



pennsylvania
DEPARTMENT OF EDUCATION



**PENNSYLVANIA
KEYSTONE EXAMS**

BIOLOGY

ITEM AND SCORING SAMPLER

2015

INFORMATION ABOUT BIOLOGY

Introduction 1
 About the Keystone Exams 1
 Item and Scoring Sampler Format 3
 Biology Exam Directions 4
 General Description of 3-Point Scoring Guidelines for Biology 5

BIOLOGY MODULE 1

Multiple-Choice Items..... 6
 Constructed-Response Item 20
 Constructed-Response Item 32
 Biology Module 1—Summary Data 44

BIOLOGY MODULE 2

Multiple-Choice Items..... 45
 Constructed-Response Item 62
 Constructed-Response Item 74
 Biology Module 2—Summary Data 86

INTRODUCTION

The Pennsylvania Department of Education (PDE) provides districts and schools with tools to assist in delivering focused instructional programs aligned to the Pennsylvania Core Standards. These tools include the standards, assessment anchor documents, assessment handbooks, and content-based item and scoring samplers. This 2015 Biology Item and Scoring Sampler is a useful tool for Pennsylvania educators in preparing students for the Keystone Exams.

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

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

ABOUT THE KEYSTONE EXAMS

The Keystone Exams are end-of-course assessments currently designed to assess proficiencies in Algebra I, Biology, and Literature. The Pennsylvania Department of Education continues to evaluate the implementation schedule for additional subjects, including English Composition, Civics and Government, U.S. History, World History, Algebra II, Geometry, and Chemistry. The Keystone Exams are just one component of Pennsylvania's high school graduation requirements. Students must also earn state-specified credits, complete a culminating project, and complete any additional district requirements to receive a Pennsylvania high school diploma.

For detailed information about how the Keystone Exams are being integrated into the Pennsylvania graduation requirements, please contact the Pennsylvania Department of Education or visit the PDE website at <http://www.education.pa.gov>.

Alignment

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

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

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

Depth of Knowledge

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

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

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

Exam Format

The Keystone Exams are delivered in a paper-and-pencil format as well as in a computer-based online format. The multiple-choice 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 minute to one and a half minutes to complete. Each constructed-response item is designed to take about eight minutes to complete. The estimated time to respond to a test question is the same for both test formats. During an actual exam administration, students are given additional time as necessary to complete the exam.

ITEM AND SCORING SAMPLER FORMAT

This sampler includes the test directions and scoring guidelines that appear in the Keystone Exams. Each sample multiple-choice item is followed by a table that includes the alignment, answer key, DOK, the percentage² 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, DOK, and the mean student score. Additionally, each of the included item-specific scoring guidelines is combined with sample student responses representing each score point to form a practical, item-specific scoring guide. The General Description of Scoring Guidelines for Biology used to develop the item-specific scoring guidelines should be used if any additional item-specific scoring guidelines are created for use within local instructional programs.

Example Multiple-Choice Item Information Table

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

Example Constructed-Response Item Information Table

Alignment	Assigned AAEC	Depth of Knowledge	Assigned DOK	Mean Score	

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

BIOLOGY EXAM DIRECTIONS

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

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

There are two types of questions in this module.

Multiple-Choice Questions

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

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

Constructed-Response Questions

These questions will require you to write your response.

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

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

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

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

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

GENERAL DESCRIPTION OF 3-POINT SCORING GUIDELINES FOR BIOLOGY

3 POINTS

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

2 POINTS

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

1 POINT

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

0 POINTS

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

BIOLOGY MODULE 1

MULTIPLE-CHOICE ITEMS

1. Which characteristic is shared by **all** prokaryotic and eukaryotic organisms?
- the ability to reproduce asexually
 - the ability to make their own food
 - the need for a source of energy
 - the need for oxygen for respiration

Item Information				Option Annotations
Alignment		BIO.A.1.1.1		<p>A. Reproduction in prokaryotes is asexual, but reproduction in eukaryotes can be asexual or sexual.</p> <p>B. Many prokaryotes and eukaryotes are heterotrophic, which means they consume other organisms as food.</p> <p>C. Key: All prokaryotic and eukaryotic cells require a source of energy to survive.</p> <p>D. Some prokaryotes and eukaryotes perform anaerobic cellular respiration.</p>
Answer Key		C		
Depth of Knowledge		2		
p-values				
A	B	C	D	
20%	13%	50%	17%	

2. Life functions are performed at many levels of biological organization. Which level of biological organization is the simplest level at which a structure can support life functions?
- A. cell
 - B. tissue
 - C. organelle
 - D. organ system

Item Information				Option Annotations
Alignment		BIO.A.1.2.2		<p>A. Key: A cell is the smallest functional unit that can reproduce and survive independently.</p> <p>B. Tissue is made up of similar cells that work together to perform a specific function.</p> <p>C. An organelle is a membrane-bound structure within a cell that performs an integral function for the cell but is not capable of surviving independently.</p> <p>D. An organ system is a group of organs that work together to perform a task for an organism.</p>
Answer Key		A		
Depth of Knowledge		2		
<i>p</i>-values				
A	B	C	D	
62%	9%	18%	11%	

3. The opening of the stomata allows water to evaporate from inside the leaf in a process known as transpiration. As this occurs, water molecules cling to one another and pull water in a continuous stream up the stem of the plant from the roots to the leaves. Which property of water makes this movement possible?
- A. cohesion
 - B. freezing point
 - C. high specific heat
 - D. temperature-dependent density

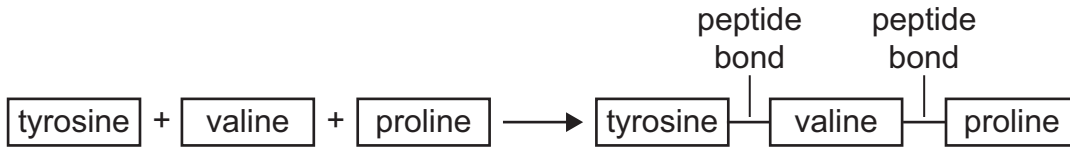
Item Information				Option Annotations
Alignment		BIO.A.2.1.1		A. Key: Cohesion is a property of water that describes the attraction of water molecules to one another, which enables water to move along a pressure gradient up to the leaves. B. The low freezing point of water is not associated with the cohesive properties of liquid water. C. High specific heat refers to the amount of heat required to raise water temperature, not its force of attraction. D. Water’s change in density in relation to temperature is unrelated to the force of attraction between water molecules.
Answer Key		A		
Depth of Knowledge		2		
p-values				
A	B	C	D	
59%	8%	11%	22%	

4. Cells are largely made of organic compounds that contain carbon. Which property of the carbon atom makes it an essential component of organic compounds?
- Carbon is a nonmetal.
 - Carbon oxidizes to carbon dioxide.
 - Carbon is solid at room temperature.
 - Carbon can form four covalent bonds.

Item Information				Option Annotations
Alignment		BIO.A.2.2.1		<p>A. Similar to carbon, other nonmetals, such as oxygen and nitrogen, are also components of many organic compounds, but being a nonmetal is not the reason carbon is able to bond with hydrogen to form organic compounds.</p> <p>B. Carbon in its elemental form, not as carbon dioxide, is an essential component of organic compounds.</p> <p>C. Many elements other than carbon are solid at room temperature.</p> <p>D. Key: Carbon is unique in its ability to share all the electrons in its outer shell and form four strong covalent bonds with other elements and also with itself.</p>
Answer Key		D		
Depth of Knowledge		2		
p-values				
A	B	C	D	
15%	22%	11%	52%	

Use the diagram below to answer question 5.

Biological Reaction



5. Which statement **best** describes the event shown in the diagram?
- A. Glucose is being synthesized in the chloroplast using nitrogen from plants.
 - B. Amino acid monomers are joining together to form a protein macromolecule.
 - C. A polymer in the nucleus is being broken into its individual monomer subunits.
 - D. Lipid molecules are forming fatty acid chains in a dehydration synthesis reaction.

Item Information				Option Annotations
Alignment		BIO.A.2.2.2		A. Glucose is synthesized from carbon, hydrogen, and oxygen, not from amino acids. B. Key: Tyrosine, valine, and proline are all amino acid monomers that are joined by peptide bonds during protein synthesis. C. This reaction shows individual parts bonding together form a larger molecule, not the reverse. D. This reaction shows the presence of amino acids and peptide bonds, which are associated with the formation of proteins, not the formation of fatty acid chains.
Answer Key		B		
Depth of Knowledge		2		
p-values				
A	B	C	D	
11%	54%	17%	18%	

6. Plant cells use sunlight to make their own food. Which structure allows plant cells to perform this function?
- A. nucleus
 - B. vacuole
 - C. chloroplast
 - D. mitochondrion

Item Information				Option Annotations
Alignment		BIO.A.3.1.1		A. The nucleus contains DNA and directs cell activities. B. A vacuole is a large membrane-bound compartment that stores cellular substances, including water. C. Key: A chloroplast is a plastid involved in the transformation of light energy into chemical energy in the form of glucose. D. The mitochondrion is a membrane-bound organelle involved in transforming chemical energy in glucose into ATP.
Answer Key		C		
Depth of Knowledge		1		
p-values				
A	B	C	D	
10%	8%	73%	9%	

7. Which statement **best** explains why cellular respiration in plants and other organisms is dependent on photosynthesis?
- A. Photosynthesis is one of the final steps in cellular respiration.
 - B. Photosynthesis provides the materials that fuel cellular respiration.
 - C. Photosynthesis absorbs excess energy produced by cellular respiration.
 - D. Photosynthesis absorbs materials that are catalyzed during cellular respiration.

Item Information				Option Annotations
Alignment		BIO.A.3.2.1		A. Photosynthesis occurs independent of cellular respiration. B. Key: Cellular respiration in plants depends on photosynthesis because the sugar produced during photosynthesis is a reactant during cellular respiration. C. Photosynthesis converts light energy into the chemical energy that is used during cellular respiration to produce ATP. D. Photosynthesis uses carbon dioxide and water from the environment to produce glucose, which is a reactant for cellular respiration.
Answer Key		B		
Depth of Knowledge		2		
p-values				
A	B	C	D	
12%	55%	19%	14%	

Use the list below to answer question 8.

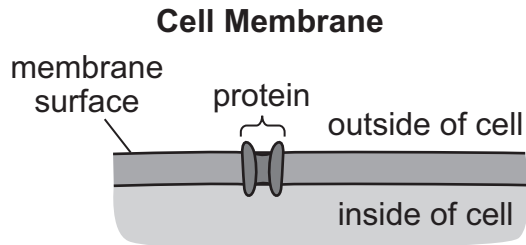
Molecules Needed for Protein Synthesis

- mRNA
- tRNA
- amino acids
- ATP molecules

8. A plant cell uses the molecules in the list to synthesize a protein. What role do the ATP molecules play in the protein synthesis process?
- A. They provide energy.
 - B. They increase activation energy.
 - C. They convert energy into hereditary information.
 - D. They absorb excess energy to prevent overheating.

