model the types of items that may appear on an operational Keystone Exam. These items will not appear on any future Keystone Exams. Released items provide an idea of the types of items that have appeared on previous exams and that will appear on future operational Keystone Exams. Each sample test question has been through a rigorous review process to ensure alignment with the STEELS standards prior to being on a Keystone exam. Answer keys, scoring guidelines, and any related stimulus material are also included. Additionally, example responses are provided with each constructed-response item to demonstrate the range of responses to these items.

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.

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

Alignment

The Biology Keystone Exam consists of questions grouped into two modules: Module 1: Molecules to Organisms—Structures, Functions, and Natural Cycles and Module 2: Continuity and Unity of Life—Biodiversity, Genetics, and Changes over Time. Each module corresponds to specific STEELS standards in the life science domain. The Biology content included in the Keystone Biology multiple-choice items and constructed-response items will align with the course-specific STEELS standards. The process skills, directive, and action statements will also specifically align with the course-specific STEELS standards.

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.

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_Exams_Understanding_Depth_of_Knowledge_and_Cognitive_Complexity.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 items 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 item 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 item is designed to take about one 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 official exam administration, students are given additional time as necessary to complete the exam.

Item and Scoring Sampler Format

This Item and Scoring Sampler includes the test directions and scoring guidelines that appear in the Keystone Exams. Each sample multiple-choice item is followed by a table that includes the alignment, the answer key, the DOK, the percentage 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 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. The responses in this Item and Scoring Sampler are example responses.

Example Multiple-Choice Item Information Table

Category	Item-Specific Information
Alignment	Assigned AAEC
Answer Key	Correct Answer
Depth of Knowledge	Assigned DOK
p-value[2] A	Percentage of students who selected option A
p-value[2] B	Percentage of students who selected option B
p-value[2] C	Percentage of students who selected option C
p-value[2] D	Percentage of students who selected option D
Option Annotations	Brief answer option analysis or rationale

Example Constructed-Response Item Information Table

Category	Item-Specific Information
Alignment	Assigned AAEC
Depth of Knowledge	Correct DOK
Mean Score[3]	Average Score

[2] The *p*-values are not included for the MC items in this 2024 Item and Scoring Sampler.
[3] The mean student scores are not included for the CR items in this 2024 Item and Scoring Sampler.

Biology Exam Directions

Directions:

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

There are two types of questions in this module.

Multiple-Choice Questions

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

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

Constructed-Response Questions

These questions will require you to write your response.

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

In addition, 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.

BIOLOGY MODULE 1

Multiple-Choice Items

1. Use the model below to answer the question.

Incomplete Student Model

DNA sequence → ? → ? → ? → protein

A student develops a model to show how DNA and proteins are related. Which sequence correctly completes the model to show the protein synthesis process?

Ⓐ amino acid sequence → tRNA sequence → mRNA sequence

Ⓑ tRNA sequence → mRNA sequence → amino acid sequence

Ⓒ mRNA sequence → tRNA sequence → amino acid sequence

Ⓓ mRNA sequence → amino acid sequence → tRNA sequence

Category	Item-Specific Information
Alignment	3.1.9-12.A
Answer Key	C
Depth of Knowledge	1
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. The amino acid sequence is formed following transcription of mRNA and then translation of tRNA. B. Transcription of the DNA sequence to RNA results in the immediate production of messenger RNA (mRNA), which then is decoded in the ribosomes to produce tRNA. C. Key: First, mRNA carries information from DNA to a ribosome, and then tRNA carries amino acids to the ribosome during translation to build the amino acid sequence that forms a protein. D. Translation of tRNA results in the assembly of the amino acid sequence that forms a protein.

2. Use the information below to answer the question.

Fight-or-Flight Response in a Rabbit

1. A rabbit hears a noise perceived as dangerous.
2. Neurons signal the brain that danger may be near.
3. Signals from the brain cause chemical signals to be released through blood vessels.
4. Cells in the heart receive the chemical signals.
5. The rabbit's heart rate increases.

Which model correctly identifies the organization of an organ system and explains how organ systems interact when a rabbit perceives danger?

Ⓐ nervous system ⟶ brain ⟶ nerve tissue ⟶ neurons
The nervous system and circulatory system work together in response to danger.

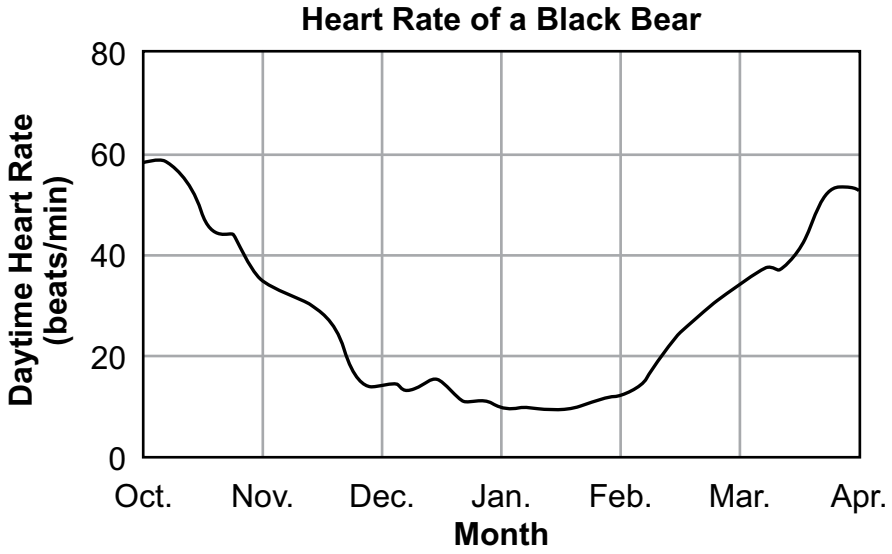
Ⓑ circulatory system ⟶ heart ⟶ cardiac tissue ⟶ myocardial cells
The nervous system and circulatory system respond independently to danger.

Ⓒ nervous system ⟶ neurons ⟶ nerve tissue ⟶ brain
The nervous system and circulatory system respond independently to danger.

Ⓓ circulatory system ⟶ myocardial cells ⟶ cardiac tissue ⟶ heart
The nervous system and circulatory system work together in response to danger.

Category	Item-Specific Information
Alignment	3.1.9-12.B
Answer Key	A
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Key: Sensory information received by the nervous system is processed in the brain, which directs neurons to communicate with the circulatory system in a coordinated response to danger. B. Sensory information is received by the nervous system, which works with the circulatory system to respond to danger. C. Sensory information received by the nervous system is processed in the brain. The nervous system and the circulatory system work together, not independently, to respond to danger. D. Sensory information is received by the nervous system, which processes information to direct a response from the circulatory system.

3. Use the graph below to answer the question.



The graph shows data collected from studying a black bear. Which investigation would provide the **best** evidence that changes in a bear's heart rate are a response to temperature changes and are a mechanism that helps the bear maintain homeostasis?

Ⓐ measuring the heart rate of a grizzly bear in the same seven-month period

Ⓑ measuring the heart rate of another black bear and the average temperatures during the day for a one-month period

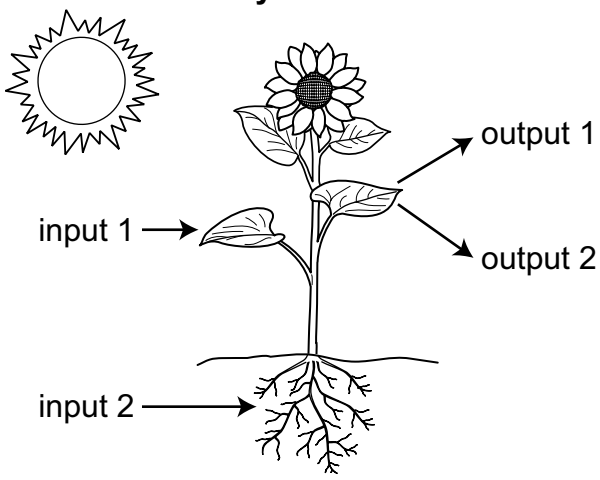
Ⓒ measuring the average temperatures in a polar bear's ecosystem in the same seven-month period

Ⓓ measuring the heart rates of a larger sample size of black bears and the average temperatures during the same seven-month period

Category	Item-Specific Information
Alignment	3.1.9-12.C
Answer Key	D
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. This measurement allows for a comparison of heart rates between two bear species but does not provide information about temperature change. B. Average temperature data should be collected for the same seven-month period. C. This measurement provides data for a different bear species that lives in a different ecosystem. D. Key: Temperature data over the same seven-month period and heart rates from a larger sample size of the same bear species are needed to collect relevant data.

4. Use the information below to answer the question.

Photosynthesis Model



Labels for Student Photosynthesis Models

Student	Site of Process	Input 1	Input 2	Output 1	Output 2
1	mitochondrion	oxygen	water	carbon dioxide	water
2	chloroplast	carbon dioxide	water	oxygen	glucose
3	mitochondrion	oxygen	water	carbon dioxide	glucose
4	chloroplast	carbon dioxide	glucose	oxygen	water

Students labeled a photosynthesis model. Which student labeled the model correctly?

Ⓐ student 1

Ⓑ student 2

Ⓒ student 3

Ⓓ student 4

Category	Item-Specific Information
Alignment	3.1.9-12.E
Answer Key	B
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Photosynthesis occurs in the chloroplast. Oxygen is an output, and carbon dioxide is an input. B. Key: Carbon dioxide and water enter the chloroplast as inputs for photosynthesis. Oxygen and glucose are outputs. C. Photosynthesis occurs in the chloroplast. Oxygen is an output, and carbon dioxide is an input. D. Glucose is an output and water is an input of photosynthesis.

5. A student claims that sugar molecules can be converted directly to proteins by the cell since proteins contain the same elements as sugar. Which statement **best** evaluates this claim?

Ⓐ The claim is incorrect because proteins contain nitrogen. Cells can use the elements in sugar but will need to combine them with other elements to form proteins.

Ⓑ The claim is incorrect because all proteins are enzymes, which are used to make sugar molecules.

Ⓒ The claim is correct because proteins help form DNA, and DNA synthesis uses energy from sugar molecules.

Ⓓ The claim is correct because proteins are made from only carbon, hydrogen, and oxygen, which are all parts of a sugar molecule.

Category	Item-Specific Information
Alignment	3.1.9-12.F
Answer Key	A
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Key: The claim is incorrect because sugar molecules are composed of carbon, hydrogen, and oxygen atoms and lack the nitrogen needed to form proteins. B. The claim is incorrect, but not all proteins are enzymes. C. The claim is incorrect because sugar molecules lack nitrogen atoms. D. The claim is incorrect because proteins contain nitrogen, which is not present in sugar molecules.

6. Use the table below to answer the question.

Effects of Exercise on Carbon Dioxide and Oxygen Levels

Exercise Intensity	Carbon Dioxide Production (L/min)	Oxygen Consumption (mL/kg/min)
Low (e.g., washing dishes)	0.3	40
Moderate (e.g., walking)	0.7	60
High (e.g., dancing)	1.3	80

Which statement correctly identifies the relationship between cellular respiration and energy requirements?

Ⓐ More intense exercise causes cellular respiration to decrease, resulting in a reduced output of oxygen.

Ⓑ The intensity of exercise does not change the rate of cellular respiration, so the carbon dioxide input remains unchanged.

Ⓒ As exercise intensity increases, the rate of cellular respiration increases. This requires more oxygen and produces more carbon dioxide.

Ⓓ As exercise intensity decreases, the rate of cellular respiration decreases. This requires less carbon dioxide and produces less oxygen.

Category	Item-Specific Information
Alignment	3.1.9-12.G
Answer Key	C
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. More intense exercise increases the rate of cellular respiration. B. The rate of cellular respiration increases as the intensity of exercise increases. C. Key: The increased rate of cellular respiration that occurs with increased exercise intensity demands a greater input of oxygen and results in a greater output of carbon dioxide. D. Oxygen is an input for cellular respiration, and carbon dioxide is an output.

7. Energy pyramids represent the flow of energy through organisms at different trophic levels in the same ecosystem. If the producers in a desert ecosystem receive 90,000 kilocalories (kcal) of energy from the Sun, about how much energy would be available to secondary consumers in this ecosystem?

Ⓐ 90 kcal

Ⓑ 900 kcal

Ⓒ 9,000 kcal

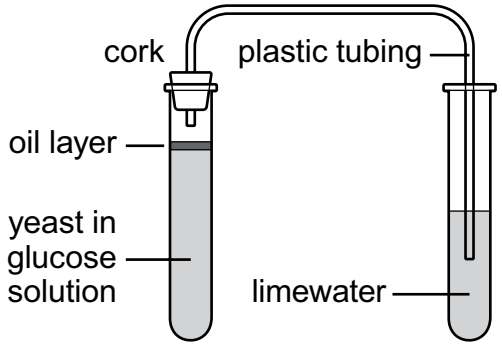
Ⓓ 900,000 kcal

Category	Item-Specific Information
Alignment	3.1.9-12.H
Answer Key	B
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Tertiary consumers would have about 90 kcal of available energy. B. Key: Since about 10% of energy originally from the Sun is passed from one trophic level to the next, secondary consumers would have 900 kcal of available energy. C. Primary consumers would have about 9,000 kcal of available energy. D. No organisms in the desert ecosystem would receive more energy than the producers receive.

THIS PAGE IS INTENTIONALLY BLANK.

