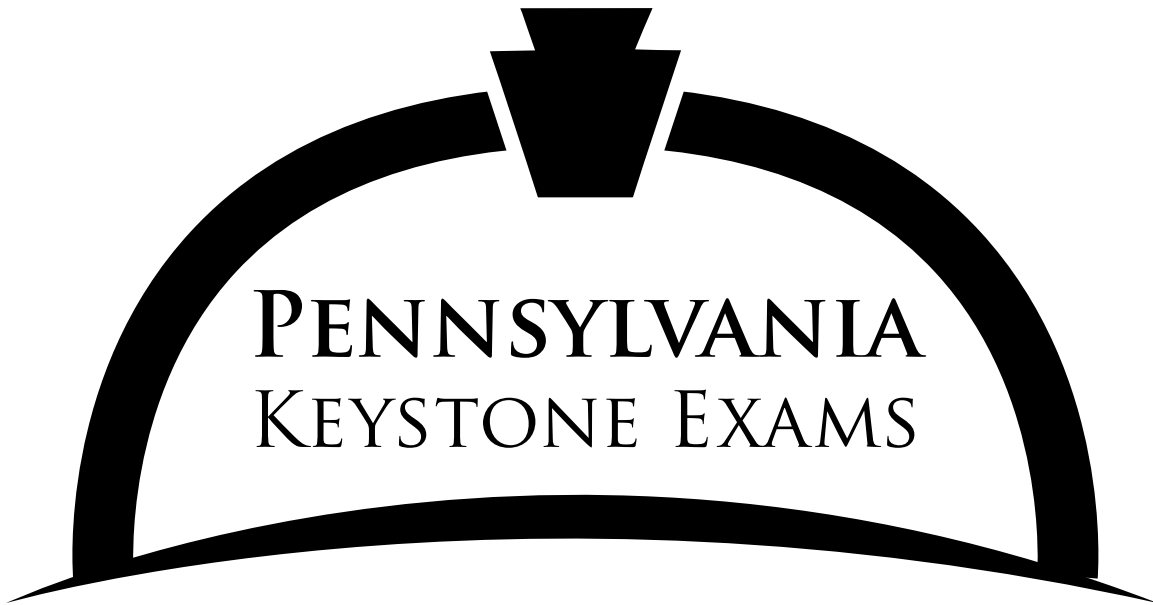




pennsylvania
DEPARTMENT OF EDUCATION



Biology
Item and Scoring Sampler

2017

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INTRODUCTION

The Pennsylvania Department of Education (PDE) provides districts and schools with tools to assist in delivering focused instructional programs aligned to the Pennsylvania Core Standards. These tools include the standards, Assessment Anchor documents, Keystone Exams Test Definition, Classroom Diagnostic Tool, Standards Aligned System, and content-based item and scoring samplers. This 2017 Biology Item and Scoring Sampler is a useful tool for Pennsylvania educators in preparing students for the Keystone Exams.

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

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

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

ABOUT THE KEYSTONE EXAMS

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

Alignment

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

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

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

Depth of Knowledge

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

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

Each Keystone item has been through a rigorous review process and is assigned a DOK level. For additional information about DOK, please visit the PDE website at http://static.pdesas.org/Content/Documents/Keystone_Exam_Program_Overview.pdf.

Exam Format

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

ITEM AND SCORING SAMPLER FORMAT

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

Example Multiple-Choice Question Information Table

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

Example Open-Ended Item Information Table

Alignment	Assigned AAEC	Depth of Knowledge	Assigned DOK	Mean Score	
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² All p-value percentages listed in the item information tables have been rounded.

BIOLOGY EXAM DIRECTIONS

Directions:

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

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

There are two types of questions in this module.

Multiple-Choice Questions:

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

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

Constructed-Response Questions:

These questions will require you to write your response.

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

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

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

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

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

GENERAL DESCRIPTION OF SCORING GUIDELINES FOR BIOLOGY

3 Points

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

2 Points

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

1 Point

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

0 Points

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

BIOLOGY MODULE 1

MULTIPLE-CHOICE QUESTIONS

1. Which characteristic is shared by both prokaryotes and eukaryotes?
- A. have organ systems
 - B. make their own food
 - C. contain genetic material
 - D. need oxygen gas to breathe

Item Information	
Alignment	BIO.A.1.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	12%
p-value B	13%
p-value C	66% (correct answer)
p-value D	9%
Option Annotations	A. All prokaryotes and some eukaryotes lack organ systems. B. Only some prokaryotes (i.e., photosynthetic cyanobacteria and chemosynthetic bacteria) and some eukaryotes (i.e., plants) make their own food. C. Key: Both prokaryotes and eukaryotes contain genetic material (DNA). D. Breathing involves organs called lungs, which are present in some eukaryotes.