Item Information				Option Annotations
Alignment		BIO.A.3.2.2		A. Key: ATP provides energy for all biochemical reactions in a cell, including protein synthesis. B. ATP is the energy source used to surpass an activation energy barrier in a reaction like protein synthesis, but ATP does not increase the activation energy needed for the reaction to proceed. C. ATP is energy that fuels the translation and transcription of genetic information contained in DNA, but ATP does not convert energy into DNA. D. During protein synthesis, ATP molecules fuel the formation of a peptide bond, which stores energy.
Answer Key		A		
Depth of Knowledge		2		
p-values				
A	B	C	D	
64%	18%	12%	6%	

Use the diagram below to answer question 9.



9. The indicated protein is part of a cell membrane. What is the **most likely** purpose of this protein?
- A. It allows passage of particles into and out of the cell.
 - B. It manufactures phospholipids to repair membrane damage.
 - C. It releases stored chemical energy in membrane carbohydrates.
 - D. It attracts unbalanced electrical charges in the cell's environment.

Item Information				Option Annotations
Alignment		BIO.A.4.1.1		A. Key: A protein that extends across the cell membrane functions as a pathway that allows ions and molecules to move into and out of the cell. B. Phospholipids used for membrane repair are produced by the endoplasmic reticulum, not by cell membrane proteins. C. Mitochondria, not cell membrane proteins, convert energy stored in carbohydrates into ATP for use by the cell. D. A channel protein can permit the passage of ions across the membrane to balance electrical charges, but it does not attract electrical charges.
Answer Key		A		
Depth of Knowledge		2		
p-values				
A	B	C	D	
61%	15%	18%	6%	

10. Which statement **best** describes how active transport differs from passive transport?

- A. Only active transport requires ATP.
- B. Only active transport moves small particles.
- C. Only active transport relies on a plasma membrane.
- D. Only active transport allows substances to leave a cell.

Item Information				Option Annotations
Alignment		BIO.A.4.1.2		A. Key: Active transport requires ATP energy; passive transport occurs without an input of energy. B. Diffusion and osmosis are forms of passive transport involving the movement of small particles from an area of high concentration to an area of low concentration. C. Facilitated diffusion is a form of passive transport that relies on integral proteins in the plasma membrane. D. Both active and passive transport processes allow substances to leave the cell.
Answer Key		A		
Depth of Knowledge		2		
<i>p-values</i>				
A	B	C	D	
59%	11%	12%	18%	

11. All living organisms must maintain homeostasis in order to survive. Which statement **best** describes one way humans maintain homeostasis?
- A. Temperature is regulated by giving off carbon dioxide.
 - B. Water content is regulated by giving off carbon dioxide.
 - C. Temperature is regulated by sweating.
 - D. Water content is regulated by sweating.

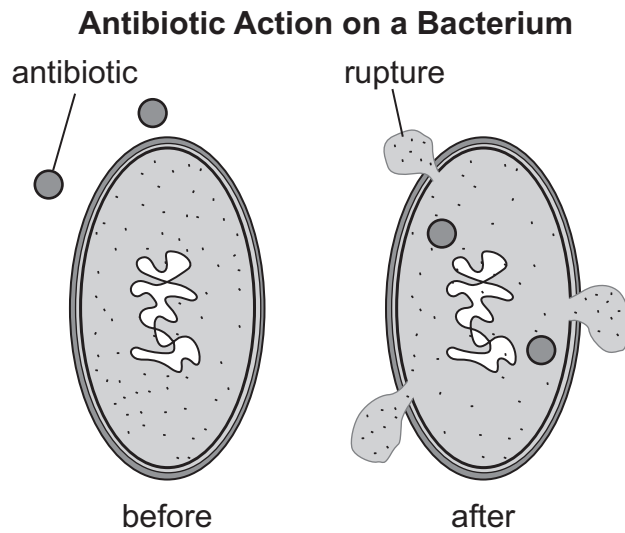
Item Information				Option Annotations
Alignment		BIO.A.4.2.1		A. Releasing carbon dioxide from the lungs helps regulate oxygen levels, not temperature, in the body. B. Water content in humans is regulated by the rate of urine production, not by the release of carbon dioxide. C. Key: Sweating involves the release of water through pores in the skin, and as the water evaporates, heat is removed from the skin, reducing body temperature. D. Water is released by sweating, but the rate of urine production by the kidneys is the primary way that humans regulate water balance.
Answer Key		C		
Depth of Knowledge		2		
p-values				
A	B	C	D	
12%	9%	64%	15%	

**THIS PAGE IS
INTENTIONALLY BLANK.**

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

Bacteria and Antibiotics

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



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

- A. heart
- B. liver
- C. pancreas
- D. skin

Item Information				Option Annotations
Alignment		BIO.A.1.2.2		A. The heart does not provide protection as a regulatory structure. B. The liver does not provide protection as a regulatory structure. C. The pancreas does not provide protection as a regulatory structure. D. Key: The cell walls of bacteria act as regulatory structures similar to the skin of humans.
Answer Key		D		
Depth of Knowledge		2		
p-values				
A	B	C	D	
6%	13%	7%	74%	

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

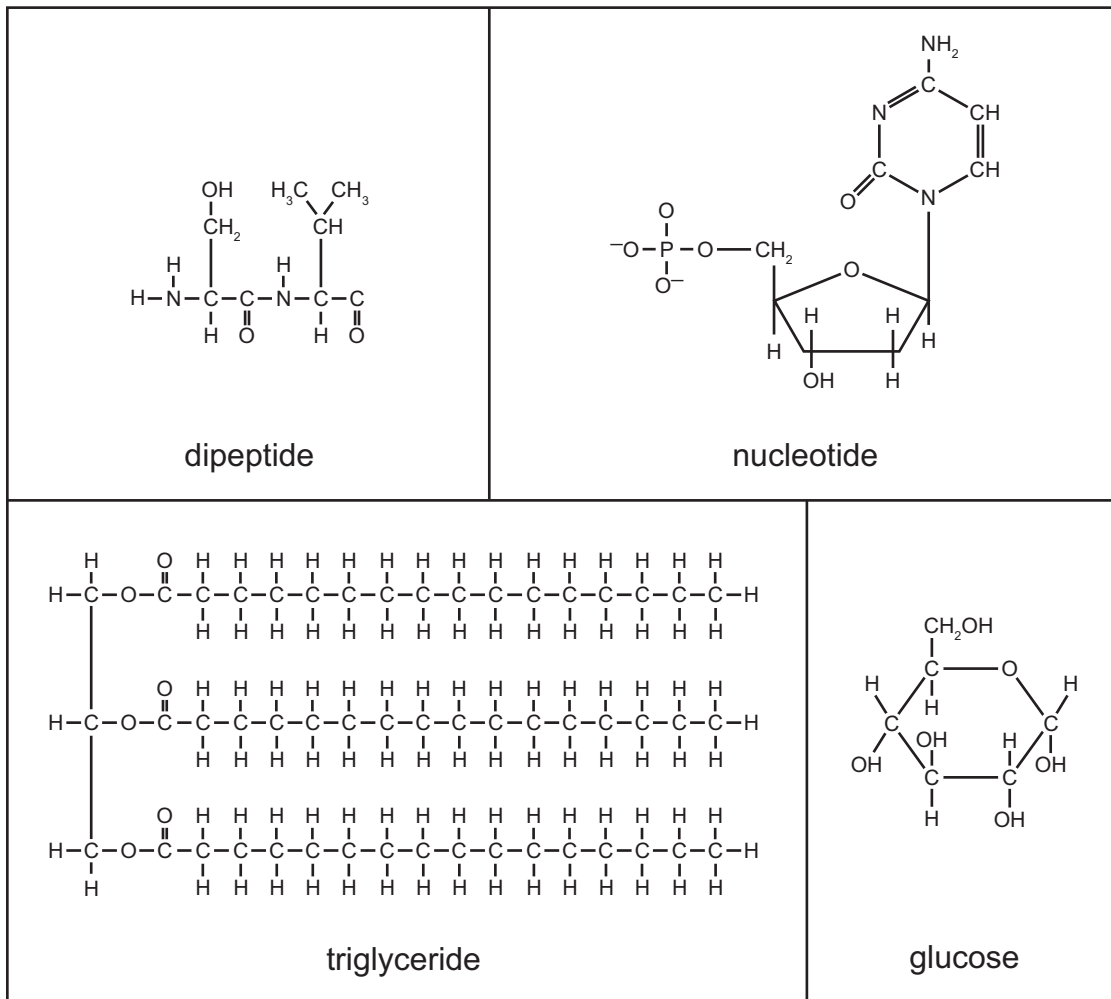
- A. Antibiotics remove chloroplasts from plant cells to cause starvation.
- B. Antibiotics interfere with the transport of intracellular and extracellular materials.
- C. Antibiotics increase the rate of DNA replication in human cells by forming nucleotides.
- D. Antibiotics decrease the rate of cellular respiration in animal cells by producing oxygen.

Item Information				Option Annotations
Alignment		BIO.A.4.2.1		A. Antibiotics work on bacterial cells, not plant cells. Antibiotics do not remove chloroplasts. B. Key: Homeostasis is maintained by different processes to regulate an organism's internal environment. The antibiotic action described in the scenario causes the cell wall to rupture and the cell to burst, so there can no longer be regulation of transport across the plasma membrane. C. Antibiotics do not affect the rate of DNA replication and do not function against human cells. D. Antibiotics do not produce oxygen and do not function against animal cells.
Answer Key		B		
Depth of Knowledge		2		
p-values				
A	B	C	D	
11%	62%	18%	9%	

CONSTRUCTED-RESPONSE ITEM

Use the illustration below to answer question 14.

Four Organic Molecules



Go to the next page to finish question 14.

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

Part A: Describe two similarities in the structure of the organic molecules shown.

Similarity 1: _____

Similarity 2: _____

Part B: “Structure determines function” is an important concept to biology. Select one of the organic molecules shown and explain how its structure is related to its function.

SCORING GUIDE

#14 ITEM INFORMATION

Alignment	BIO.A.2.2.3	Depth of Knowledge	3	Mean Score	1.09
-----------	-------------	--------------------	---	------------	------

ITEM-SPECIFIC SCORING GUIDELINE

Score	Description
3	<p>The response demonstrates a <i>thorough</i> understanding of comparing and contrasting the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms by</p> <ul style="list-style-type: none"> describing two similarities in the structure of the organic molecules shown <p>AND</p> <ul style="list-style-type: none"> explaining how the structure of one of the organic molecules is related to its function. <p>The response is clear, complete, and correct.</p>
2	<p>The response demonstrates a <i>partial</i> understanding of comparing and contrasting the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms by</p> <ul style="list-style-type: none"> describing two similarities in the structure of the organic molecules shown <p>OR</p> <ul style="list-style-type: none"> describing one similarity in the structure of the organic molecules shown and explaining how the structure of one of the organic molecules is related to its function. <p>The response may contain some work that is incomplete or unclear.</p>
1	<p>The response demonstrates a <i>minimal</i> understanding of comparing and contrasting the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms by</p> <ul style="list-style-type: none"> describing one similarity in the structure of the organic molecules shown <p>OR</p> <ul style="list-style-type: none"> explaining how the structure of one of the organic molecules is related to its function. <p>The response may contain some work that is incomplete or unclear.</p>
0	<p>The response provides <i>insufficient</i> evidence to demonstrate any understanding of the concept being tested.</p>
Non-scorables	<p>B – No response written or refusal to respond F – Foreign language K – Off task U – Unreadable</p>

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

Responses that will receive credit:**Part A (2 points; 1 point for each correct similarity):**

- They all have C, H, and O (carbon, hydrogen, and oxygen).
- They all have covalent bonds.
- They are all branched to some degree.
- They are all carbon-based molecules.
- They all have single or double bonds.