8. Use the diagram and list below to answer the question.

Investigation Setup



- The oil layer allows gas to bubble upward through the oil.
- The oil layer does not allow gas to move downward through the oil.
- Yeast consume glucose as a food source.
- Limewater turns from clear to cloudy when carbon dioxide is added to it.

Students constructed the setup shown in the diagram and noticed that the limewater changed from clear to cloudy. Which phrase **best** describes the student investigation?

Ⓐ evidence of aerobic respiration

Ⓑ evidence of anaerobic respiration

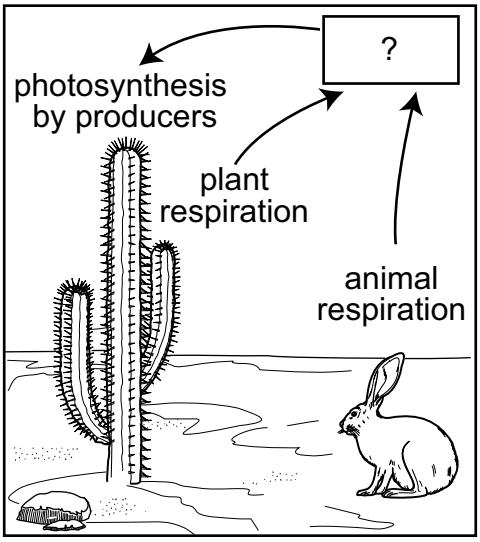
Ⓒ evidence of photosynthetic oxygen release

Ⓓ evidence of photosynthetic carbon dioxide release

Category	Item-Specific Information
Alignment	3.1.9-12.J
Answer Key	B
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Aerobic respiration occurs in the presence of oxygen. The oil layer prevents oxygen from mixing with the glucose solution. B. Key: The oil layer prevents oxygen from mixing with the glucose solution. Yeast perform anaerobic respiration in the absence of oxygen, and the product of this process is carbon dioxide. C. Yeast are not photosynthetic organisms, and cloudy limewater provides evidence for the release of carbon dioxide. D. Yeast are not photosynthetic organisms.

9. Use the model below to answer the question.

Cycling of Matter



The model shows some ways that matter moves between the biosphere and the atmosphere as a result of different processes. Which label correctly identifies the question mark in the model?

Ⓐ carbon dioxide gas

Ⓑ hydrogen gas

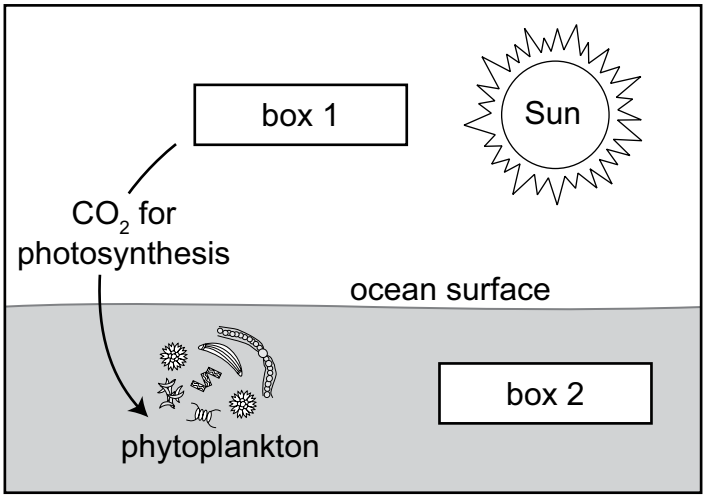
Ⓒ nitrogen gas

Ⓓ oxygen gas

Category	Item-Specific Information
Alignment	3.1.9-12.K
Answer Key	A
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Key: Carbon dioxide gas is an input for photosynthesis and a product of respiration. B. Hydrogen gas is neither an input of photosynthesis nor an output of respiration. C. Nitrogen gas from the atmosphere is fixed by bacteria in the soil. D. Oxygen gas is an input for respiration and a product of photosynthesis.

10. Use the diagram below to answer the question.

Student's Model



A student draws a model of the carbon cycle in an ecosystem that includes phytoplankton. The model is missing the final labels for box 1 and box 2. Which set of labels should the student use to complete the model?

Ⓐ box 1: geosphere
box 2: biosphere

Ⓑ box 1: hydrosphere
box 2: geosphere

Ⓒ box 1: biosphere
box 2: atmosphere

Ⓓ box 1: atmosphere
box 2: hydrosphere

Category	Item-Specific Information
Alignment	3.1.9-12.K
Answer Key	D
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. The geosphere is not represented in the model, and the biosphere is represented by the phytoplankton. B. The hydrosphere is represented by the ocean, and the geosphere is not represented in the model. C. The biosphere is represented by the phytoplankton, and the ocean is part of the hydrosphere. D. Key: Carbon dioxide from the atmosphere is used for photosynthesis, and phytoplankton live in the hydrosphere.

11. Fragments are areas of a habitat that are separated from other areas of the same habitat. Corridors connect two or more fragments and allow individuals of a population to move between different fragments. Which statement **best** describes the relationship between a fragment and a population?

Ⓐ A larger fragment with few corridors supports fewer individuals, increasing its population.

Ⓑ A smaller fragment with few corridors supports more individuals, increasing its population.

Ⓒ A larger fragment with many corridors supports more individuals, increasing its population.

Ⓓ A smaller fragment with many corridors supports fewer individuals, increasing its population.

Category	Item-Specific Information
Alignment	3.1.9-12.L
Answer Key	C
Depth of Knowledge	3
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. A fragment with few corridors limits the size of a population. B. A smaller fragment with few corridors supports few individuals and reduces a population's size. C. Key: A large fragment that is connected to other fragments supports population growth by providing more space and access to resources than a small, confined fragment. D. A smaller fragment supports fewer individuals and reduces a population's size.

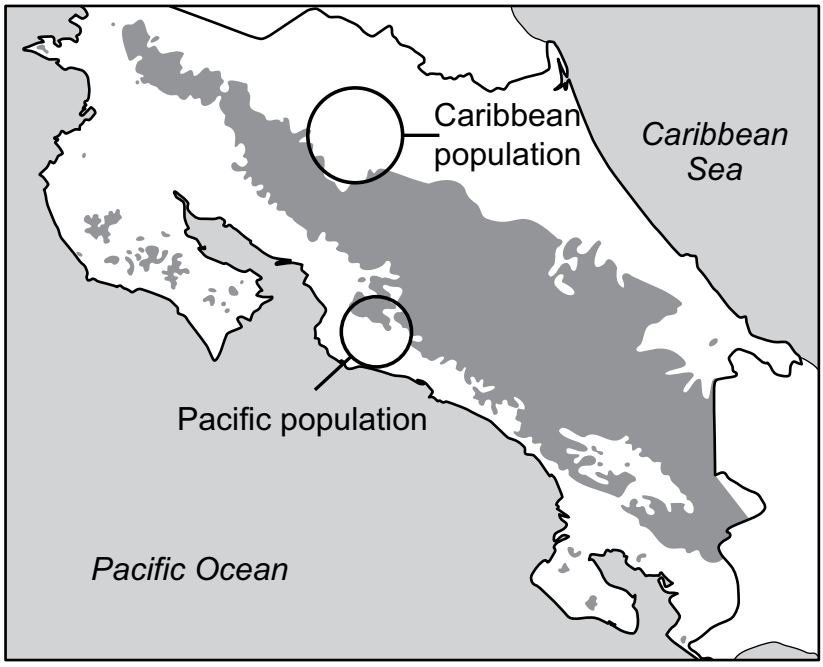
Directions: Use the information presented on page 25 to answer questions 12 and 13.

The Fer-de-Lance

The fer-de-lance pit viper is responsible for most snakebites that occur in southern Mexico, Central America, and northern South America. These snakes can survive in a variety of habitats, including areas that have been cleared for agriculture, which puts them in contact with humans. Scientists are studying the venom of different populations to make more effective antivenom treatments.

In Costa Rica, scientists studied two fer-de-lance populations living on either side of a mountain range. The mountain range creates a geographic barrier between the populations.

Populations of Fer-de-Lance Pit Vipers in Costa Rica



Snake venom is a mixture of various proteins, peptides, and nucleotides that help break down muscle tissue in prey. A snake uses its venom to immobilize prey and to defend itself. Venom is secreted by glands in the snake's head, similar to how saliva is produced.

In Costa Rica, studies of the two populations show that the similarity of the proteins in their venom is only about 52%. When scientists investigated one particular protein, they found a single amino acid difference between the Caribbean and Pacific populations.

12. Which factor **most** directly caused the difference in the venom of the Caribbean and Pacific fer-de-lance populations?

Ⓐ the different types of prey that the juveniles and adults consume

Ⓑ the different types of producers and consumers in the populations' environments

Ⓒ the different weather conditions the populations experience in their environments

Ⓓ the different DNA sequences that provide the templates for the production of protein molecules

Category	Item-Specific Information
Alignment	3.1.9-12.A
Answer Key	D
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. The differences in proteins present in venom are determined by an organism's DNA and not by its diet. B. The differences in proteins present in venom are determined by an organism's DNA. C. The differences in proteins present in venom are determined by an organism's DNA and not by weather. D. Key: DNA provides a template for the sequence of amino acids that form specific proteins present in snake venom.

13. Which sequence represents the process by which snake venoms are **most likely** formed?

Ⓐ Protein molecules from prey are broken down and used to form sugars. Sugars form amino acids in the venom.

Ⓑ Sugar molecules from prey are broken down and used to form proteins. Proteins form amino acids in the venom.

Ⓒ Sugar molecules from prey are broken down and used to form amino acids. Amino acids form proteins in the venom.

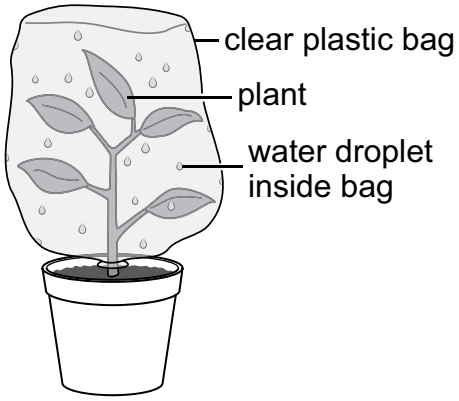
Ⓓ Protein molecules from prey are broken down and used to form amino acids. Amino acids form sugars in the venom.

Category	Item-Specific Information
Alignment	3.1.9-12.F
Answer Key	C
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Sugar molecules from prey are broken down and used to form amino acids. B. Sugar molecules from prey are broken down and used to form amino acids that combine to form proteins. C. Key: The oxygen, hydrogen, and carbon molecules in the hydrocarbon backbones of sugar molecules are used to produce the amino acids that combine to form proteins. D. Sugar molecules from prey are broken down and used to form amino acids that combine to form proteins.

Constructed-Response Item

14. A researcher investigated how stomata in plant leaves open and close in response to temperature changes. Four of the same plants were each given 120 milliliters (mL) of water and placed in separate rooms with different temperatures. Each room had a similar light source. The diagram shows the investigation setup, and the table shows the results of the investigation.

Investigation Setup



Investigation Results

Room Temperature (°C)	Amount of Water Collected after 24 Hours (mL)
16	5.5
21	7.3
27	9.9
37	3.8

Part A: Describe the purpose of the plastic bags that were placed over the plants.

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

Part B: Describe the relationship between the temperature of the room and the amount of water collected.

Part C: Using the data, describe how stomata **most likely** help plants maintain homeostasis.

Item-Specific Scoring Guideline

#14 Item Information

Category	Item-Specific Information
Alignment	3.1.9-12.C
Depth of Knowledge	2
Mean Score	N/A

Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a *thorough* understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis by • describing the purpose of the plastic bags that were placed over the plants **AND** • describing the relationship between the temperature of the room and the amount of water collected **AND** • describing, with evidence, how stomata most likely help plants maintain homeostasis. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis by fulfilling **two** of the bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis 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.

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

Responses that will receive credit:

Part A (1 point):

- The purpose of each plastic bag was to make a closed system that the researcher could control and measure the water collected as temperature changed.
- The plastic bag allowed for the collection of gases/water vapor.
- The plastic bags prevented the evaporation of water so that the temperature was the only factor being changed and water could be collected/measured from the plant.

Part B (1 point):

- The amount of water collected increased with temperature up to a point (37°C), where the amount of water collected then decreased.
- When the temperature increased, the amount of water collected (released by the plant) increased until the temperature became too warm (beyond 27°C).
- Cooler and warmer temperatures resulted in less water collected.
- There is likely an optimal temperature for a plant to release water at, since cold and hot temperatures resulted in less water being collected.

Part C (1 point):

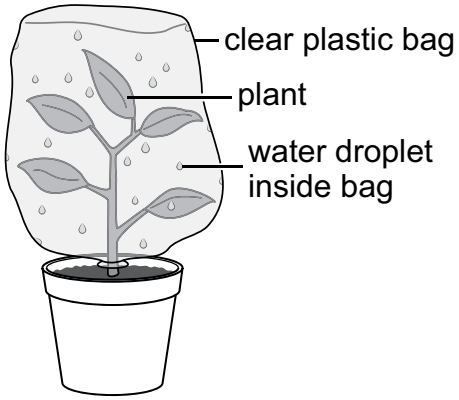
- Stomata are openings (pores) in the leaves that open and close to help regulate the amount of water that the plant releases. To help the plant not lose too much water in warmer (or colder) temperatures, the stomata close to reduce water loss.
- The stomata allow water to leave the plant and close to conserve water in hotter temperatures (or cooler temperatures).
- Stomata open to release water when conditions are good and close when conditions are poor (temperature too high or too low).
- Stomata regulate transpiration in plants, where water is released by the leaves. When water is released by the leaves, more water is drawn up by the stem or roots of the plants. If the temperature is too high (or too low), transpiration decreases to conserve water.
- The plant in the highest temperature released the least amount of water because it was trying to conserve water. Plants need more water in hotter conditions. By closing the stomata, the plant can maintain homeostasis (stable internal conditions).
- The stomata are open for CO_2 to enter and water and oxygen to leave until it gets too hot. At 37°C, the openings of the stomata are likely smaller/closed and do not allow water to leave (or CO_2 to enter). This will decrease the rate of photosynthesis and the internal water requirements for photosynthetic reactions to occur.