Part B (1 point):

- Glucose—small size allows it to pass (through the intestines and into the bloodstream and then) into cells that need glucose for energy.
- Glucose is soluble in water.
- Glucose is an energy source because of its large proportion of hydrogen atoms.

OR

- Triglyceride—has long carbon chains that are a good source of energy.
- The long alkyl group (“alkane end”) is hydrophobic, which is good for forming the bilayer plasma membrane (when combined with a phosphate group and glycerol).

OR

- Dipeptide—has a peptide bond, which is how amino acids are combined to form proteins.
- It also contains nitrogen, which is necessary for new tissue formation.

OR

- Nucleotide (deoxycytidine monophosphate is pictured)—the phosphate group of the nucleotide can bind (through a dehydration reaction) to the (deoxy)ribose of another nucleotide, forming a phosphodiester bond. Long chains of nucleotides form RNA and DNA. The double-stranded structure of DNA is formed by hydrogen bonding between bases on two strands.

STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS



Question 14
Page 1 of 2

Item ID

?

Line Guide

Search

Calculator

Eraser

Arrow

Four Organic Molecules

Next

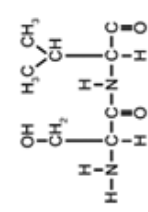
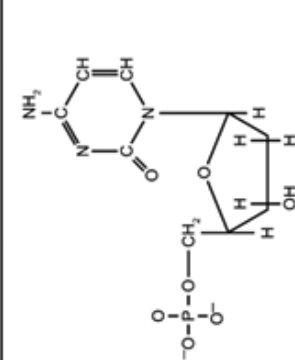
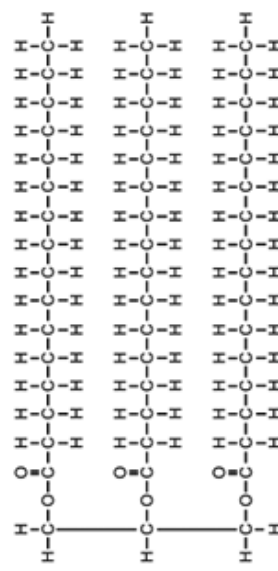
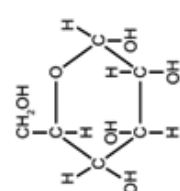
Options

Flag

Pause

Review/End Test

Use the illustrations below to answer the question.

 <p>dipeptide</p>	 <p>nucleotide</p>
 <p>triglyceride</p>	 <p>glucose</p>

Part A: Describe two similarities in the structure of the organic molecules shown.

Similarity 1:

One similarity that the four organic molecules have is that they all have carbon and hydrogen.

94 / 1000

Similarity 2:

Another similarity is that they all have oxygen.

49 / 1000

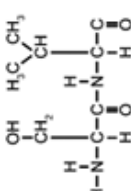
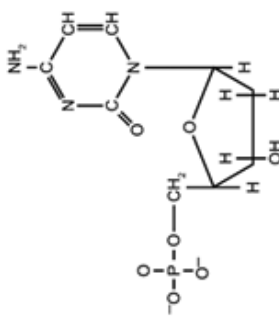

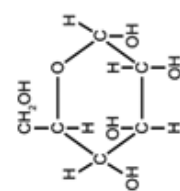
Question 14
Page 2 of 2

Line Guide

Item ID

Use the illustrations below to answer the question.

Four Organic Molecules

 <p>dipeptide</p>	 <p>nucleotide</p>
 <p>triglyceride</p>	 <p>glucose</p>

307 / 1000

Part B: "Structure determines function" is an important concept to biology. Select one of the organic molecules shown and explain how its structure is related to its function.

EQ

In the triglyceride its structure relates to its function because the three long strands of carbon and hydrogen allow it to store lots of energy that can be used at a later time. The triglycerides also have hydrophobic ends that when the triglycerides bond to make a chain they are great for cell membranes.

Back

Options

Flag

Pause

Review/End Test

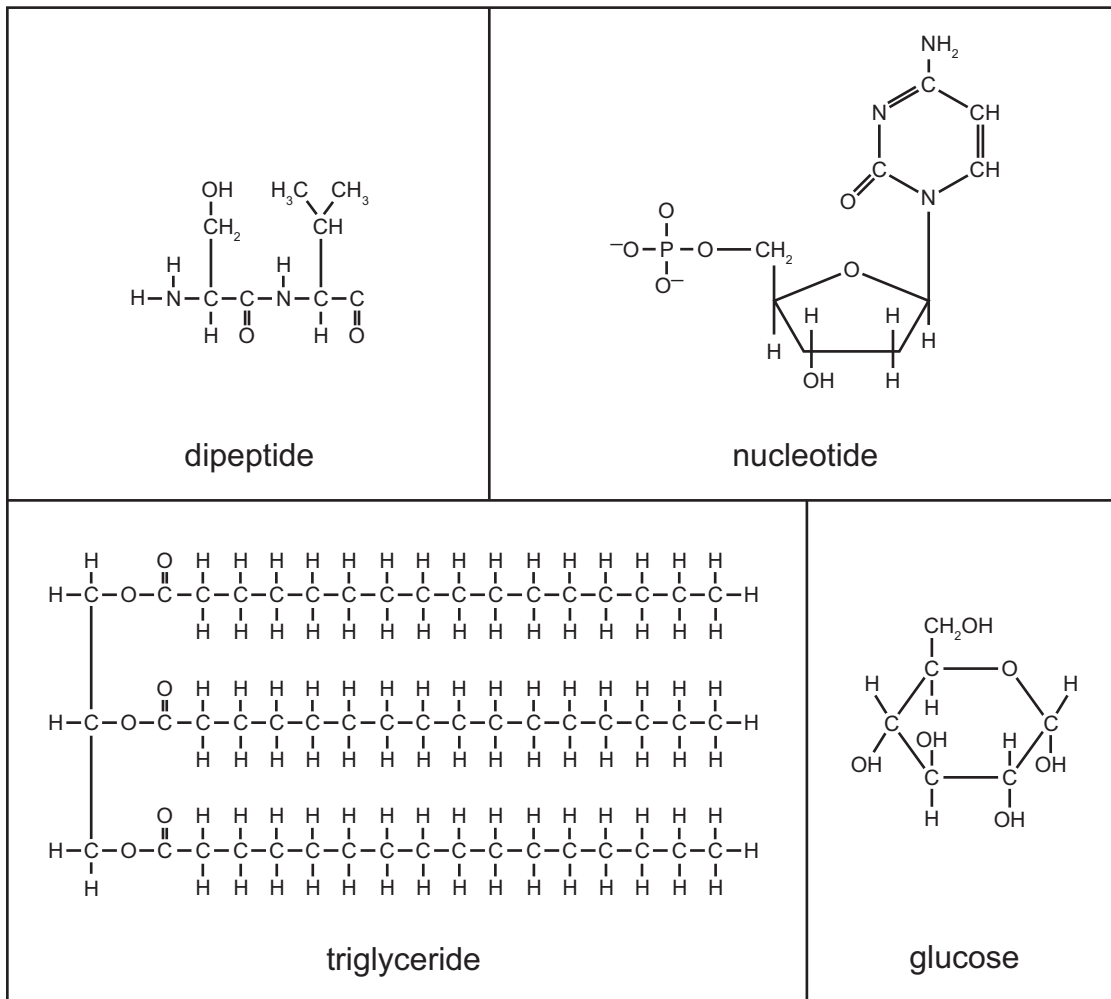
This response demonstrates a *thorough* understanding of comparing and contrasting the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms by completing all three tasks presented in the item. The student states that the organic molecules all have carbon and hydrogen. The student also provides the second similarity that all the molecules have oxygen. In Part B, the student explains that the triglyceride exists in three long chains of carbon and hydrogen (structure) to allow it to store lots of energy for later use (function). Additionally, the student discusses that triglycerides have hydrophobic ends. These ends, when chained together, are great for forming cell membranes. The response is complete, clear, and correct.

STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS

Use the illustration below to answer question 14.

Four Organic Molecules



Go to the next page to finish question 14.

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

Part A: Describe two similarities in the structure of the organic molecules shown.

Similarity 1: *They all contain carbon as their "backbone" (They all have carbon)*

Similarity 2: *They all contain oxygen molecules as well.*

Part B: "Structure determines function" is an important concept to biology. Select one of the organic molecules shown and explain how its structure is related to its function.

I choose the triglyceride. This has carbon, hydrogen, and oxygen. This structure relates to its function because in lipids hydrogen, carbon, and oxygen is present. Also, there are three chains. giving the name TRIGlyceride.

This response demonstrates a *partial* understanding of comparing and contrasting the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms by completing two of the tasks presented in the item. The student explains that the structures of the molecules are similar because they all contain carbon as their "backbone." Additionally, the student explains that all the molecules contain oxygen. In Part B, the student fails to provide an acceptable explanation how the structure of the molecules is related to its function. The student breaks the structure of the triglyceride into its components (carbon, hydrogen, oxygen) but fails to relate the components to the function of the molecule. This response contains some work that is incomplete or unclear.

STUDENT RESPONSE

RESPONSE SCORE: 1 POINT



Question 14
Page 1 of 2

Item ID

?

Line Guide

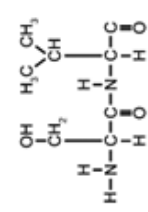
Search

Home

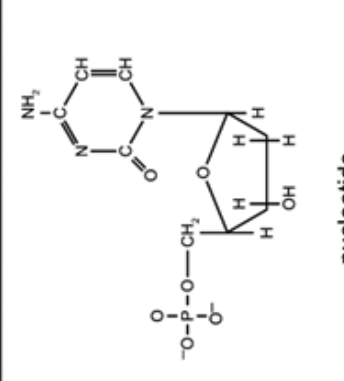
Back

Forward

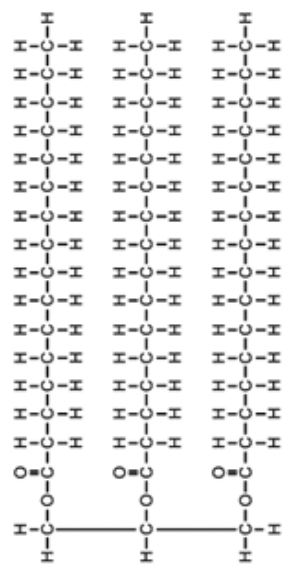
Four Organic Molecules



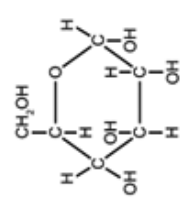
dipeptide



nucleotide



triglyceride



glucose

Options

Flag

Pause

Review/End Test

Part A: Describe two similarities in the structure of the organic molecules shown.

Similarity 1:

They both have oxygen.

22 / 1000

Similarity 2:

both have chlorine.

20 / 1000

Next

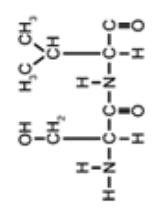
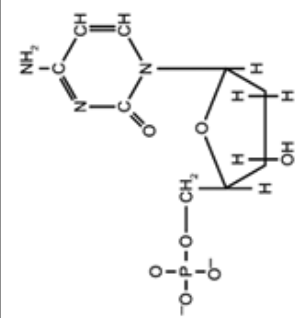

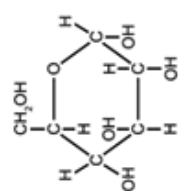
Question 14
Page 2 of 2

Item ID ?

Line Guide

Use the illustrations below to answer the question.

Four Organic Molecules

 <p style="text-align: center;">dipeptide</p>	 <p style="text-align: center;">nucleotide</p>
 <p style="text-align: center;">triglyceride</p>	 <p style="text-align: center;">glucose</p>

Part B: "Structure determines function" is an important concept to biology. Select one of the organic molecules shown and explain how its structure is related to its function.

they are both except they have different structures so they do different things!

76 / 1000

Options

Flag

Pause

Review/End Test

Back

This response demonstrates a *minimal* understanding of comparing and contrasting the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms by completing one of the tasks presented in the item. The student correctly states that a similarity between the organic molecules is that they have oxygen. The second similarity provided is incorrect because the organic molecules shown do not contain chlorine. The student fails to provide a specific explanation of how the structure of one of the organic molecules shown relates to its function. This response contains work that is incomplete or unclear.

STUDENT RESPONSE

RESPONSE SCORE: 0 POINTS



Question 14
Page 1 of 2

Item ID

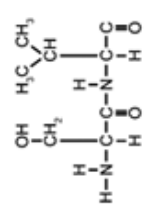
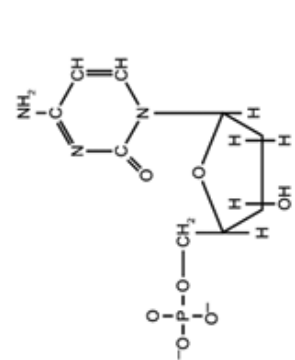
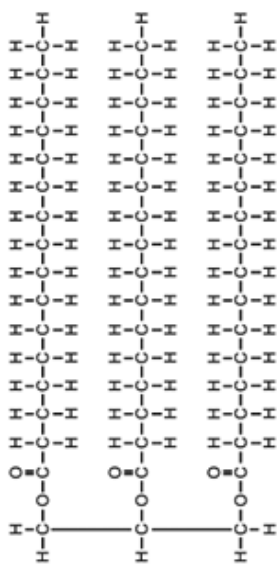
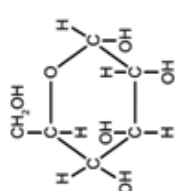
?

Line Guide

←

↶

Four Organic Molecules

 <p>dipeptide</p>	 <p>nucleotide</p>
 <p>triglyceride</p>	 <p>glucose</p>

Part A: Describe two similarities in the structure of the organic molecules shown.

Similarity 1:

one similarity is that they all have fatty acids

49 / 1000

Similarity 2:

the second similarity is that they are all made up of monomers.

63 / 1000

Review/End Test









Pause

Flag

Options

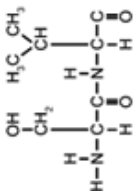
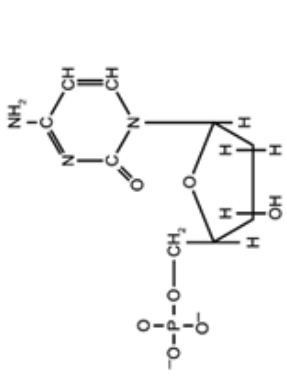
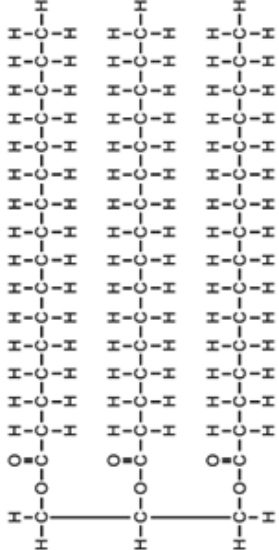
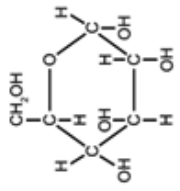
Next

Question 14
Page 2 of 2

Use the illustrations below to answer the question.

Four Organic Molecules

 <p style="text-align: center;">dipeptide</p>	 <p style="text-align: center;">nucleotide</p>
 <p style="text-align: center;">triglyceride</p>	 <p style="text-align: center;">glucose</p>

Part B: "Structure determines function" is an important concept to biology. Select one of the organic molecules shown and explain how its structure is related to its function.

Eq

glucose is a starch and is very important

41 / 1000



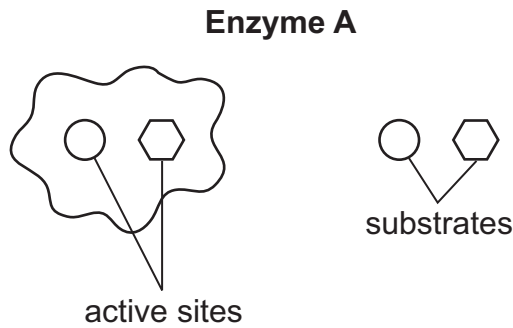
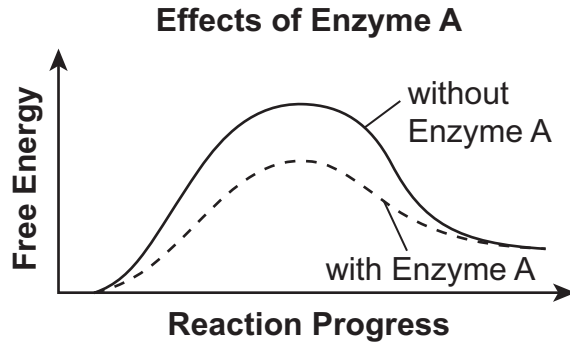




This response demonstrates an *insufficient* understanding of comparing and contrasting the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms by not completing any of the tasks presented. The description of the first similarity is incorrect because not all the organic molecules shown are fatty acids. The second similarity is also incorrect because all the organic molecules shown are monomers themselves and are not made up of monomers. The student makes a minimal attempt in part B but fails to explain how the structure of one of the organic molecules is related to its function. The response contains work that is incomplete or unclear.

CONSTRUCTED-RESPONSE ITEM

Use the graph and diagram below to answer question 15.



15.

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

Go to the next page to finish question 15.

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

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

SCORING GUIDE

#15 ITEM INFORMATION

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

ITEM-SPECIFIC SCORING GUIDELINE

Score	Description
3	<p>The response demonstrates a <i>thorough</i> understanding of the role of an enzyme as a catalyst in regulating a specific biochemical reaction by</p> <ul style="list-style-type: none"> explaining how Enzyme A acts as a catalyst in the reaction with respect to energy <p>AND</p> <ul style="list-style-type: none"> explaining how Enzyme A acts as a catalyst in the reaction with respect to time <p>AND</p> <ul style="list-style-type: none"> predicting how changing the shape of the enzyme's active site would affect the enzyme's ability to catalyze the reaction. <p>The response is clear, complete, and correct.</p>
2	<p>The response demonstrates a <i>partial</i> understanding of the role of an enzyme as a catalyst in regulating a specific biochemical reaction by fulfilling two of the three bullets listed under the 3-point response.</p> <p>The response may contain some work that is incomplete or unclear.</p>
1	<p>The response demonstrates a <i>minimal</i> understanding of the role of an enzyme as a catalyst in regulating a specific biochemical reaction by fulfilling one of the three bullets listed under the 3-point response.</p> <p>The response may contain some work that is incomplete or unclear.</p>
0	<p>The response provides <i>insufficient</i> evidence to demonstrate any understanding of the concept being tested.</p>
Non-scorables	<p>B – No response written or refusal to respond F – Foreign language K – Off task U – Unreadable</p>

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

Responses that will receive credit:**Part A (2 points):**

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

Part B (1 point):

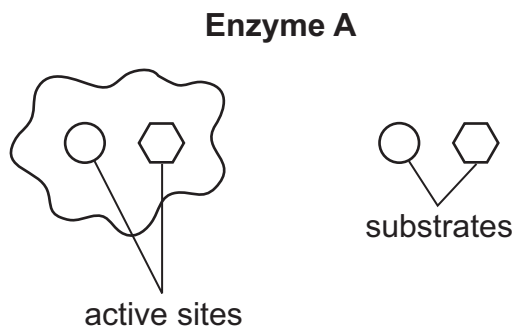
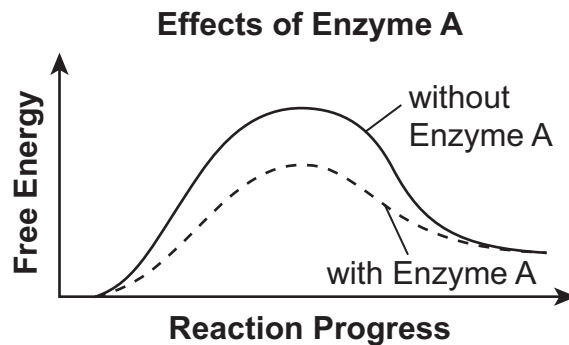
- When the shape of an enzyme's active site is changed, the substrate cannot attach to the active site; it will not "fit." The enzyme would not be able to catalyze the reaction.
- When the shape of the enzyme's active site is slightly changed (caused by a change in pH, for example), the enzyme activity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

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

STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS

Use the graph and diagram below to answer question 15.



15.

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

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

Go to the next page to finish question 15.

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

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

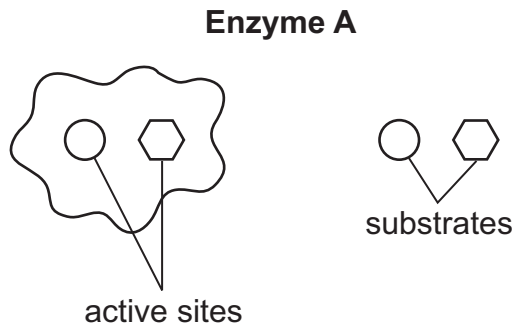
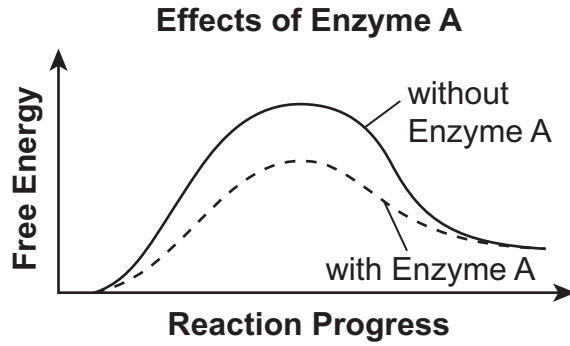
It would affect the enzyme's ability to catalyze the reaction because they might not react right. The active sites could change, and then they wouldn't fit like a lock and key anymore, so therefore, the enzyme would no longer act as a catalyst.