STUDENT RESPONSE

Response Score: 3 points

14. A researcher investigated how stomata in plant leaves open and close in response to temperature changes. Four of the same plants were each given 120 milliliters (mL) of water and placed in separate rooms with different temperatures. Each room had a similar light source. The diagram shows the investigation setup, and the table shows the results of the investigation.

Investigation Setup



Investigation Results

Room Temperature (°C)	Amount of Water Collected after 24 Hours (mL)
16	5.5
21	7.3
27	9.9
37	3.8

Part A: Describe the purpose of the plastic bags that were placed over the plants.

The bag is there to prevent water from evaporating and to allow for more accurate measurements of the results.

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

Part B: Describe the relationship between the temperature of the room and the amount of water collected.

As temperature increases the amount of water collected increases up until 27 degrees Celsius.

Part C: Using the data, describe how stomata **most likely** help plants maintain homeostasis.

The stomata help maintain homeostasis by opening when temperatures are optimal and closing when they are not to adjust the release of water from the plant.

The response demonstrates a thorough understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis. In Part A, the response correctly describes the purpose of the plastic bags that were placed over the plants (*to prevent water from evaporating and to allow for more accurate measurements of the results*). In Part B, the response correctly describes the relationship between the temperature of the room and the amount of water collected (*As temperature increases the amount of water collected increases up until 27 degrees Celsius*). In Part C, the response correctly describes, with evidence, how stomata most likely help plants maintain homeostasis (*by opening when temperatures are optimal and closing when they are not to adjust the release of water from the plant*). The response is clear, complete, and correct.

STUDENT RESPONSE

Computer Response Score: 2 points

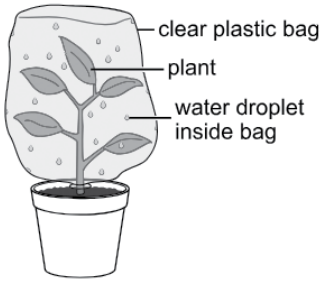
PARTS A and B

Question 14
Page 1 of 2

Line Guide | Item ID | ?

A researcher investigated how stomata in plant leaves open and close in response to temperature changes. Four of the same plants were each given 120 milliliters (mL) of water and placed in separate rooms with different temperatures. Each room had a similar light source. The diagram shows the investigation setup, and the table shows the results of the investigation.

Investigation Setup



Investigation Results

Room Temperature (°C)	Amount of Water Collected after 24 Hours (mL)
16	5.5
21	7.3
27	9.9
37	3.8

Part A: Describe the purpose of the plastic bags that were placed over the plants.

EQ

The plastic bag is used to create an enclosed environment so that temperature is the only variable being tested.

112 / 200

Part B: Describe the relationship between the temperature of the room and the amount of water collected.

EQ

Less water was collected when the temperatures were extreme. When the temperatures were more in the middle, more water was collected.

133 / 500

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

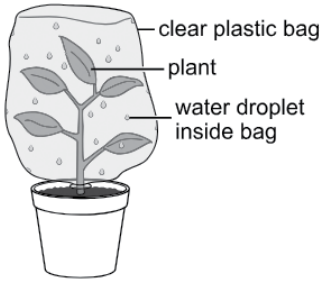
PART C

Question 14
Page 2 of 2

Line Guide | Item ID | ?

A researcher investigated how stomata in plant leaves open and close in response to temperature changes. Four of the same plants were each given 120 milliliters (mL) of water and placed in separate rooms with different temperatures. Each room had a similar light source. The diagram shows the investigation setup, and the table shows the results of the investigation.

Investigation Setup



Investigation Results

Room Temperature (°C)	Amount of Water Collected after 24 Hours (mL)
16	5.5
21	7.3
27	9.9
37	3.8

Part C: Using the data, describe how stomata **most likely** help plants maintain homeostasis.

EQ

The stomata maintain homeostasis by controlling the amount of water that can enter and leave the plant.

103 / 500

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

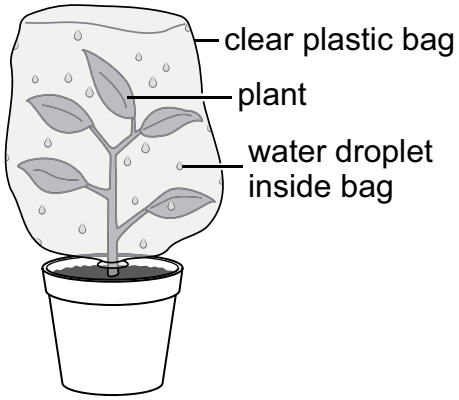
The response demonstrates a partial understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis. In Part A, the response correctly describes the purpose of the plastic bags that were placed over the plants (*to create an enclosed environment so that temperature is the only variable being tested*). In Part B, the response correctly describes the relationship between the temperature of the room and the amount of water collected (*Less water was collected when the temperatures were extreme. When the temperatures were more in the middle, more water was collected*). In Part C, the response (*by controlling the amount of water that can enter and leave the plant*) incorrectly describes how stomata most likely help plants maintain homeostasis and does not receive any credit.

STUDENT RESPONSE

Response Score: 1 point

14. A researcher investigated how stomata in plant leaves open and close in response to temperature changes. Four of the same plants were each given 120 milliliters (mL) of water and placed in separate rooms with different temperatures. Each room had a similar light source. The diagram shows the investigation setup, and the table shows the results of the investigation.

Investigation Setup



Investigation Results

Room Temperature (°C)	Amount of Water Collected after 24 Hours (mL)
16	5.5
21	7.3
27	9.9
37	3.8

Part A: Describe the purpose of the plastic bags that were placed over the plants.

It protects them from the environment

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

Part B: Describe the relationship between the temperature of the room and the amount of water collected.

Higher temps mean more water is collected until 27 degrees

Part C: Using the data, describe how stomata **most likely** help plants maintain homeostasis.

Homeostasis is maintained by keeping balance inside an organism which is what the stomata does for these plants.

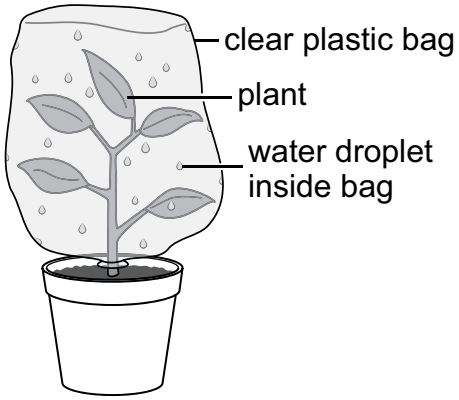
The response demonstrates a minimal understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis. In Part A, the response (*It protects them from the environment*) incorrectly describes the purpose of the plastic bags that were placed over the plants and does not receive any credit. In Part B, the response correctly describes the relationship between the temperature of the room and the amount of water collected (*Higher temps mean more water is collected until 27 degrees*). In Part C, the response (*by keeping balance inside an organism which is what the stomata does for these plants*) incorrectly describes how stomata most likely help plants maintain homeostasis and does not receive any credit.

STUDENT RESPONSE

Response Score: 0 points

14. A researcher investigated how stomata in plant leaves open and close in response to temperature changes. Four of the same plants were each given 120 milliliters (mL) of water and placed in separate rooms with different temperatures. Each room had a similar light source. The diagram shows the investigation setup, and the table shows the results of the investigation.

Investigation Setup



Investigation Results

Room Temperature (°C)	Amount of Water Collected after 24 Hours (mL)
16	5.5
21	7.3
27	9.9
37	3.8

Part A: Describe the purpose of the plastic bags that were placed over the plants.

It covers the plants

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

Part B: Describe the relationship between the temperature of the room and the amount of water collected.

The room temperature can affect the amount of water collected in unexpected ways.

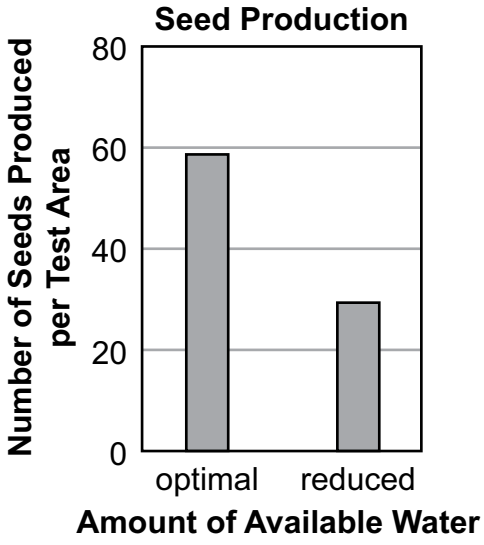
Part C: Using the data, describe how stomata **most likely** help plants maintain homeostasis.

They just do

The response demonstrates insufficient evidence of any understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis. In Part A, the response (*It covers the plants*) incorrectly describes the purpose of the plastic bags that were placed over the plants and does not receive any credit. In Part B, the response (*The room temperature can affect the amount of water collected in unexpected ways*) incorrectly describes the relationship between the temperature of the room and the amount of water collected and does not receive any credit. In Part C, the response (*They just do*) incorrectly describes how stomata most likely help plants maintain homeostasis and does not receive any credit.

Constructed-Response Item

15. A researcher observed that water resources in an area had become limited. The researcher investigated how the role of pollinators, organisms that fertilize flowering plants, is affected by reduced water availability. The graph summarizes the data collected during the investigation.



Part A: Identify the abiotic limiting factor the researcher studied.

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

Part B: Predict how the number of seeds produced by flowering plants would **most likely** be affected by access to unlimited resources.

Part C: Describe the effect of water availability on the abundance of species in the area.

Item-Specific Scoring Guideline

#15 Item Information

Category	Item-Specific Information
Alignment	3.1.9-12.L
Depth of Knowledge	2
Mean Score	N/A

Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a *thorough* understanding of using mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales by • identifying the abiotic limiting factor the researcher studied **AND** • predicting how the number of seeds produced by flowering plants would most likely be affected by access to unlimited resources **AND** • describing the effect of water availability on the abundance of species in the area. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of using mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales by fulfilling **two** of the bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of using mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales 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.

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

Responses that will receive credit:

Part A (1 point):

- The amount of available water is the abiotic limiting factor.

Part B (1 point):

- If plants had unlimited access to available water, they would increase their number of seeds produced in the test area.

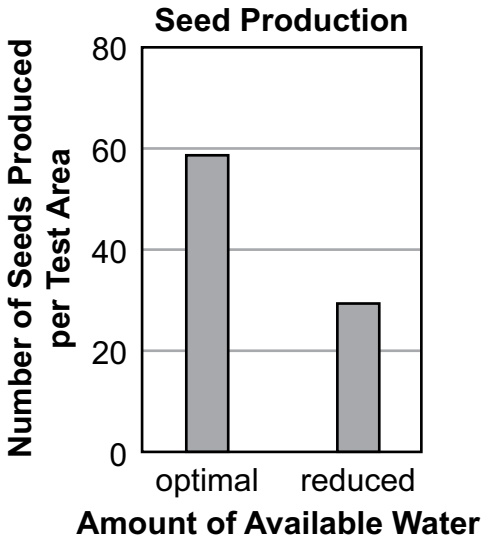
Part C (1 point):

- The less water available, the fewer seeds produced.
- A decrease in available water would result in a decrease in the number (populations) of species living in the area.
- A decrease in available water would result in a decrease in the biodiversity (number of species) living in the area.

STUDENT RESPONSE

Response Score: 3 points

15. A researcher observed that water resources in an area had become limited. The researcher investigated how the role of pollinators, organisms that fertilize flowering plants, is affected by reduced water availability. The graph summarizes the data collected during the investigation.



Part A: Identify the abiotic limiting factor the researcher studied.

The abiotic limiting factor is the amount of water that's available.

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

Part B: Predict how the number of seeds produced by flowering plants would **most likely** be affected by access to unlimited resources.

Plants having access to an unlimited water supply would cause more and more seeds to be produced.

Part C: Describe the effect of water availability on the abundance of species in the area.

If there isn't much water available then there wouldn't be as many seeds which means there wouldn't be as many plants or animals.

The response demonstrates a thorough understanding of using mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. In Part A, the response correctly identifies the abiotic limiting factor the researcher studied (*the amount of water that's available*). In Part B, the response correctly predicts how the number of seeds produced by flowering plants would most likely be affected by access to unlimited resources (*would cause more and more seeds to be produced*). In Part C, the response correctly describes the effect of water availability on the abundance of species in the area (*there wouldn't be as many seeds which means there wouldn't be as many plants or animals*). The response is clear, complete, and correct.

STUDENT RESPONSE

Computer Response Score: 2 points

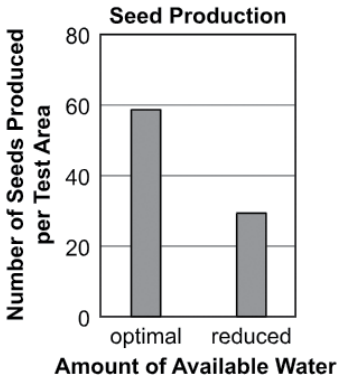
PART A

Question 15
Page 1 of 3

Line Guide

Item ID

A researcher observed that water resources in an area had become limited. The researcher investigated how the role of pollinators, organisms that fertilize flowering plants, is affected by reduced water availability. The graph summarizes the data collected during the investigation.



Part A: Identify the abiotic limiting factor the researcher studied.

EQ

It would be the water that is around.

37 / 100

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

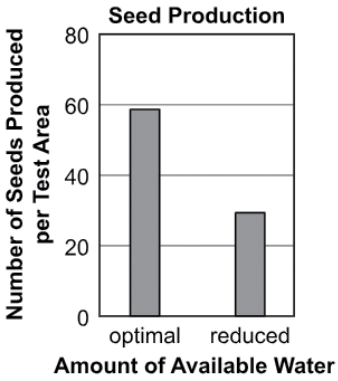
PART B

Question 15
Page 2 of 3

Line Guide

Item ID

A researcher observed that water resources in an area had become limited. The researcher investigated how the role of pollinators, organisms that fertilize flowering plants, is affected by reduced water availability. The graph summarizes the data collected during the investigation.



Part B: Predict how the number of seeds produced by flowering plants would **most likely** be affected by access to unlimited resources.

EQ

With unlimited water the area could possibly flood and kill everything.

71 / 500

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

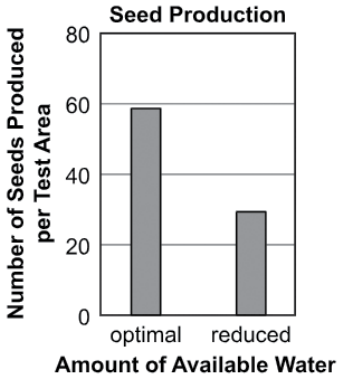
PART C

Question 15
Page 3 of 3

Line Guide

Item ID

A researcher observed that water resources in an area had become limited. The researcher investigated how the role of pollinators, organisms that fertilize flowering plants, is affected by reduced water availability. The graph summarizes the data collected during the investigation.



Part C: Describe the effect of water availability on the abundance of species in the area.

EQ

Without enough water then it would be way more difficut for species to survive.

79 / 500

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

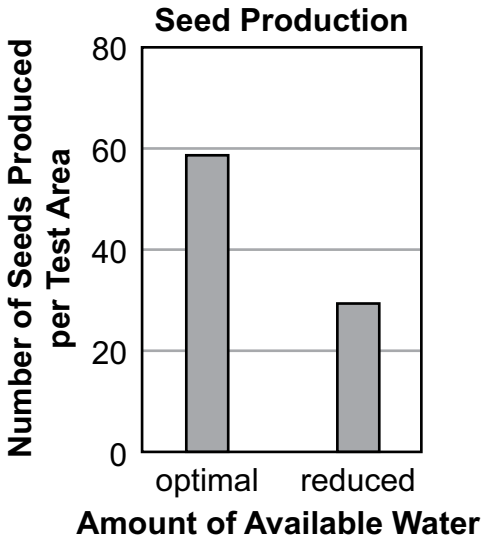
The response demonstrates a partial understanding of using mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. In Part A, the response correctly identifies the abiotic limiting factor the researcher studied (*the water that is around*). In Part B, the response (*With unlimited water the area could possibly flood and kill everything*) incorrectly predicts how the number of seeds produced by flowering plants would most likely be affected by access to unlimited resources and does not receive any credit. In Part C, the response correctly describes the effect of water availability on the abundance of species in the area (*Without enough water then it would be way more difficut for species to survive*).

THIS PAGE IS INTENTIONALLY BLANK.

STUDENT RESPONSE

Response Score: 1 point

15. A researcher observed that water resources in an area had become limited. The researcher investigated how the role of pollinators, organisms that fertilize flowering plants, is affected by reduced water availability. The graph summarizes the data collected during the investigation.



Part A: Identify the abiotic limiting factor the researcher studied.

The abiotic resource could be the land or maybe the animals

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

Part B: Predict how the number of seeds produced by flowering plants would **most likely** be affected by access to unlimited resources.

They would be able to grow more and more

Part C: Describe the effect of water availability on the abundance of species in the area.

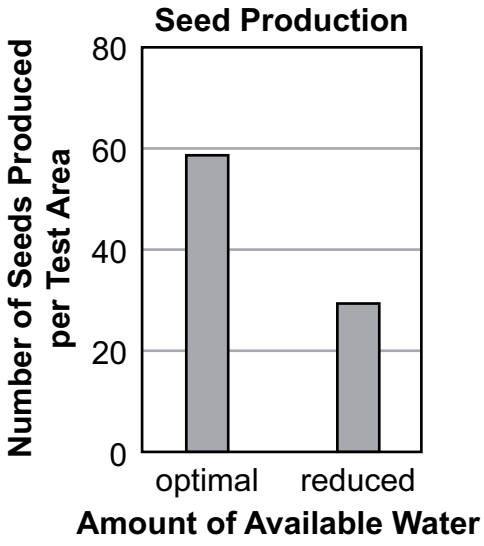
They will evolve to fit the environment and still be able to grow

The response demonstrates a minimal understanding of using mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. In Part A, the response (*the land or maybe the animals*) incorrectly identifies the abiotic limiting factor the researcher studied and does not receive any credit. In Part B, the response correctly predicts how the number of seeds produced by flowering plants would most likely be affected by access to unlimited resources (*They would be able to grow more and more*). In Part C, the response (*They will evolve to fit the environment and still be able to grow*) incorrectly describes the effect of water availability on the abundance of species in the area and does not receive any credit.

STUDENT RESPONSE

Response Score: 0 points

15. A researcher observed that water resources in an area had become limited. The researcher investigated how the role of pollinators, organisms that fertilize flowering plants, is affected by reduced water availability. The graph summarizes the data collected during the investigation.



Part A: Identify the abiotic limiting factor the researcher studied.

Sun

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

Part B: Predict how the number of seeds produced by flowering plants would **most likely** be affected by access to unlimited resources.

The number of seeds would go down

Part C: Describe the effect of water availability on the abundance of species in the area.

The number of animals would go up

The response provides insufficient evidence to demonstrate any understanding of using mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. In Part A, the response (*Sun*) incorrectly identifies the abiotic limiting factor the researcher studied and does not receive any credit. In Part B, the response (*The number of seeds would go down*) incorrectly predicts how the number of seeds produced by flowering plants would most likely be affected by access to unlimited resources and does not receive any credit. In Part C, the response (*The number of animals would go up*) incorrectly describes the effect of water availability on the abundance of species in the area and does not receive any credit.

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	3.1.9-12.A	C	1	N/A	N/A	N/A	N/A
2	3.1.9-12.B	A	2	N/A	N/A	N/A	N/A
3	3.1.9-12.C	D	2	N/A	N/A	N/A	N/A
4	3.1.9-12.E	B	2	N/A	N/A	N/A	N/A
5	3.1.9-12.F	A	2	N/A	N/A	N/A	N/A
6	3.1.9-12.G	C	2	N/A	N/A	N/A	N/A
7	3.1.9-12.H	B	2	N/A	N/A	N/A	N/A
8	3.1.9-12.J	B	2	N/A	N/A	N/A	N/A
9	3.1.9-12.K	A	2	N/A	N/A	N/A	N/A
10	3.1.9-12.K	D	2	N/A	N/A	N/A	N/A
11	3.1.9-12.L	C	3	N/A	N/A	N/A	N/A
12	3.1.9-12.A	D	2	N/A	N/A	N/A	N/A
13	3.1.9-12.F	C	2	N/A	N/A	N/A	N/A

Constructed-Response

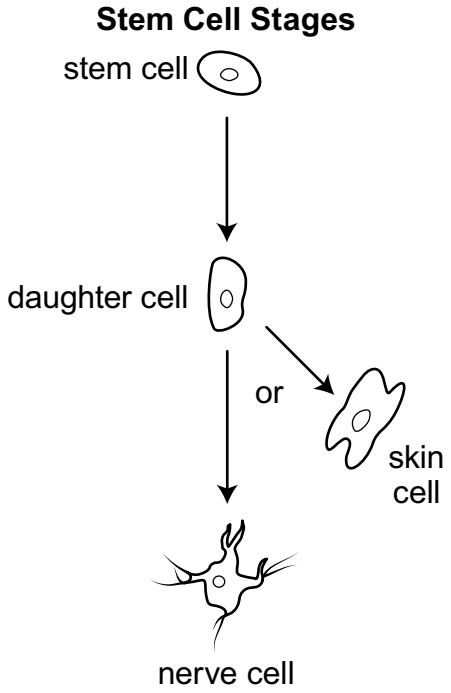
Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
14	3.1.9-12.C	3	2	N/A
15	3.1.9-12.L	3	2	N/A

THIS PAGE IS INTENTIONALLY BLANK.

BIOLOGY MODULE 2

Multiple-Choice Items

1. Use the model below to answer the question.



The model represents processes a stem cell goes through to become different types of specialized cells within an organism. Which processes demonstrated by the model allow a single cell to produce skin cells and nerve cells that all contain the same DNA?

Ⓐ mitosis and mutation

Ⓑ mitosis and differentiation

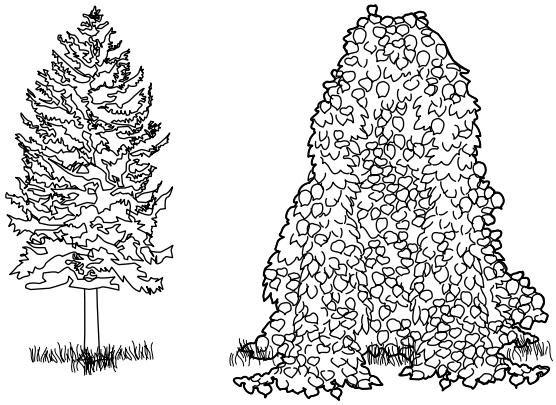
Ⓒ meiosis and mutation

Ⓓ meiosis and differentiation

Category	Item-Specific Information
Alignment	3.1.9-12.D
Answer Key	B
Depth of Knowledge	1
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. A daughter cell specializes its function because of gene expression. B. Key: Mitosis in stem cells produces identical daughter cells, and during the daughter cells' development, certain patterns of genes are expressed to guide cell function and behavior. C. A stem cell produces a daughter cell through the process of mitosis and then the daughter cell specializes its function because of gene expression. D. A stem cell produces a daughter cell through the process of mitosis.

2. Use the drawing below to answer the question.

Kudzu Covering a Tree



without kudzu with kudzu

Kudzu was planted in the southeastern United States in the 1930s to reduce soil erosion. Since then, the fast-growing vine has covered plants and structures across the region. Two solutions have been suggested to control further kudzu growth.

Solution 1: Cut existing kudzu vines that cover power lines and buildings.
Solution 2: Plant other types of vines that will compete with kudzu.

Which statement **best** evaluates the solutions?

Ⓐ Solution 1 is limited to areas with human-made structures. Solution 2 could lead to a new type of invasive species.

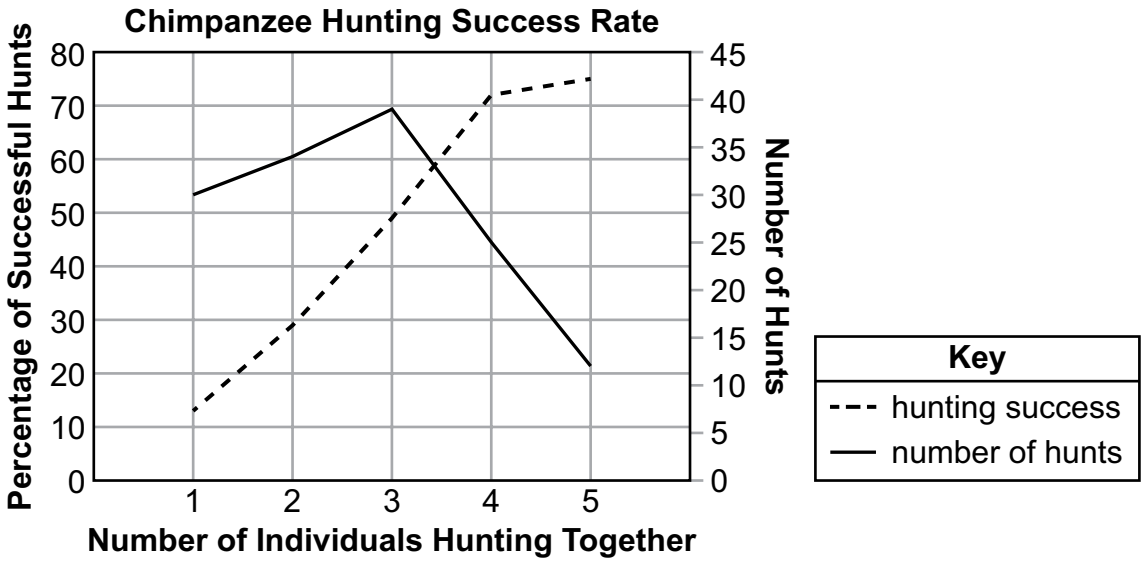
Ⓑ Solution 1 is a helpful plan with no expected problems. Solution 2 could lead to a new type of invasive species.