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

STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS

Use the graph and diagram below to answer question 15.



15.

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

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

Go to the next page to finish question 15.

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

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

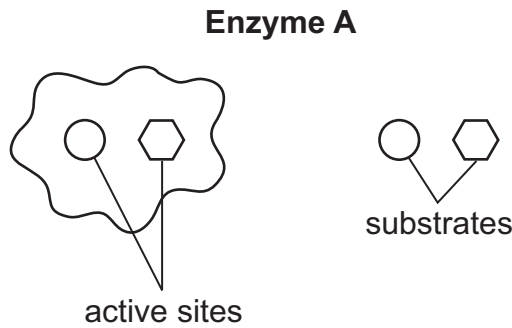
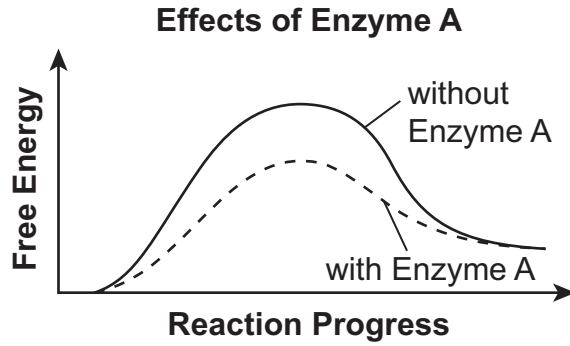
The enzyme may cause the opposite effects
with the catalyze being wed.

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

STUDENT RESPONSE

RESPONSE SCORE: 1 POINT

Use the graph and diagram below to answer question 15.



15.

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

the enzyme A reduces the activation energy

Go to the next page to finish question 15.

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

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

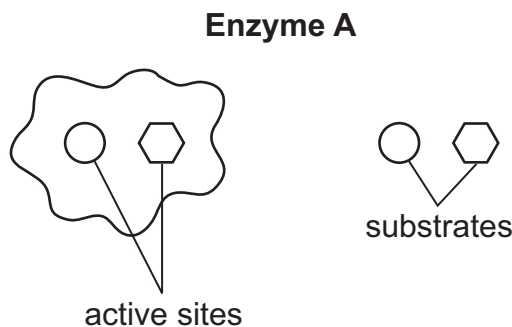
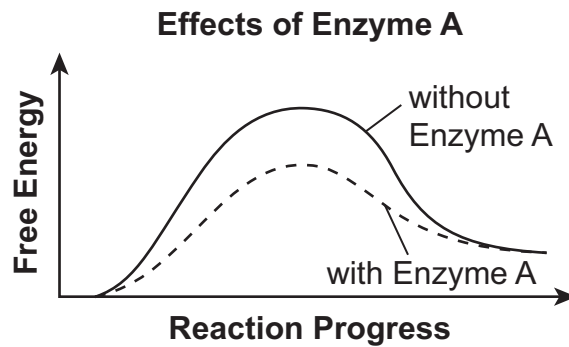
Its ability would be to speed up the
reaction by reducing the activation energy

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

STUDENT RESPONSE

RESPONSE SCORE: 0 POINTS

Use the graph and diagram below to answer question 15.



15.

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

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

Go to the next page to finish question 15.

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

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

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

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

BIOLOGY MODULE 1—SUMMARY DATA

MULTIPLE-CHOICE

Sample Number	Alignment	Answer Key	Depth of Knowledge	p-values			
				A	B	C	D
1	BIO.A.1.1.1	C	2	20%	13%	50%	17%
2	BIO.A.1.2.2	A	2	62%	9%	18%	11%
3	BIO.A.2.1.1	A	2	59%	8%	11%	22%
4	BIO.A.2.2.1	D	2	15%	22%	11%	52%
5	BIO.A.2.2.2	B	2	11%	54%	17%	18%
6	BIO.A.3.1.1	C	1	10%	8%	73%	9%
7	BIO.A.3.2.1	B	2	12%	55%	19%	14%
8	BIO.A.3.2.2	A	2	64%	18%	12%	6%
9	BIO.A.4.1.1	A	2	61%	15%	18%	6%
10	BIO.A.4.1.2	A	2	59%	11%	12%	18%
11	BIO.A.4.2.1	C	2	12%	9%	64%	15%
12	BIO.A.1.2.2	D	2	6%	13%	7%	74%
13	BIO.A.4.2.1	B	2	11%	62%	18%	9%

CONSTRUCTED-RESPONSE

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
14	BIO.A.2.2.3	3	3	1.09
15	BIO.A.2.3.1	3	3	0.89

BIOLOGY MODULE 2

MULTIPLE-CHOICE ITEMS

1. What must be transmitted to new DNA strands during replication to maintain genetic information?
- individual atoms from existing DNA strands
 - individual sugars from existing DNA strands
 - the sequence of bases from existing DNA strands
 - the sequence of phosphates from existing DNA strands

Item Information				Option Annotations
Alignment		BIO.B.1.2.1		<p>A. Individual atoms from existing DNA strands are integral components of DNA's backbone structure but are not transmitted during replication.</p> <p>B. Individual sugars bonded with a phosphate group form the backbone of DNA; this backbone is a necessary structural component of DNA that is not transmitted.</p> <p>C. Key: The sequence of bases from existing DNA strands serves as a template during replication and is necessary for conservation of genetic information in the new strand.</p> <p>D. The sequence of phosphates in existing DNA strands is a necessary structural, not transmitted, component of DNA.</p>
Answer Key		C		
Depth of Knowledge		2		
p-values				
A	B	C	D	
17%	11%	54%	18%	

2. The genetic material of two different individuals of the same species is analyzed. One individual has brown eyes. The other has blue eyes. Which characteristic for eye color would be the same for both individuals?
- A. the allele
 - B. the DNA sequence
 - C. the amount of pigment
 - D. the location of the gene

Item Information				Option Annotations
Alignment		BIO.B.1.2.2		<p>A. An allele is a form of a particular gene that can be expressed as a phenotype; since the phenotypes are different for both individuals, so are the alleles.</p> <p>B. Different eye colors are the result of variations in the DNA sequence that produce different alleles.</p> <p>C. The amount and color of pigment are different in individuals with different eye colors, as coded by DNA.</p> <p>D. Key: The allele for eye color is located at the same position on any chromosome.</p>
Answer Key		D		
Depth of Knowledge		2		
p-values				
A	B	C	D	
24%	19%	13%	44%	

3. Which effect is **most likely** caused by nondisjunction during meiosis?
- A. an increase in nuclei
 - B. an extra chromosome
 - C. only two types of nitrogenous bases
 - D. increased survival benefits from traits

Item Information				Option Annotations
Alignment		BIO.B.2.1.2		A. Nondisjunction during meiosis affects the number of chromosomes in the nuclei, not the number of nuclei. B. Key: Nondisjunction means that a chromosome pair fails to separate during meiosis, creating an imbalance in the number of chromosomes in daughter cells. C. Nondisjunction during meiosis affects the number of chromosomes in the daughter cells, not the types of nitrogenous bases involved in replication. D. Nondisjunction alters the number of chromosomes in daughter cells, which can reduce viability of the embryo and is not associated with increased survival benefits.
Answer Key		B		
Depth of Knowledge		2		
p-values				
A	B	C	D	
11%	62%	16%	11%	

4. A genetic mutation involving a single base causes an error that affects the sequence of the next 500 amino acids in a protein. Which type of mutation could have produced this type of error in the protein?
- A. silent
 - B. nonsense
 - C. frame-shift
 - D. substitution

Item Information				Option Annotations
Alignment		BIO.B.2.3.1		A. A silent mutation alters a single codon but does not result in a change in the amino acid sequence of a protein. B. A nonsense mutation can involve a single base, but the change produces a stop codon that shortens the protein. C. Key: A frame-shift mutation may involve the insertion or deletion of a single base, can shift the reading frame of the gene, and can produce many subsequent changes in amino acids. D. A substitution mutation exchanges a single base for another, altering a single amino acid in the protein, but a substitution mutation would not affect the next 500 amino acids in a protein sequence.
Answer Key		C		
Depth of Knowledge		2		
p-values				
A	B	C	D	
9%	9%	54%	28%	

5. New technologies enable oils to be extracted from plants to make renewable biodiesel fuel. Scientists have altered the genome of a specific plant species to increase the amount of oil produced by each plant. Which statement explains why this technology **most likely** benefits farmers?
- A. It makes each plant more resistant to disease.
 - B. It lowers the cost of each acre of plants cultivated.
 - C. It increases the value of each acre of land cultivated.
 - D. It eliminates the processing needed to extract plant oils.

Item Information				Option Annotations
Alignment		BIO.B.2.4.1		<p>A. Increasing oil production by each plant is not directly related to disease resistance in plants.</p> <p>B. The cost of cultivating each acre of plants will not be reduced by this technology.</p> <p>C. Key: The value of each acre of cultivated land will increase as yield increases because selling the oil generates income.</p> <p>D. The processing required to extract plant oils will remain the same, or increase, due to the greater volume of oil extracted using new technologies; processing will not be eliminated.</p>
Answer Key		C		
Depth of Knowledge		2		
<i>p-values</i>				
A	B	C	D	
12%	15%	56%	17%	

6. A population of squirrels was separated during the formation of the Grand Canyon. Over time the squirrels, separated by the canyon walls and the Colorado River, became unique species. Which mechanism **most likely** caused the development of the new species?
- A. habitat preference
 - B. increased gene flow
 - C. geographic isolation
 - D. behavioral isolation

Item Information				Option Annotations
Alignment		BIO.B.3.1.2		<p>A. Separation and subsequent speciation in this population was the result of a physical barrier, not habitat preference.</p> <p>B. Speciation is more likely to occur in a population with reduced, not increased, gene flow.</p> <p>C. Key: A physical barrier that separates a population and prevents individuals from mating with one another reduces gene flow, leading to speciation.</p> <p>D. Behavioral isolation can be a strong isolating mechanism, but a physical barrier isolated the squirrel populations.</p>
Answer Key		C		
Depth of Knowledge		2		
p-values				
A	B	C	D	
17%	13%	63%	7%	

7. A researcher observes two species of frogs in the same area. Both species have a similar diet. One species breeds in fast-moving streams, while the other species breeds in ponds. Both species are similar in appearance and have very similar DNA. Which information provides the **best** evidence that these two species descended from a common ancestor?
- A. the species' similar diets
 - B. the species' shared habitat
 - C. the species' mating behaviors
 - D. the species' physical characteristics

Item Information				Option Annotations
Alignment		BIO.B.3.2.1		A. Organisms with similar diets may share a common ancestor, but distant organisms can also have similar diets. B. Organisms living in the same habitat may have very specific niches that reflect differences in descent. C. Having different environmental conditions and locations for mating are unlikely evidence for sharing a common ancestor. D. Key: Physical characteristics are directed by inherited information contained in DNA, which provides objective evidence for evolution from a common ancestor.
Answer Key		D		
Depth of Knowledge		2		
p-values				
A	B	C	D	
14%	14%	12%	60%	

Use the statements below to answer question 8.

Statement 1: All living things are composed of cells.

Statement 2: If soil contains high levels of salt, the plants will die.

Statement 3: The temperature reading on the thermometer is 21°C.

Statement 4: It must have rained this morning because the soil is wet.

8. A teacher lists four statements for students to interpret. Which table of information correctly distinguishes between the statements?

A.

Statement 1	Statement 2	Statement 3	Statement 4
theory	hypothesis	observation	inference

B.

Statement 1	Statement 2	Statement 3	Statement 4
fact	theory	hypothesis	observation

C.

Statement 1	Statement 2	Statement 3	Statement 4
inference	observation	theory	fact

D.

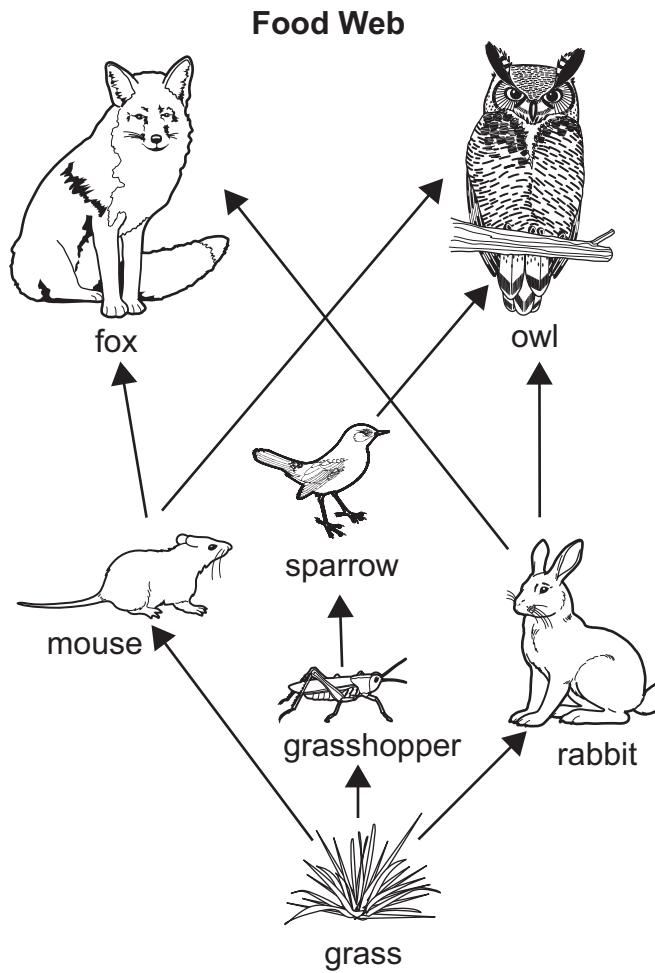
Statement 1	Statement 2	Statement 3	Statement 4
observation	inference	fact	hypothesis

Item Information				Option Annotations
Alignment		BIO.B.3.3.1		A. Key: This table correctly distinguishes between scientific terms: a theory is an explanation that remains valid through repeated testing, a hypothesis can be observed and experimentally tested, an observation is a statement of knowledge obtained through the senses or measurement, and an inference is a conclusion based on known facts or evidence. B. None of the statements are correctly identified in this table. C. None of the statements are correctly identified in this table. D. None of the statements are correctly identified in this table.
Answer Key		A		
Depth of Knowledge		2		
p-values				
A	B	C	D	
52%	23%	10%	15%	

9. Which description is the **best** example of a population?
- A. all of the red foxes in a forest
 - B. all of the red foxes in every forest
 - C. all of the organisms in a forest
 - D. all of the organisms in every forest

Item Information				Option Annotations
Alignment		BIO.B.4.1.1		A. Key: A population describes all the individuals of a species within a specific, singular area. B. This example refers to individuals of a species within many areas, but a population exists within a single, defined area. C. This example describes a community, which comprises the populations of all organisms living in a specific, singular area. D. This example lacks a given species and a specific, singular area.
Answer Key		A		
Depth of Knowledge		2		
p-values				
A	B	C	D	
51%	15%	22%	12%	

Use the diagram below to answer question 10.



10. Which energy transfer **most likely** occurs between organisms in the food web?

- A. from owl to fox
- B. from rabbit to fox
- C. from sparrow to grass
- D. from mouse to grasshopper

Item Information				Option Annotations
Alignment		BIO.B.4.2.1		<p>A. The owl is a top-level consumer in this food web; it receives energy from the rabbit, sparrow, and mouse.</p> <p>B. Key: Energy is transferred from the rabbit to the fox when the fox consumes the rabbit.</p> <p>C. There is no direct transfer of energy between the sparrow and grass in this food web.</p> <p>D. The mouse and the grasshopper are both primary consumers in this food web; there is no direct transfer of energy between these organisms.</p>
Answer Key		B		
Depth of Knowledge		2		
p-values				
A	B	C	D	
8%	73%	15%	4%	

11. In Pennsylvania, a nonnative plant called stiltgrass out-competes native plants in many forest ecosystems. Which statement **best** describes how the spread of stiltgrass negatively affects native herbivores?
- A. Stiltgrass stops the life cycles of native herbivores.
 - B. Stiltgrass reduces the size of the native plant populations.
 - C. Stiltgrass increases the flow of energy through the ecosystem.
 - D. Stiltgrass attracts other nonnative plants to the forest ecosystem.

Item Information		Option Annotations	
Alignment	BIO.B.4.2.4	<p>A. Stiltgrass harms native herbivores by reducing their preferred food sources, not by stopping the life cycles of all native herbivores.</p> <p>B. Key: Many nonnative species, like stiltgrass, lack natural enemies or pests and can tolerate a variety of habitat conditions, which enables them to outcompete native species.</p> <p>C. Stiltgrass replaces native plants that would have occurred in an ecosystem, so it does not increase the flow of energy.</p> <p>D. Stiltgrass competes with other nonnative plants rather than attracting them to the forest ecosystem.</p>	
Answer Key	B		
Depth of Knowledge	2		
p-values			
A	B		
16%	57%	14%	13%

**THIS PAGE IS
INTENTIONALLY BLANK.**

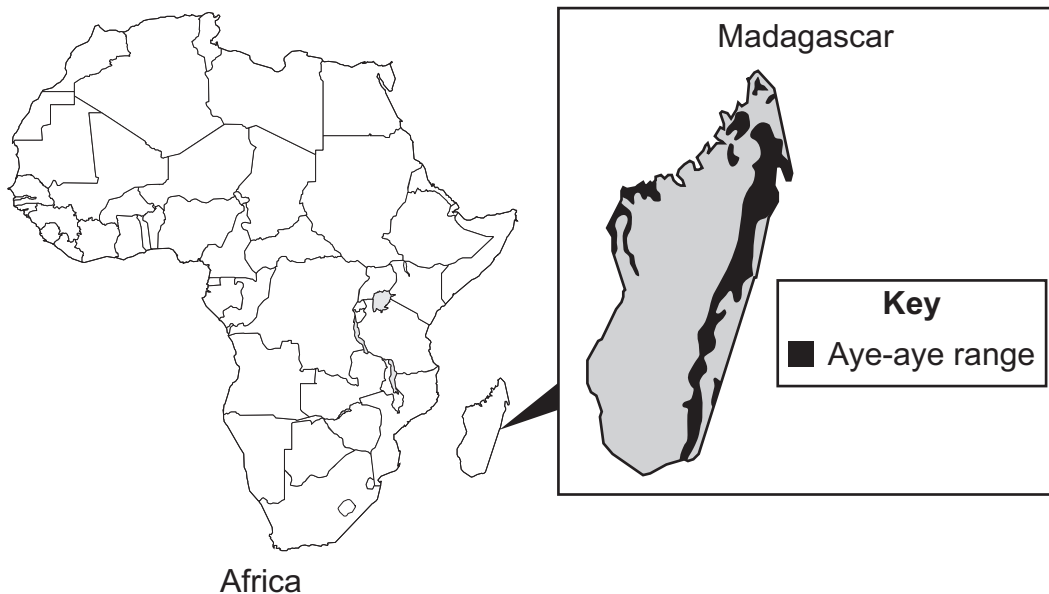
Directions: Use the information presented on page 58 to answer questions 12 and 13.

Aye-aye



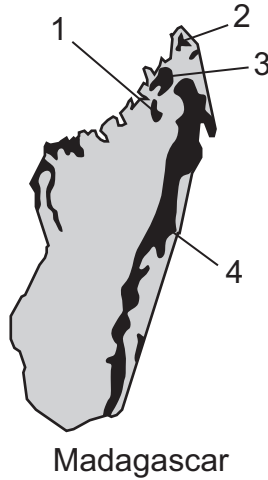
An aye-aye is a small nocturnal lemur that weighs about four pounds. This endangered species is found in Madagascar, a large island off the east coast of southern Africa. The main food for aye-ayes is larvae that live in wood. Aye-ayes find the larvae by tapping on tree branches. They also eat nuts and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

Aye-aye Range



Use the map below to answer question 12.

Four Locations of Aye-eyes



12. The map indicates four locations of aye-aye populations. Which location would **most likely** have an aye-aye population with the greatest variation in allele frequencies?
- A. location 1
 - B. location 2
 - C. location 3
 - D. location 4

Item Information				Option Annotations
Alignment		BIO.B.3.1.1		A. This location is a small, isolated area that would likely have a smaller population that experiences inbreeding and low genetic diversity. B. This location is a small, isolated area that would likely have a smaller population that experiences inbreeding and low genetic diversity. C. This location is an isolated area that would likely have a smaller population and less genetic diversity than the largest location. D. Key: This population occupies the largest area of the island, which likely has a more diverse environment than the other locations; its population is likely much larger than the other populations, resulting in a greater variation in allele frequencies.
Answer Key		D		
Depth of Knowledge		2		
p-values				
A	B	C	D	
5%	8%	7%	79%	

13. For the aye-aye species, what is **most likely** the primary value of individuals living alone?
- A. decreased space needs for the species
 - B. increased survival rates with habitat loss
 - C. reduced competition for natural resources
 - D. greater genetic variability within the species

Item Information				Option Annotations
Alignment		BIO.B.4.2.2		<p>A. A population with individuals living alone likely requires more rather than less habitat space.</p> <p>B. An increase in habitat loss would not increase survival rates among individuals that require large, solitary territories.</p> <p>C. Key: Individuals who live alone in a territory have the resources they need within their territory and are less likely to compete for resources such as shelter, food, and water.</p> <p>D. Living alone, rather than in groups, often results in increased difficulty in finding mates, which could result in fewer chances of increasing genetic variability within a population or species.</p>
Answer Key		C		
Depth of Knowledge		2		
p-values				
A	B	C	D	
11%	17%	64%	8%	

**THIS PAGE IS
INTENTIONALLY BLANK.**

CONSTRUCTED-RESPONSE ITEM

14. White-tailed deer from North America were brought to the islands of New Zealand around the year 1900. This species of deer has survived in several regions in New Zealand.