Ⓒ Solution 1 could lead to a new type of invasive species. Solution 2 is a helpful plan with no expected problems.

Ⓓ Both are good solutions because there are no expected problems.

Category	Item-Specific Information
Alignment	3.1.9-12.N
Answer Key	A
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Key: Both solutions have limits or present risk for additional problems. B. Solution 1 is limiting because it neglects kudzu growth over other plants. C. Unlike solution 2, solution 1 is unlikely to lead to a new type of invasive species. Solution 2 presents a risk for additional problems. D. Each solution has a limit or presents a risk for additional problems.

3. Use the graph below to answer the question.



Scientists studied hunting in a population of wild chimpanzees. The data they collected are shown. Which statement is supported by the data?

Ⓐ An individual chimpanzee gains no advantage from hunting in a group.

Ⓑ A group of three hunters is the ideal number of hunters for the greatest success.

Ⓒ The larger the group of hunters, the greater the number of hunts needed to be successful.

Ⓓ Larger groups of hunters have greater success in their hunts than an individual hunter does.

Category	Item-Specific Information
Alignment	3.1.9-12.O
Answer Key	D
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. An individual chimpanzee has low hunting success compared to a group of hunters. B. Groups of four or five hunters had greater hunting success than a group of three hunters. C. Larger groups of hunters needed far fewer hunts to be successful than smaller groups or individuals. D. Key: Chimpanzees that hunted in larger groups had more hunting success in fewer hunts than did an individual chimpanzee.

4. Some cats have a striped fur pattern. Scientists discovered that striped patterns in cat fur correspond to areas of thick and thin skin on the developing embryo. Which question could a student use to **best** discover how DNA coding affects this pattern?

Ⓐ Do cats with striped fur have smaller cells in areas of thin skin?

Ⓑ Does a striped cat's behavior have an effect on the thickness of its skin?

Ⓒ Do cats with striped fur have an allele that is absent from cats with solid fur patterns?

Ⓓ Does a striped cat have more genetic material in its cells than either of its parents do?

Category	Item-Specific Information
Alignment	3.1.9-12.P
Answer Key	C
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Cell thickness is studied with a microscope, which would not provide genetic information. B. Studying a striped cat's behavior would not provide information about DNA coding. C. Key: Investigating the presence or absence of certain alleles is appropriate since alleles are versions of genes that contain the DNA code for specific traits. D. The presence or absence of specific alleles related to fur patterns determine a cat's phenotype rather than the quantity of genetic material.

5. In rabbits, the allele for brown fur is dominant and the allele for white fur is recessive. A rabbit that is homozygous dominant for brown fur mates with a rabbit that is heterozygous. What is the probability that any one offspring will have white fur?

Ⓐ 0 percent

Ⓑ 25 percent

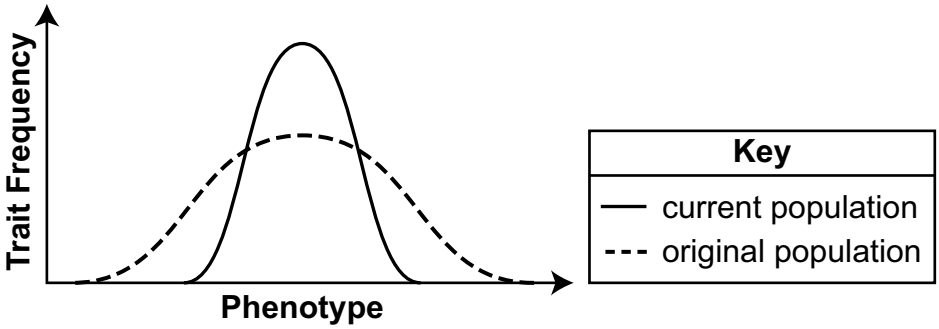
Ⓒ 50 percent

Ⓓ 75 percent

Category	Item-Specific Information
Alignment	3.1.9-12.R
Answer Key	A
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Key: A rabbit must inherit two recessive alleles to have white fur, and that is not possible in this cross, because only one parent has a single allele for the recessive trait. B. A cross between a rabbit that is homozygous for brown fur with a rabbit that is heterozygous will result in 100% of the offspring inheriting a dominant allele for brown fur. C. Offspring need to inherit two recessive alleles to exhibit white fur, and this cross results in 50% of the offspring inheriting only a single allele for the recessive trait. D. A cross between a rabbit that is homozygous for brown fur with a rabbit that is heterozygous will result in 100% of the offspring inheriting a dominant allele for brown fur.

6. Use the graph below to answer the question.

Change in Phenotype in a Population over Time



The graph represents a change in phenotype distribution for a population in an ecosystem over time. Which statement is supported by the graph?

Ⓐ A larger population is more stable than a smaller population is.

Ⓑ An increase in favorable conditions allows the population size to increase.

Ⓒ The ecosystem favors extreme versions of the phenotype of the organism.

Ⓓ Individuals with extreme phenotypes are less likely to survive and reproduce in the ecosystem.

Category	Item-Specific Information
Alignment	3.1.9-12.R
Answer Key	D
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. This graph provides data about the diversity of traits in a population, not the population size. B. This graph provides data about the diversity of traits in a population, not the population size. C. Over time, the population has evolved to favor the intermediate versions of the phenotype. D. Key: The graph supports the conclusion that individuals with intermediate versions of the phenotype are more likely to survive than those with extreme phenotypes.

7. Rabbits, hares, and pikas are known to be related species, but their exact relatedness has been debated by scientists. Scientists have used molecular DNA evidence to propose two different cladograms that show the relationships between the species.

Which additional characteristic should be compared so scientists can better understand the common ancestry of these species?

Ⓐ their skull shapes

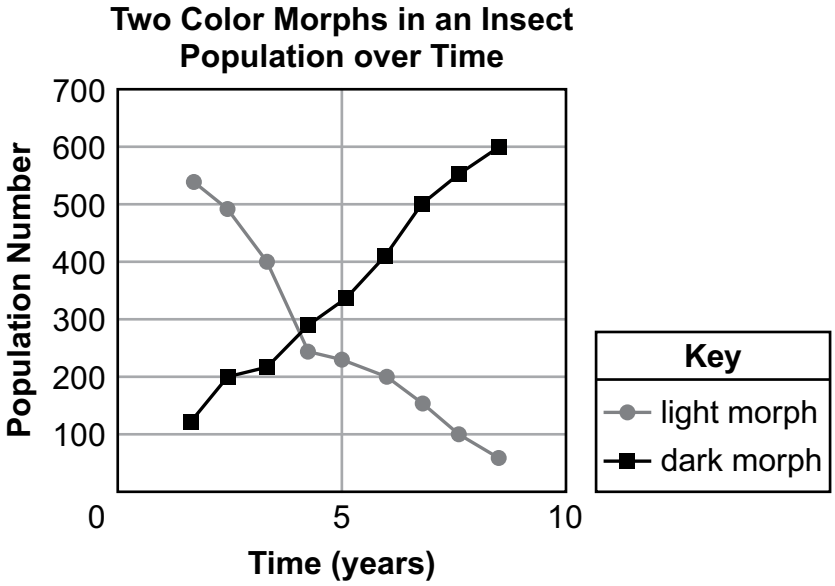
Ⓑ their fur colors

Ⓒ their habitats

Ⓓ their diets

Category	Item-Specific Information
Alignment	3.1.9-12.S
Answer Key	A
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Key: Skull shape is determined by an organism's DNA. B. Fur color is not an indicator of genetic relatedness between species. C. Information about where an organism lives will not necessarily provide information about the genetic relatedness between species. D. An organism's diet is influenced by environmental and behavioral factors.

8. Use the graph below to answer the question.



A certain type of insect can be either a light morph or a dark morph. The graph shows the numbers of light-morph insects and dark-morph insects in a population for an area over time. Which explanation is **best** supported by the graph?

Ⓐ The light morph was a harmful trait, so the light-morph insects changed over time to become the dark-morph insects.

Ⓑ The environmental conditions initially favored the light morph, but over time the dark morph was a more advantageous trait.

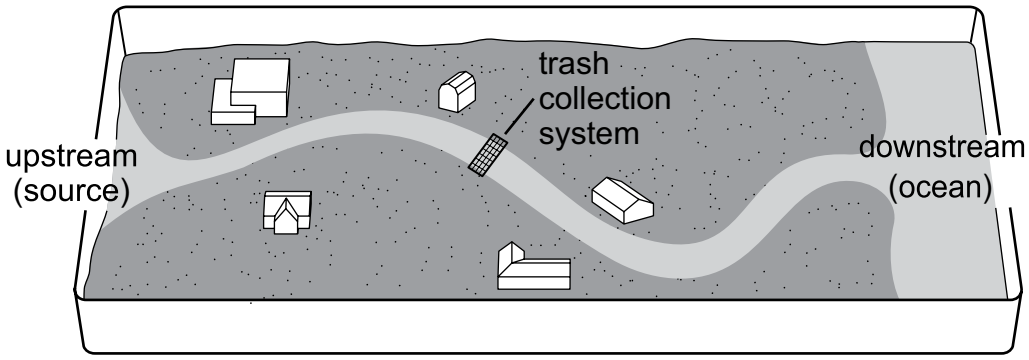
Ⓒ The dark morph did not provide individual insects with an advantage, so that trait was less likely to be passed on to offspring.

Ⓓ The dark-morph insects were eaten by predators more often than the light-morph insects, so the light morph became more common in the population.

Category	Item-Specific Information
Alignment	3.1.9-12.U
Answer Key	B
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Insects are unable to change traits based on need. Natural selection results in the change in proportion of variation already present in a population over time. B. Key: The light morph decreased over time as it became less advantageous, and the dark morph increased over time as it helped insects survive and pass on the dark morph trait to offspring. C. The dark morph provided insects with a survival advantage, and over time insects with the dark morph increased in proportion to insects with the light morph. D. The dark-morph insects were eaten less often and survived to be the dominant phenotype in the population.

9. Use the diagram below to answer the question.

Stream Table Model



Two students are designing a solution to reduce the amount of trash in local waterways. Their goal is to design a solution with the least impact on the local ecosystem. They use a stream table to create a model of their solution.

Which set of questions would **best** help the students evaluate the effectiveness of their solution in the actual environment?

Ⓐ What will the system cost to operate?
How well can the solution allow organisms to pass through it?

Ⓑ What types of trash will the system collect?
How much trash from the ocean will enter the stream?

Ⓒ What will the system cost to operate?
How many pounds of trash will the system collect per minute?

Ⓓ What types of trash will the system collect?
How well can the solution allow organisms to pass through it?

Category	Item-Specific Information
Alignment	3.1.9-12.V
Answer Key	D
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Operation cost is unrelated to the evaluation of the system's effectiveness in the environment. B. Evaluating the quantity of trash collected provides data related to the system's function and not how it affects the ecosystem. C. Operation cost is unrelated to the evaluation of the system's effectiveness in the environment. Evaluating the rate of trash collection provides data related to the system's function and not how it affects the ecosystem. D. Key: Analyzing the types of trash the system collects is useful, and analyzing the behaviors and survival of organisms in response to the system will allow students to evaluate how the system affects living parts of the ecosystem.

10. Many species of fish and other aquatic animals have darker coloration on their top side and lighter coloration on their underside. This phenomenon is called countershading, and it occurs in oceans and bodies of fresh water. Which statement **best** explains this phenomenon?

Ⓐ The common ancestor of all fish had this color pattern.

Ⓑ Sediment tends to fall onto the tops of aquatic animals, making them darker on top.

Ⓒ This color pattern provides camouflage and is favored by natural selection in many species.

Ⓓ The tops of aquatic animals receive more sunlight than the undersides do, so the tops become darker.

Category	Item-Specific Information
Alignment	3.1.9-12.W
Answer Key	C
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. The presence of a trait in organisms today does not imply that all organisms in the past had this trait. B. Sediment falling onto the tops of aquatic animals would not be an inheritable trait. C. Key: Countershading provides a survival advantage to organisms in certain species, and so this trait continues to be passed to offspring. D. The effects of sunlight on coloration would not be an inheritable trait.

11. Scientists studied a plant species growing in two types of soil: soil polluted by heavy metals and unpolluted soil. They found some genetic variations that were more common in the plants living in polluted soil. Which statement **best** explains how the pollution impacted the genetic diversity within the plant species?

Ⓐ The pollution caused all individual plants to have the same genes.

Ⓑ The pollution affected which individual plants survive and successfully reproduce.

Ⓒ The pollution was absorbed by an individual plant's roots and transferred to its cells.

Ⓓ The pollution caused individual plants to choose a stronger gene variation to increase survival.

Category	Item-Specific Information
Alignment	3.1.9-12.X
Answer Key	B
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. The pollution caused plants with genetic variation to be more successful. B. Key: The pollution resulted in plants with advantageous genetic variations surviving and passing on those variations to offspring. C. Absorption of pollution by a plant does not explain the change in genetic diversity within the plant species. D. Genetic variation in living organisms is not a choice; rather, it is a result of organisms with advantageous traits surviving to pass those traits onto offspring.

Directions: Use the information presented on page 72 to answer questions 12 and 13.

Managing Pennsylvania's Forests

Forests cover about 60% of the land in Pennsylvania. These ecosystems protect drinking water, provide recreational opportunities, and are a source of lumber, which provides many jobs. Forest managers make decisions about when and how trees are cut, whether new trees are planted, and other actions that can have significant effects on the environment and on people's lives.

Another function of forest ecosystems is carbon storage. As trees grow, they remove carbon from the air and store it in their tissues. However, about 40% of the carbon stored in a forest is contained in the upper layers of soil, and about 23% is stored in the layer of plant litter that lies on top of the soil. The remaining 37% is stored in the trees themselves. This type of carbon storage, called sequestration, can offset some of the carbon released into the atmosphere by human activities.

There are many factors that affect how much carbon a forest sequesters (stores). Large mature trees store large amounts of carbon and provide habitat for wildlife; young trees absorb more carbon as they grow. A product made from wood continues to store carbon until it is burned or begins to decompose, so the ways that harvested trees are used can also affect the carbon cycle.

Through the choices they make, Pennsylvania's forest managers affect not only carbon sequestration but also forest ecosystem health and the benefits that forests provide to residents and visitors.

12. Wild pigs are invasive animals that consume a wide variety of plants and small animals. What is the **most likely** result of recent increases in wild pig populations living in forests?

Ⓐ a decrease of carbon storage due to increased health of the forests' trees

Ⓑ decreased populations of native species due to consumption of their food sources

Ⓒ an increase of carbon storage due to increased health of the forests' trees

Ⓓ increased populations of native species due to consumption of their food sources

Category	Item-Specific Information
Alignment	3.1.9-12.M
Answer Key	B
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Increased health of the forests' trees would result in an increase in carbon storage. B. Key: Native plant and animal populations are likely to be reduced as they are consumed by growing wild pig populations. C. The growing wild pig populations are likely to reduce the forest health by reducing native plant and animal populations and disrupting ecosystem balance. D. The growing wild pig populations are likely to reduce native plant and animal populations.

13. A forest manager proposes cutting down specific areas of an old-growth forest and planting young trees. The forest manager's goal is to reduce the total amount of carbon in the atmosphere. Which method of disposing of the old-growth trees will **best** help the forest manager meet this goal?

Ⓐ transforming the wood into paper products

Ⓑ allowing the wood to decompose for use as compost

Ⓒ using the wood to build furniture or other durable products

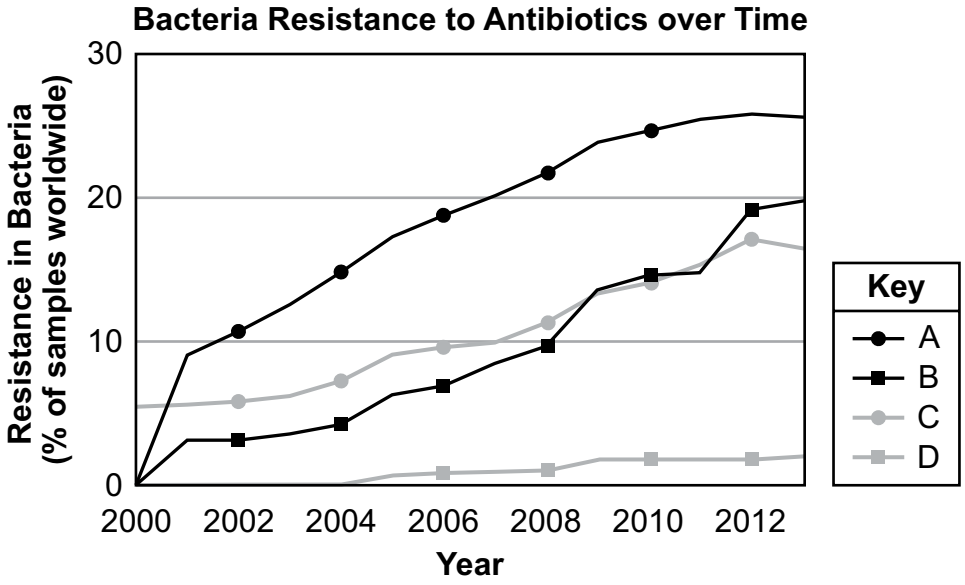
Ⓓ grinding up the wood into chips used for gardening and landscaping

Category	Item-Specific Information
Alignment	3.1.9-12.N
Answer Key	C
Depth of Knowledge	2
p-value A	N/A
p-value B	N/A
p-value C	N/A
p-value D	N/A
Option Annotations	A. Transforming wood into paper products will release stored carbon. B. Decomposition of wood releases stored carbon. C. Key: Wood that is used for furniture continues to store carbon. D. Grinding wood into chips accelerates its decomposition and results in the release of stored carbon.

THIS PAGE IS INTENTIONALLY BLANK.

Constructed-Response Item

14. Resistance to antibiotics is a trait that is developing in several types of bacteria. The graph shows four types of antibiotics and the percentage of bacteria that have become resistant to each type of antibiotic over time.



Part A: Using evidence from the graph, identify the type of antibiotic to which bacteria have developed the **most** resistance.

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

Part B: Describe how changes in bacterial DNA enable bacteria populations to develop resistance to a type of antibiotic.

Part C: Identify the antibiotic that scientists should investigate to understand how to effectively treat bacterial infections. Explain your answer using the data provided.

Item-Specific Scoring Guideline

#14 Item Information

Category	Item-Specific Information
Alignment	3.1.9-12.Q
Depth of Knowledge	3
Mean Score	N/A

Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a *thorough* understanding of making and defending a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors by • analyzing a graph to identify the type of antibiotic to which bacteria have developed the most resistance **AND** • describing how changes in bacterial DNA enable bacteria populations to develop resistance to a type of antibiotic **AND** • identifying and explaining the antibiotic that scientists should investigate to understand how to effectively treat bacterial infections. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of making and defending a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors by fulfilling **two** of the bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of making and defending a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors 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.

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

Responses that will receive credit:

Part A (1 point):

- Bacteria have developed the most resistance to antibiotic A.

Part B (1 point):

- Bacteria that survive antibiotic treatment have some mutation in DNA that allows them to survive to reproduce, resulting in more antibiotic-resistant bacteria.
- Genetic mutations can result in new traits. Changes in bacterial DNA may result in a new trait that provides resistance to antibiotics. The bacteria with the new trait (beneficial trait) will increase in the population.
- Changes in bacterial DNA caused by mutations may provide some bacteria with a survival advantage. These surviving bacteria pass their DNA (mutations) on to offspring. The offspring will have antibiotic resistance and can successfully survive and reproduce.

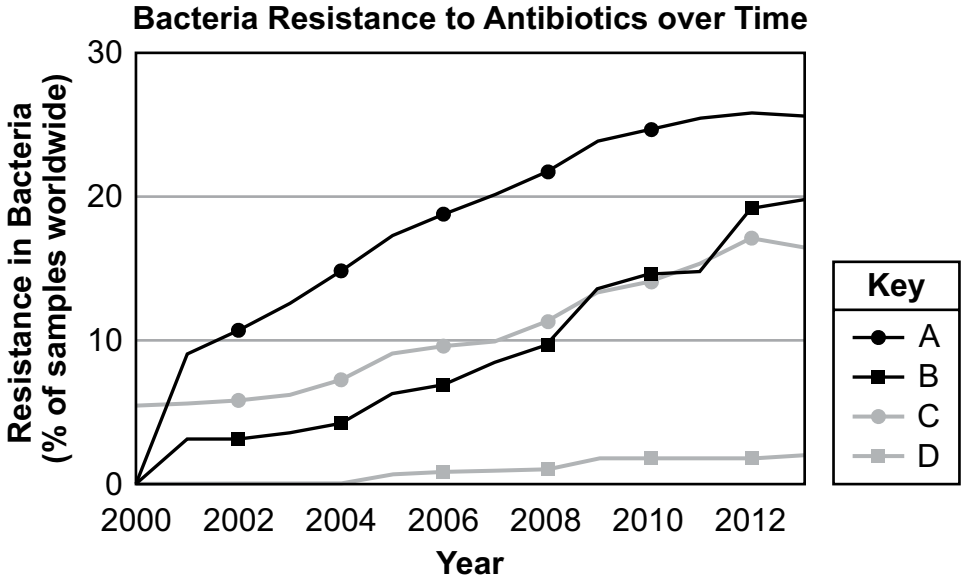
Part C (1 point):

- Scientists should investigate antibiotic D since it produced the least amount of antibiotic-resistant bacteria over time (less than 5% of total bacteria).
- Scientists should investigate antibiotic D since the resistance to the antibiotic has remained steady and is lower than all the other antibiotics.

STUDENT RESPONSE

Response Score: 3 points

14. Resistance to antibiotics is a trait that is developing in several types of bacteria. The graph shows four types of antibiotics and the percentage of bacteria that have become resistant to each type of antibiotic over time.



Part A: Using evidence from the graph, identify the type of antibiotic to which bacteria have developed the **most** resistance.

Antibiotic A

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

Part B: Describe how changes in bacterial DNA enable bacteria populations to develop resistance to a type of antibiotic.

There's probably a mutation that allows them to survive

Part C: Identify the antibiotic that scientists should investigate to understand how to effectively treat bacterial infections. Explain your answer using the data provided.

I think it should be D. From the graph it has the least resistance

The response demonstrates a thorough understanding of making and defending a claim based on evidence that inheritable genetic variations may result from new genetic combinations through meiosis, viable errors occurring during replication, and/or mutations caused by environmental factors. In Part A, the response correctly analyzes a graph to identify the type of antibiotic to which bacteria have developed the most resistance (*Antibiotic A*). In Part B, the response correctly describes how changes in bacterial DNA enable bacteria populations to develop resistance to a type of antibiotic (*There's probably a mutation that allows them to survive*). In Part C, the response correctly identifies and explains the antibiotic that scientists should investigate to understand how to effectively treat bacterial infections (*it should be D. From the graph it has the least resistance*). The response is clear, complete, and correct.

STUDENT RESPONSE

Computer Response Score: 2 points

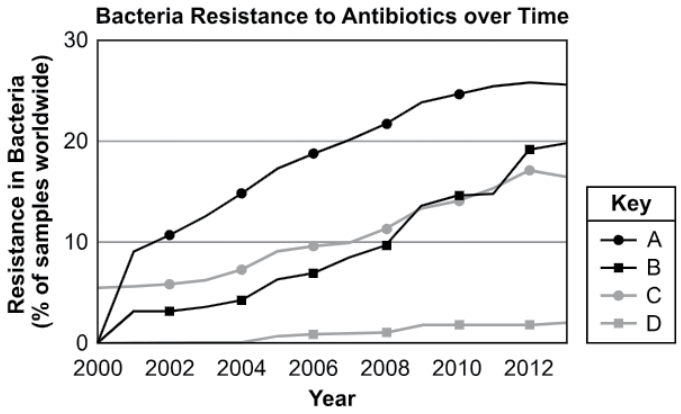
PART A

Question 14
Page 1 of 3

Line Guide

Item ID

Resistance to antibiotics is a trait that is developing in several types of bacteria. The graph shows four types of antibiotics and the percentage of bacteria that have become resistant to each type of antibiotic over time.



Part A: Using evidence from the graph, identify the type of antibiotic to which bacteria have developed the **most** resistance.

EQ

A

1 / 500

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

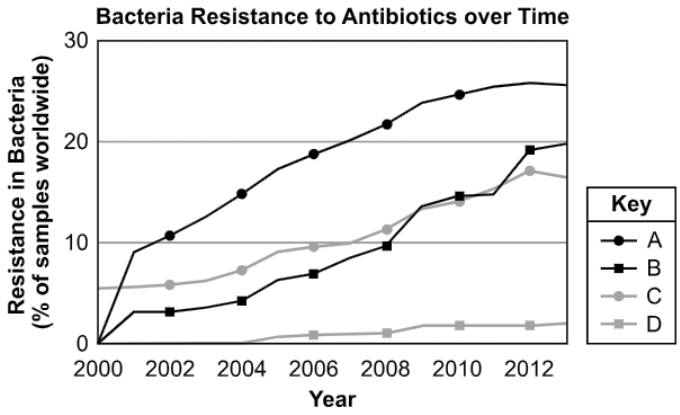
PART B

Question 14
Page 2 of 3

Line Guide

Item ID

Resistance to antibiotics is a trait that is developing in several types of bacteria. The graph shows four types of antibiotics and the percentage of bacteria that have become resistant to each type of antibiotic over time.



Part B: Describe how changes in bacterial DNA enable bacteria populations to develop resistance to a type of antibiotic.

EQ

They could have a special immunity like something in their DNA.

63 / 500

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

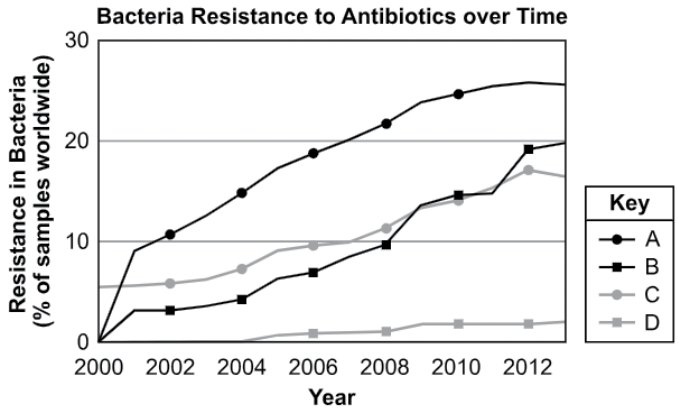
PART C

Question 14
Page 3 of 3

Line Guide

Item ID

Resistance to antibiotics is a trait that is developing in several types of bacteria. The graph shows four types of antibiotics and the percentage of bacteria that have become resistant to each type of antibiotic over time.