Part A: Explain why the white-tailed deer population is considered a nonnative species in New Zealand.

Go to the next page to finish question 14.

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

Part B: Describe one possible effect that a nonnative species can have on a native ecosystem and explain why this effect might occur.

SCORING GUIDE

#14 ITEM INFORMATION

Alignment	BIO.B.4.2.4	Depth of Knowledge	3	Mean Score	1.51
------------------	-------------	---------------------------	---	-------------------	------

ITEM-SPECIFIC SCORING GUIDELINE

Score	Description
3	<p>The response demonstrates a <i>thorough</i> understanding of how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires) by</p> <ul style="list-style-type: none"> explaining why the white-tailed deer population is considered a nonnative species in New Zealand <p>AND</p> <ul style="list-style-type: none"> describing a possible effect that a nonnative species can have on a native ecosystem <p>AND</p> <ul style="list-style-type: none"> explaining why this effect might occur. <p>The response is clear, complete, and correct.</p>
2	<p>The response demonstrates a <i>partial</i> understanding of how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires) by fulfilling two of the three bullets listed in the 3-point response.</p> <p>The response may contain some work that is incomplete or unclear.</p>
1	<p>The response demonstrates a <i>minimal</i> understanding of how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires) by fulfilling one of the three bullets listed in the 3-point response.</p> <p>The response may contain some work that is incomplete or unclear.</p>
0	<p>The response provides <i>insufficient</i> evidence to demonstrate any understanding of the concept being tested.</p>
Non-scorables	<p>B – No response written or refusal to respond F – Foreign language K – Off task U – Unreadable</p>

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

Responses that will receive credit:**Part A (1 point):**

- The white-tailed deer is native to North America and was brought to New Zealand.
- The white-tailed deer did not evolve from ancestors in New Zealand.
- The white-tailed deer did not live in New Zealand before humans brought them to the islands.

Part B (2 points):*Possible effects:*

- A decrease in the number of native plants in the areas where the nonnative species is present
 - Explanation: The nonnative species becomes a consumer of some of the native species of plants.
 - Explanation: The nonnative species has no natural predators and is able to outcompete native organisms for resources.
- Limited food available for native species
 - Explanation: The nonnative species becomes a consumer of some of the native species of plants and may outcompete some native herbivores.
- The nonnative species migrating to another area in search of food after it depletes existing food sources in the area in which it was introduced
 - Explanation: The nonnative species consumes native plant species in an area until there is not enough food to sustain its population and it must migrate, if possible.
- Increase in the population of the nonnative species if the conditions for survival remain favorable
 - Explanation: If the nonnative species moves into the area and has enough food and water to sustain its population and reproduce, its population will increase.
- Native species moving into a different area or dying
 - Explanation: Nonnative species may move into the habitat of native species and/or consume their food resources, causing the native populations in the area to either move or risk dying if the nonnative species is a better competitor for resources.

Other effects students may describe and explain:

- Nonnative species can increase the exotic diseases brought into the ecosystem.
- Nonnative species could become pests in the ecosystem.
- Nonnative species may grow faster and withstand diseases better than native species do.
- Nonnative species can cause predatory animal populations to increase due to greater numbers of available prey.

STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS



Question 14
Page 1 of 2

Item ID ?

Line Guide

White-tailed deer from North America were brought to the islands of New Zealand around the year 1900. This species of deer has survived in several regions in New Zealand.

Part A: Explain why the white-tailed deer population is considered a nonnative species in New Zealand.

The white-tailed deer is nonnative to New Zealand because it originated in North America. It was then transported by ship to New Zealand. They weren't born there but they now reside there because we took them there.

2/16 / 1000

Next

Options

Flag

Pause

Review/End Test

Question 14
Page 2 of 2

Item ID ?

Line Guide

White-tailed deer from North America were brought to the islands of New Zealand around the year 1900. This species of deer has survived in several regions in New Zealand.

Part B: Describe one possible effect that a nonnative species can have on a native ecosystem and explain why this effect might occur.

It could have a bad effect on New Zealand for many reasons. One is because it may eat foods that native animals eat thus taking the native animal's food source and depleting that certain population. Another is that maybe they have a disease or something that the native animals aren't used to that may kill the native species off or at least endanger them.

356 / 1000

Review/End Test

Pause

Flag

Options

Back

The response demonstrates a *thorough* understanding of how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires) by completing all tasks presented in the item. The student explains that the white-tailed deer are considered a nonnative species because they originated in North America and were transported to New Zealand. The description of one possible effect that the nonnative species can have on a native ecosystem (depleting a certain population of native animals or killing and endangering the native species) is correct. The student explains why this effect might occur by stating that nonnative animals eat the native animals' food source or may introduce a disease that the native population is susceptible to. The response is complete, clear, and correct.

STUDENT RESPONSE**RESPONSE SCORE: 2 POINTS**

14. White-tailed deer from North America were brought to the islands of New Zealand around the year 1900. This species of deer has survived in several regions in New Zealand.

Part A: Explain why the white-tailed deer population is considered a nonnative species in New Zealand.

they didnt alway live there

they were brought there.

Go to the next page to finish question 14.

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

Part B: Describe one possible effect that a nonnative species can have on a native ecosystem and explain why this effect might occur.

they could make another
species go extinct

The response demonstrates a *partial* understanding of how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires) by completing two of the tasks presented in the item. The student explains that the white-tailed deer are considered a nonnative population in New Zealand because the deer were introduced into the ecosystem. In Part B, the student describes a possible effect that a nonnative species could have on a native ecosystem (they could make another species go extinct), but fails to explain why this effect might occur. This response contains work that is incomplete or unclear.

STUDENT RESPONSE**RESPONSE SCORE: 1 POINT**

14. White-tailed deer from North America were brought to the islands of New Zealand around the year 1900. This species of deer has survived in several regions in New Zealand.

Part A: Explain why the white-tailed deer population is considered a nonnative species in New Zealand.

Because they weren't originally from New Zealand they originally were from North America.

Go to the next page to finish question 14.

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

Part B: Describe one possible effect that a nonnative species can have on a native ecosystem and explain why this effect might occur.

They could be interfering with another ecosystem
because they weren't there first.

The response demonstrates a *minimal* understanding of how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires) by completing one of the tasks in the item. The student explains that the white-tailed deer are considered a nonnative population in New Zealand because the deer were introduced from North America. The description of the possible effect and the explanation about why it might occur are not specific enough for credit. This response contains work that is incomplete or unclear.

STUDENT RESPONSE**RESPONSE SCORE: 0 POINTS**

14. White-tailed deer from North America were brought to the islands of New Zealand around the year 1900. This species of deer has survived in several regions in New Zealand.

Part A: Explain why the white-tailed deer population is considered a nonnative species in New Zealand.

The white-tailed deer is a big population because New Zealand is an over populated country with alot of animals.

Go to the next page to finish question 14.

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

Part B: Describe one possible effect that a nonnative species can have on a native ecosystem and explain why this effect might occur.

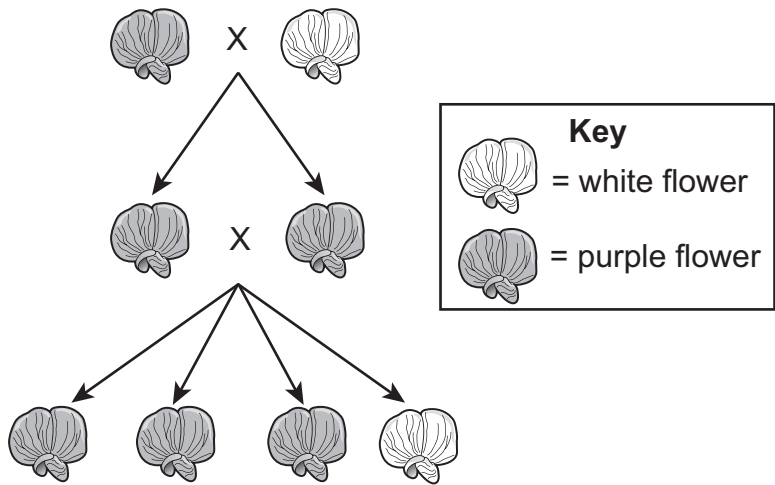
because it does not belong in the ecosystem.

The response demonstrates an *insufficient* understanding of how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires) by completing none of the tasks in the item. The student's response in Part A does not explain why the white-tailed deer is considered nonnative to New Zealand. Additionally, the response in Part B is unclear because the student explains why an effect might occur without describing the effect. Without additional explanation, the response is unclear and does not demonstrate enough understanding for credit.

CONSTRUCTED-RESPONSE ITEM

Use the diagram below to answer question 15.

Pea Flower Color Cross



15. In pea plants, the flowers can be purple or white. The diagram shows three generations of pea plant crosses.

Part A: Using the pea flower color cross, identify the pattern of inheritance shown and explain how the cross shows this pattern.

Go to the next page to finish question 15.

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

Part B: Explain how farmers could ensure that they only grow white flowers.

SCORING GUIDE

#15 ITEM INFORMATION

Alignment	BIO.B.2.1.1	Depth of Knowledge	3	Mean Score	1.28
-----------	-------------	--------------------	---	------------	------

ITEM-SPECIFIC SCORING GUIDELINE

Score	Description
3	<p>The response demonstrates a <i>thorough</i> understanding of observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles) by</p> <ul style="list-style-type: none"> identifying the pattern of inheritance shown in the pea flower color cross <p>AND</p> <ul style="list-style-type: none"> explaining how the cross shows this pattern <p>AND</p> <ul style="list-style-type: none"> explaining how farmers could ensure that they only grow white flowers <p>The response is clear, complete, and correct.</p>
2	<p>The response demonstrates a <i>partial</i> understanding of observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles) by fulfilling two of the three bullets listed under the 3-point response.</p> <p>The response may contain some work that is incomplete or unclear.</p>
1	<p>The response demonstrates a <i>minimal</i> understanding of observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles) by fulfilling one of the three bullets listed under the 3-point response.</p> <p>The response may contain some work that is incomplete or unclear.</p>
0	<p>The response provides <i>insufficient</i> evidence to demonstrate any understanding of the concept being tested.</p>
Non-scorables	<p>B – No response written or refusal to respond F – Foreign language K – Off task U – Unreadable</p>

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

Responses that will receive credit:**Part A (2 points):**

- Purple color is dominant; white color is recessive.
- Dominant/recessive inherited pattern

AND

- When a purple-flowered plant was crossed with the white-flowered plant, the offspring (F1 generation) all have purple flowers, because purple flower color is a dominant trait. However, each offspring also received the allele for white flower color; so, when the F1 generation pea plants were crossed, the F2 generation had three offspring with purple flowers and one with white flowers (see Punnett square).