Part C: Identify the antibiotic that scientists should investigate to understand how to effectively treat bacterial infections. Explain your answer using the data provided.

EQ

They should investigate D it the lowest on the graph meaning it has the least amount of immunity.

97 / 500

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

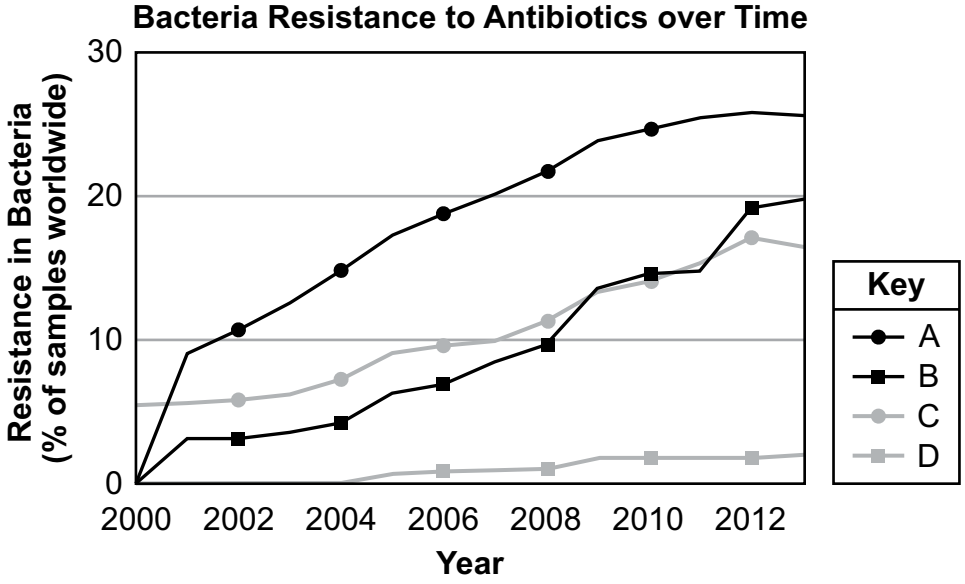
The response demonstrates a partial understanding of making and defending a claim based on evidence that inheritable genetic variation may result from new genetic combinations through meiosis, viable errors occurring during replication, and/or mutations caused by environmental factors. In Part A, the response correctly analyzes a graph to identify the type of antibiotic to which bacteria have developed the most resistance (*A*). In Part B, the response incorrectly describes how changes in bacterial DNA enable bacteria populations to develop resistance to a type of antibiotic (*They could have a special immunity like something in their DNA*) and does not receive any credit. In Part C, the response correctly identifies and explains the antibiotic that scientists should investigate to understand how to effectively treat bacterial infections (*They should investigate D it the lowest on the graph meaning it has the least amount of immunity*).

THIS PAGE IS INTENTIONALLY BLANK.

STUDENT RESPONSE

Response Score: 1 point

14. Resistance to antibiotics is a trait that is developing in several types of bacteria. The graph shows four types of antibiotics and the percentage of bacteria that have become resistant to each type of antibiotic over time.



Part A: Using evidence from the graph, identify the type of antibiotic to which bacteria have developed the **most** resistance.

It's antibiotic A or B

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

Part B: Describe how changes in bacterial DNA enable bacteria populations to develop resistance to a type of antibiotic.

Bacteria can develop resistance through genetic mutation of the DNA that allows it to survive the antibiotic.

Part C: Identify the antibiotic that scientists should investigate to understand how to effectively treat bacterial infections. Explain your answer using the data provided.

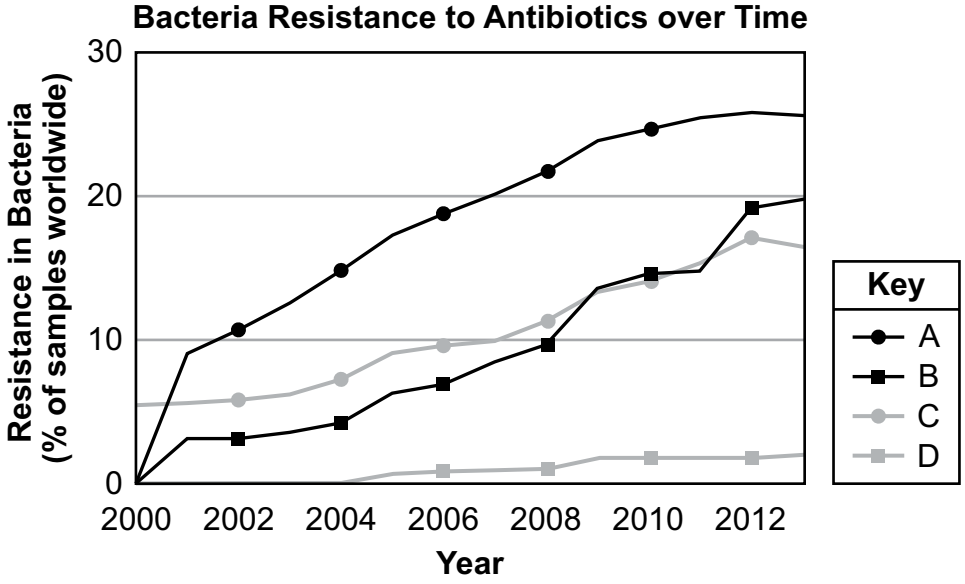
The bacteria that should be investigated is C or D because they have the lowest numbers on the graph meaning they have the least resistance to antibiotics.

The response demonstrates a minimal understanding of making and defending a claim based on evidence that inheritable genetic variation may result from new genetic combinations through meiosis, viable errors occurring during replication, and/or mutations caused by environmental factors. In Part A, the response (*It's antibiotic A or B*) incorrectly analyzes a graph to identify the type of antibiotic to which bacteria have developed the most resistance and does not receive any credit. In Part B, the response correctly describes how changes in bacterial DNA enable bacteria populations to develop resistance to a type of antibiotic (*Bacteria can develop resistance through genetic mutation of the DNA*). In Part C, the response (*The bacteria that should be investigated is C or D*) incorrectly identifies and explains the antibiotic that scientists should investigate to understand how to effectively treat bacterial infections and does not receive any credit.

STUDENT RESPONSE

Response Score: 0 points

14. Resistance to antibiotics is a trait that is developing in several types of bacteria. The graph shows four types of antibiotics and the percentage of bacteria that have become resistant to each type of antibiotic over time.



Part A: Using evidence from the graph, identify the type of antibiotic to which bacteria have developed the **most** resistance.

They all go up somewhat

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

Part B: Describe how changes in bacterial DNA enable bacteria populations to develop resistance to a type of antibiotic.

The genes and the DNA

Part C: Identify the antibiotic that scientists should investigate to understand how to effectively treat bacterial infections. Explain your answer using the data provided.

Bacteria A because its at the top

The response provides insufficient evidence to demonstrate any understanding of making and defending a claim based on evidence that inheritable genetic variation may result from new genetic combinations through meiosis, viable errors occurring during replication, and/or mutations caused by environmental factors. In Part A, the response (*They all go up somewhat*) incorrectly analyzes a graph to identify the type of antibiotic to which bacteria have developed the most resistance and does not receive any credit. In Part B, the response (*The genes and the DNA*) incorrectly describes how changes in bacterial DNA enable bacteria populations to develop resistance to a type of antibiotic and does not receive any credit. In Part C, the response (*Bacteria A because its at the top*) incorrectly identifies and explains the antibiotic that scientists should investigate to understand how to effectively treat bacterial infections and does not receive any credit.

Constructed-Response Item

15. The blue-tailed skink is a small lizard. It was listed as extinct in the wild after its populations on a remote island experienced massive declines. The reasons for the population declines were unknown, but they were suspected to be related to an invasive predator species (a centipede) that was introduced to the island by humans. The centipedes are still present on the island.

Scientists developed a breeding program to keep the skink from extinction. Before introducing the blue-tailed skinks back into the wild, scientists conducted a simulation with small numbers of the organisms. The tables summarize the conditions tested and the results of the simulation.

Results of Small-Group Simulation

Condition Tested	Skink Survival after 3 Months
no centipedes	93%
low density of centipedes	63%
high density of centipedes	49%

Average Skink Overall Health at Start and End of Simulation

Condition Tested	0 Months	12 Months
no centipedes	healthy	healthy
low density of centipedes	healthy	unhealthy
high density of centipedes	healthy	unhealthy

Part A: Identify a likely reason why the scientists first conducted a small-scale simulation instead of directly introducing the blue-tailed skink into the wild.

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

Part B: Predict the likely outcome for reintroducing blue-tailed skinks to their native island. Support your answer with evidence from the simulation.

Part C: Describe the long-term genetic benefit to introducing blue-tailed skinks from a zoo population to a habitat with wild blue-tailed skinks.

Item-Specific Scoring Guideline

#15 Item Information

Category	Item-Specific Information
Alignment	3.1.9-12.V
Depth of Knowledge	2
Mean Score	N/A

Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a *thorough* understanding of creating or revising a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity by • identifying a likely reason why the scientists first conducted a small-scale simulation instead of directly introducing the blue-tailed skink into the wild **AND** • predicting the likely outcome for reintroducing blue-tailed skinks to their native island **AND** • describing the long-term genetic benefit to introducing blue-tailed skinks from a zoo population to a habitat with wild blue-tailed skinks. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of creating or revising a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity by fulfilling **two** of the bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of creating or revising a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity 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.

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

Responses that will receive credit:

Part A (1 point):

- Small-scale simulations allow scientists to predict what will happen without harming the actual population.
- Time and money may be a limitation (constraint) of the breeding program.
- Reintroducing skinks to the wild without doing a small-scale simulation could end the breeding program.
- Small-scale simulations conserve resources that might have been lost if a large-scale reintroduction failed.
- A small-scale simulation allows scientists to carefully manipulate the variables (e.g., density of centipedes, ages/sexes of the skinks).

Part B (1 point):

- If there were no changes to the centipede populations on the island, then the skinks would likely have a survival rate of 49%–63% after 3 months depending on centipede density. After 12 months, the population would be unhealthy.
- If the centipede population did not exist on the native island, the population would be healthy and survive. However, if there were a centipede population, the skink would once again be quite unsuccessful at surviving on its native island over time.
- A large percentage of the skinks would become sick or die, as shown by the large percentage that became sick or died in the presence of the centipedes in the simulation.

Part C (1 point):

- The genetic diversity in a population can increase over time when captive and wild skinks are allowed to interact and reproduce with one another.
- The addition of the zoo skinks will change the genetic diversity of the population. This change will be positive if beneficial traits are introduced.

STUDENT RESPONSE

Response Score: 3 points

15. The blue-tailed skink is a small lizard. It was listed as extinct in the wild after its populations on a remote island experienced massive declines. The reasons for the population declines were unknown, but they were suspected to be related to an invasive predator species (a centipede) that was introduced to the island by humans. The centipedes are still present on the island.

Scientists developed a breeding program to keep the skink from extinction. Before introducing the blue-tailed skinks back into the wild, scientists conducted a simulation with small numbers of the organisms. The tables summarize the conditions tested and the results of the simulation.

Results of Small-Group Simulation

Condition Tested	Skink Survival after 3 Months
no centipedes	93%
low density of centipedes	63%
high density of centipedes	49%

Average Skink Overall Health at Start and End of Simulation

Condition Tested	0 Months	12 Months
no centipedes	healthy	healthy
low density of centipedes	healthy	unhealthy
high density of centipedes	healthy	unhealthy

Part A: Identify a likely reason why the scientists first conducted a small-scale simulation instead of directly introducing the blue-tailed skink into the wild.

The scientists conducted a small-scale simulation so they could control as many variables and resources as possible.

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

Part B: Predict the likely outcome for reintroducing blue-tailed skinks to their native island. Support your answer with evidence from the simulation.

It depends, based on the charts if there are no centipedes most of the skinks will survive and be healthy. If there is a low density of centipedes a little more than half will survive but they'll be unhealthy. If there's a high density of centipedes less than half will live and they'll still be unhealthy.

Part C: Describe the long-term genetic benefit to introducing blue-tailed skinks from a zoo population to a habitat with wild blue-tailed skinks.