	P	w
P	PP	Pw
w	Pw	ww

Part B (1 point):

- If farmers want only white flowers, they should only cross white-flowered plants, because white-flowered plants are homozygous for white flowers (they only have alleles for white flowers).

STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS



Question 15
Page 1 of 2

Item ID

Pea Flower Color Cross

Use the diagram below to answer the question.

In pea plants, the flowers can be purple or white. The diagram shows three generations of pea plant crosses.

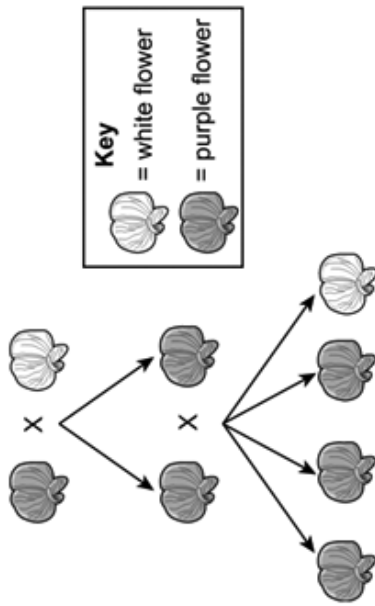
Part A: Using the pea flower color cross, identify the pattern of inheritance shown and explain how the cross shows this pattern.

In this pea flower cross, the purple flower is dominant and the white flower is recessive. The first cross we can assume that the purple flower is homozygous dominant (PP) and the white flower is homozygous recessive (ww). This would produce two heterozygous dominant offspring (Pw). When the two heterozygous dominant (Pw) flowers are crossed the result is one homozygous dominant offspring (PP), two heterozygous dominant offspring (Pw), and one homozygous recessive offspring (ww).

Question 15
Page 2 of 2

Use the diagram below to answer the question.

Pea Flower Color Cross



In pea plants, the flowers can be purple or white. The diagram shows three generations of pea plant crosses.

Part B: Explain how farmers could ensure that they only grow white flowers.

283 / 1000

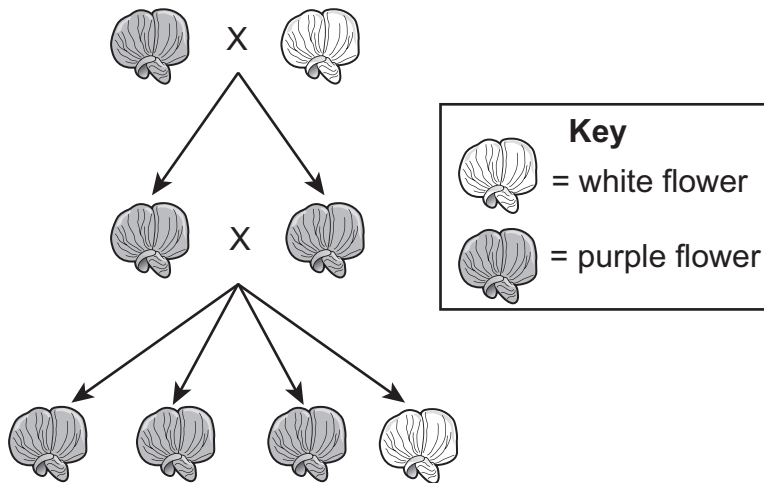
This response demonstrates a *thorough* understanding of observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles) by completing all three tasks presented in the item. The student correctly identifies the pattern of inheritance (“the purple flower is dominant and the white flower is recessive”). In addition, the student correctly explains how the cross shows the pattern by describing the genotypes of the parent flowers and following the inheritance pattern down the two generations. Finally, the student explains that by crossing only white-flowered pea plants, the farmer would only grow white flowers. The additional explanation contains correct information but is not needed for credit. The response is complete, clear, and correct.

STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS

Use the diagram below to answer question 15.

Pea Flower Color Cross



15. In pea plants, the flowers can be purple or white. The diagram shows three generations of pea plant crosses.

Part A: Using the pea flower color cross, identify the pattern of inheritance shown and explain how the cross shows this pattern.

The pattern is very interesting. It shows that purple is dominant and white is recessive. That being said most of the offspring is purple. Although there is a weak link being the white flower in the third generation.

Go to the next page to finish question 15.

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

Part B: Explain how farmers could ensure that they only grow white flowers.

The farmer would have to buy strictly white flowers. White flowers are recessive (rr), so the offspring will always be recessive and white also.

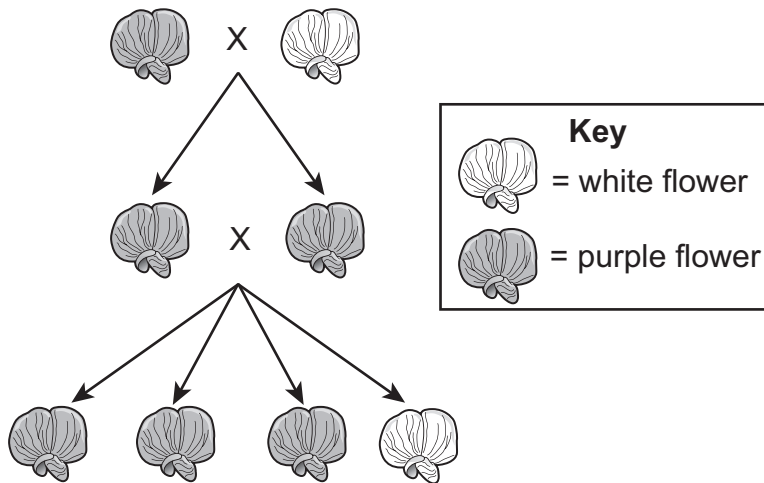
This response demonstrates a *partial* understanding of observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles) by fulfilling two of the tasks presented in the item. The student accurately identifies the pattern of inheritance but provides an incomplete explanation of how the cross shows the pattern. The explanation of how farmers could ensure they only grow white flowers is acceptable for credit. The student correctly states that the farmer should buy white flowers. Doing so would produce 100% white-flowered offspring. This response contains some work that is incomplete or unclear.

STUDENT RESPONSE

RESPONSE SCORE: 1 POINT

Use the diagram below to answer question 15.

Pea Flower Color Cross



15. In pea plants, the flowers can be purple or white. The diagram shows three generations of pea plant crosses.

Part A: Using the pea flower color cross, identify the pattern of inheritance shown and explain how the cross shows this pattern.

This shows incomplete dominance because the recessive allele was carried down until there was one totally white flower in the 3rd generation.

Go to the next page to finish question 15.

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

Part B: Explain how farmers could ensure that they only grow white flowers.

To ensure the growth of white flowers only, farmers must find two white flowers which both contain 2 recessive alleles.

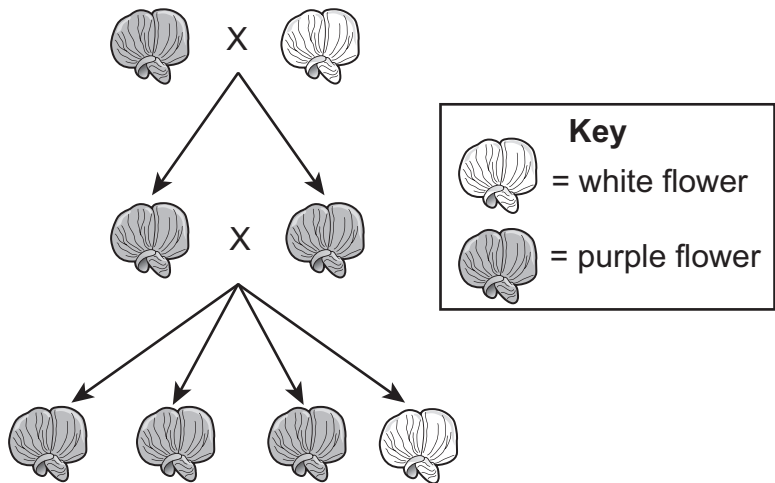
This response demonstrates a *minimal* understanding of observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles) by completing one of the tasks presented in the item. The student incorrectly identifies the pattern of inheritance as incomplete dominance, and the explanation of how the cross shows the pattern is not enough for credit (though the student does correctly state that the recessive allele is carried down to the third generation). The explanation of how farmers could ensure they grow only white flowers is acceptable for credit. Finding only “white flowers which both contain 2 recessive alleles” is correct. This response contains work that is incomplete or unclear.

STUDENT RESPONSE

RESPONSE SCORE: 0 POINTS

Use the diagram below to answer question 15.

Pea Flower Color Cross



15. In pea plants, the flowers can be purple or white. The diagram shows three generations of pea plant crosses.

Part A: Using the pea flower color cross, identify the pattern of inheritance shown and explain how the cross shows this pattern.

In the pea flower color cross, the white flower always skip a generation of inheritance.

Go to the next page to finish question 15.

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

Part B: Explain how farmers could ensure that they only grow white flowers.

Farmers could ensure that they only grow white flowers only using 2 purple parent genes to produce white flowers.

This response demonstrates an *insufficient* understanding of observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles) by not completing any of the tasks in the item. The student fails to identify the pattern of inheritance and provides a very general explanation of how the cross shows a pattern. In Part B, the student incorrectly explains how crossing two purple flowers would produce white flowers. This response contains work that is incomplete or unclear.

BIOLOGY MODULE 2—SUMMARY DATA

MULTIPLE-CHOICE

Sample Number	Alignment	Answer Key	Depth of Knowledge	<i>p</i> -values			
				A	B	C	D
1	BIO.B.1.2.1	C	2	17%	11%	54%	18%
2	BIO.B.1.2.2	D	2	24%	19%	13%	44%
3	BIO.B.2.1.2	B	2	11%	62%	16%	11%
4	BIO.B.2.3.1	C	2	9%	9%	54%	28%
5	BIO.B.2.4.1	C	2	12%	15%	56%	17%
6	BIO.B.3.1.2	C	2	17%	13%	63%	7%
7	BIO.B.3.2.1	D	2	14%	14%	12%	60%
8	BIO.B.3.3.1	A	2	52%	23%	10%	15%
9	BIO.B.4.1.1	A	2	51%	15%	22%	12%
10	BIO.B.4.2.1	B	2	8%	73%	15%	4%
11	BIO.B.4.2.4	B	2	16%	57%	14%	13%
12	BIO.B.3.1.1	D	2	5%	8%	7%	79%
13	BIO.B.4.2.2	C	2	11%	17%	64%	8%

CONSTRUCTED-RESPONSE

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
14	BIO.B.4.2.4	3	3	1.51
15	BIO.B.2.1.1	3	3	1.28



**THIS PAGE IS
INTENTIONALLY BLANK.**

KEYSTONE EXAMS
BIOLOGY

ITEM AND SCORING SAMPLER 2015

Copyright © 2015 by the Pennsylvania Department of Education. The materials contained in this publication may be duplicated by Pennsylvania educators for local classroom use. This permission does not extend to the duplication of materials for commercial use.