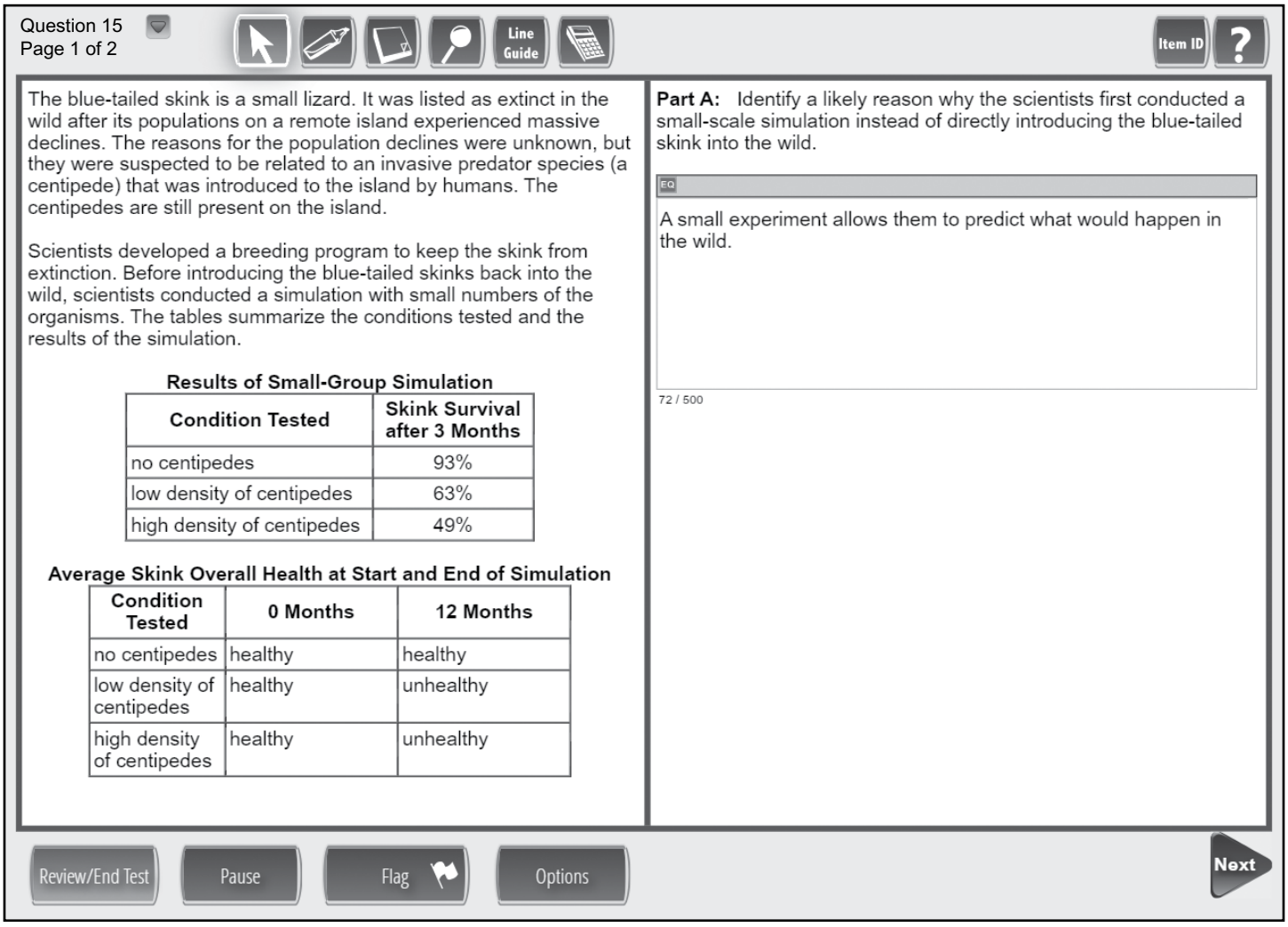
Introducing two separate populations of skinks will increase their genetic diversity which will increase their potential survivability.

The response demonstrates a thorough understanding of creating or revising a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. In Part A, the response correctly identifies a likely reason why the scientists first conducted a small-scale simulation instead of directly introducing the blue-tailed skink to the wild (*so they could control as many variables and resources as possible*). In Part B, the response correctly predicts the outcome for reintroducing blue-tailed skinks to their native island (*It depends, based on the charts if there are no centipedes most of the skinks will survive and be healthy. If there is a low density of centipedes a little more than half will survive but they'll be unhealthy. If there's a high density of centipedes less than half will live and they'll still be unhealthy*). In Part C, the response correctly describes the long-term genetic benefit to introducing blue-tailed skinks from a zoo population to a habitat with wild blue-tailed skinks (*Introducing two separate populations of skinks will increase their genetic diversity which will increase their potential survivability*). The response is clear, complete, and correct.

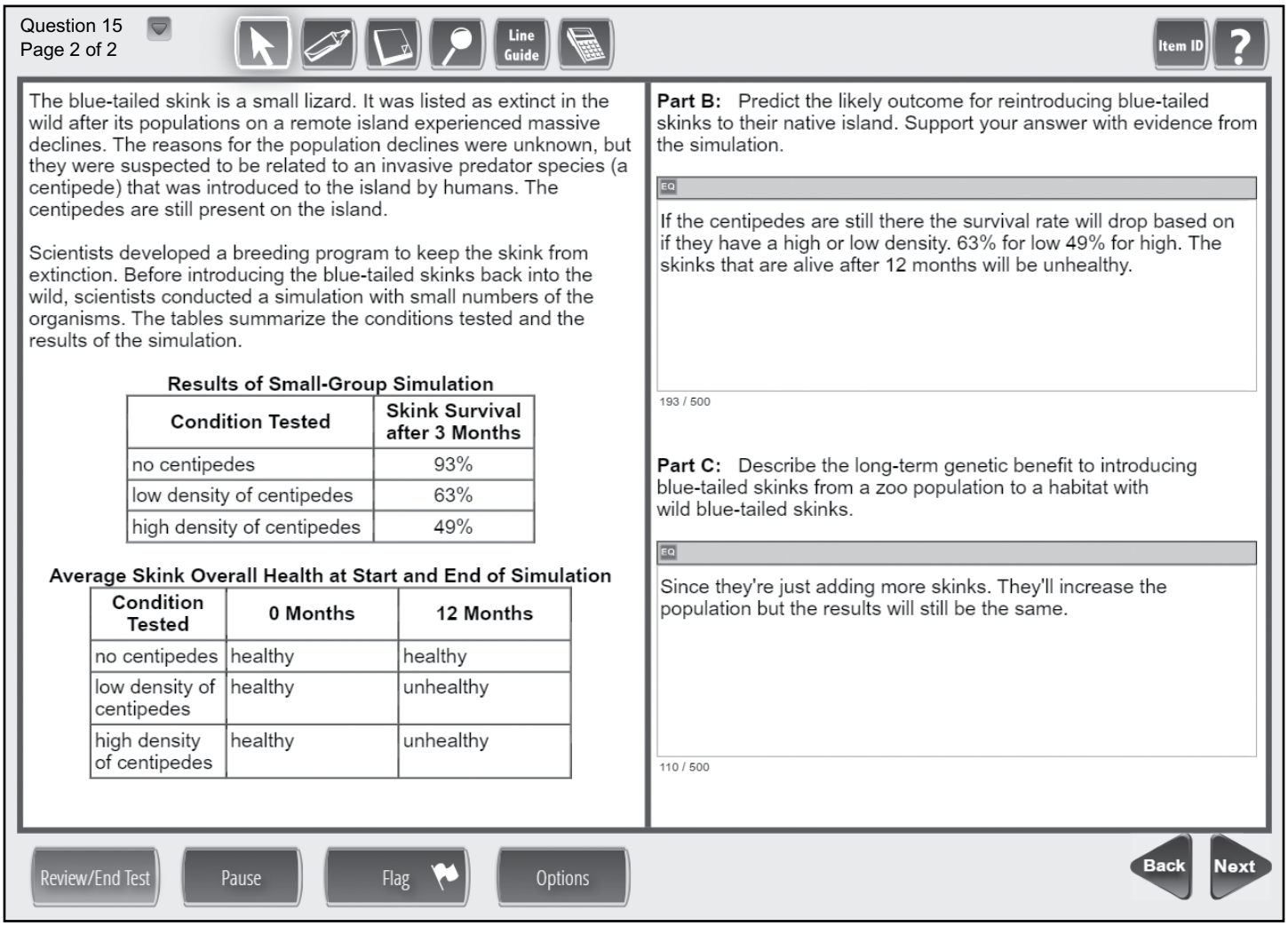
STUDENT RESPONSE

Computer Response Score: 2 points

PART A



PARTS B and C



The response demonstrates a partial understanding of creating or revising a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. In Part A, the response correctly identifies a likely reason why the scientists first conducted a small-scale simulation instead of directly introducing the blue-tailed skink to the wild (*A small experiment allows them to predict what would happen in the wild*). In Part B, the response correctly predicts the outcome for reintroducing blue-tailed skinks to their native island (*If the centipedes are still there the survival rate will drop based on if they have a high or low density. 63% for low 49% for high. The skinks that are alive after 12 months will be unhealthy*). In Part C, the response (*Since they're just adding more skinks. They'll increase the population but the results will still be the same*) incorrectly describes the long-term genetic benefit to introducing blue-tailed skinks from a zoo population to a habitat with wild blue-tailed skinks and does not receive any credit.

STUDENT RESPONSE

Response Score: 1 point

15. The blue-tailed skink is a small lizard. It was listed as extinct in the wild after its populations on a remote island experienced massive declines. The reasons for the population declines were unknown, but they were suspected to be related to an invasive predator species (a centipede) that was introduced to the island by humans. The centipedes are still present on the island.

Scientists developed a breeding program to keep the skink from extinction. Before introducing the blue-tailed skinks back into the wild, scientists conducted a simulation with small numbers of the organisms. The tables summarize the conditions tested and the results of the simulation.

Results of Small-Group Simulation

Condition Tested	Skink Survival after 3 Months
no centipedes	93%
low density of centipedes	63%
high density of centipedes	49%

Average Skink Overall Health at Start and End of Simulation

Condition Tested	0 Months	12 Months
no centipedes	healthy	healthy
low density of centipedes	healthy	unhealthy
high density of centipedes	healthy	unhealthy

Part A: Identify a likely reason why the scientists first conducted a small-scale simulation instead of directly introducing the blue-tailed skink into the wild.

They only had enough money to do a simulation.

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

Part B: Predict the likely outcome for reintroducing blue-tailed skinks to their native island. Support your answer with evidence from the simulation.

The centipedes will kill all of the skinks just like they did the first time

Part C: Describe the long-term genetic benefit to introducing blue-tailed skinks from a zoo population to a habitat with wild blue-tailed skinks.

Adding more skinks means it'll take longer for the centipedes to eat them so they'll more likely to survive.

The response demonstrates a minimal understanding of creating or revising a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. In Part A, the response correctly identifies a likely reason why the scientists first conducted a small-scale simulation instead of directly introducing the blue-tailed skink to the wild (*They only had enough money to do a simulation*). In Part B, the response (*The centipedes will kill all of the skinks just like they did the first time*) incorrectly predicts the outcome for reintroducing blue-tailed skinks to their native island and does not receive any credit. In Part C, the response (*Adding more skinks means it'll take longer for the centipedes to eat them so they'll more likely to survive*) incorrectly describes the long-term genetic benefit to introducing blue-tailed skinks from a zoo population to a habitat with wild blue-tailed skinks and does not receive any credit.

STUDENT RESPONSE

Response Score: 0 points

15. The blue-tailed skink is a small lizard. It was listed as extinct in the wild after its populations on a remote island experienced massive declines. The reasons for the population declines were unknown, but they were suspected to be related to an invasive predator species (a centipede) that was introduced to the island by humans. The centipedes are still present on the island.

Scientists developed a breeding program to keep the skink from extinction. Before introducing the blue-tailed skinks back into the wild, scientists conducted a simulation with small numbers of the organisms. The tables summarize the conditions tested and the results of the simulation.

Results of Small-Group Simulation

Condition Tested	Skink Survival after 3 Months
no centipedes	93%
low density of centipedes	63%
high density of centipedes	49%

Average Skink Overall Health at Start and End of Simulation

Condition Tested	0 Months	12 Months
no centipedes	healthy	healthy
low density of centipedes	healthy	unhealthy
high density of centipedes	healthy	unhealthy

Part A: Identify a likely reason why the scientists first conducted a small-scale simulation instead of directly introducing the blue-tailed skink into the wild.

Experiments are part of the scientific method

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

Part B: Predict the likely outcome for reintroducing blue-tailed skinks to their native island. Support your answer with evidence from the simulation.

maybe they'll live or maybe they'll die. It just depends.

Part C: Describe the long-term genetic benefit to introducing blue-tailed skinks from a zoo population to a habitat with wild blue-tailed skinks.

Since they're all skinks the genetics will be the same.

The response provides insufficient evidence to demonstrate any understanding of creating or revising a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. In Part A, the response (*Experiments are part of the scientific method*) incorrectly identifies a likely reason why the scientists first conducted a small-scale simulation instead of directly introducing the blue-tailed skink to the wild and does not receive any credit. In Part B, the response (*Maybe they'll live or maybe they'll die. It just depends*) incorrectly predicts the outcome for reintroducing blue-tailed skinks to their native island and does not receive any credit. In Part C, the response (*Since they're all skinks the genetics will be the same*) incorrectly describes the long-term genetic benefit to introducing blue-tailed skinks from a zoo population to a habitat with wild blue-tailed skinks and does not receive any credit.

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	3.1.9-12.D	B	1	N/A	N/A	N/A	N/A
2	3.1.9-12.N	A	2	N/A	N/A	N/A	N/A
3	3.1.9-12.O	D	2	N/A	N/A	N/A	N/A
4	3.1.9-12.P	C	2	N/A	N/A	N/A	N/A
5	3.1.9-12.R	A	2	N/A	N/A	N/A	N/A
6	3.1.9-12.R	D	2	N/A	N/A	N/A	N/A
7	3.1.9-12.S	A	2	N/A	N/A	N/A	N/A
8	3.1.9-12.U	B	2	N/A	N/A	N/A	N/A
9	3.1.9-12.V	D	2	N/A	N/A	N/A	N/A
10	3.1.9-12.W	C	2	N/A	N/A	N/A	N/A
11	3.1.9-12.X	B	2	N/A	N/A	N/A	N/A
12	3.1.9-12.M	B	2	N/A	N/A	N/A	N/A
13	3.1.9-12.N	C	2	N/A	N/A	N/A	N/A

Constructed-Response

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
14	3.1.9-12.Q	3	3	N/A
15	3.1.9-12.V	3	2	N/A

Keystone Exams
Biology

Item and Scoring Sampler