2. Carbon can combine with many different elements but frequently combines with oxygen, hydrogen, and nitrogen to form organic molecules. Which statement **best** explains why carbon is able to form a large number of different molecules?
- A. Carbon forms only ionic bonds.
 - B. Carbon can form only ring structures.
 - C. Carbon can form four covalent bonds.
 - D. Carbon forms small, simple structures.

Item Information	
Alignment	BIO.A.2.2.1
Answer Key	C
Depth of Knowledge	2
p-value A	9%
p-value B	4%
p-value C	73% (correct answer)
p-value D	14%
Option Annotations	A. Carbon forms covalent bonds, not ionic bonds. B. Carbon can form long chain structures or ring structures. C. Key: Carbon can form four covalent bonds with its four valence electrons. D. Carbon can form long chains or rings structures, as well as complex branching structures with combinations of single, double, and triple bonds.

3. Which statement correctly describes how a protein is formed?
- A. A monosaccharide bonded to a side chain is broken apart.
 - B. Amino acids are bonded together in a long chain to form a new molecule.
 - C. A molecule containing glycerol bonded to three fatty acids is broken apart.
 - D. A nitrogenous base, a sugar, and a phosphate group combine to form a new molecule.

Item Information	
Alignment	BIO.A.2.2.2
Answer Key	B
Depth of Knowledge	2
p-value A	4%
p-value B	58% (correct answer)
p-value C	9%
p-value D	29%
Option Annotations	A. Removing a monosaccharide from a side chain results in the freeing of a simple sugar from a molecule, not the formation of a protein. B. Key: A series of condensation reactions between amino acids eventually results in the formation of a polypeptide that, once folded, is a protein. C. Removing glycerol from three fatty acids describes the breakdown of a triglyceride. D. The combination of a nitrogenous base, a sugar, and a phosphate group results in the formation of a nucleotide, a monomer of a nucleic acid.

4. Use the chart below to answer the question.

Biological Molecule Information

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

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

- A. molecule 1: lipid
molecule 2: nucleic acid
- B. molecule 1: lipid
molecule 2: protein
- C. molecule 1: carbohydrate
molecule 2: nucleic acid
- D. molecule 1: carbohydrate
molecule 2: protein

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

5. Which action must occur for an enzyme to catalyze a chemical reaction?
- A. A competitive inhibitor must first bind to an active site.
 - B. A substrate must bind to an active site of the enzyme.
 - C. A substrate must bind to an allosteric site of the enzyme.
 - D. A noncompetitive inhibitor must first bind to an active site.

Item Information	
Alignment	BIO.A.2.3.1
Answer Key	B
Depth of Knowledge	2
p-value A	14%
p-value B	65% (correct answer)
p-value C	11%
p-value D	10%
Option Annotations	A. A competitive inhibitor prevents binding at the active site of an enzyme. B. Key: A substrate must bind to an enzyme's active site to be properly positioned for the enzyme to catalyze a chemical reaction. C. Non-substrate molecules use the allosteric site of an enzyme. D. A noncompetitive inhibitor reduces the enzyme's functional efficiency.

6. Lipase is an enzyme that breaks down lipids in the digestive system of humans. It functions best at a pH range of 4.0 to 5.0. When a person takes an antacid tablet to relieve heartburn, the antacid increases the pH to around 7 in certain areas of the digestive system. Which initial effect would **most likely** be caused by a change in pH?
- A. More lipids would be digested.
 - B. Fewer lipids would be digested.
 - C. The production of lipase molecules would increase.
 - D. The production of lipase molecules would decrease.

Item Information	
Alignment	BIO.A.2.3.2
Answer Key	B
Depth of Knowledge	2
p-value A	20%
p-value B	36% (correct answer)
p-value C	24%
p-value D	20%
Option Annotations	A. Fewer, not more, lipids would be digested at a nonoptimal pH of 7.0. B. Key: Lipid digestion decreases outside of the optimal pH range of 4.0 to 5.0. C. Lipase production occurs in cells independent of lipase function in digestion. D. Lipase production occurs in cells independent of lipase function in digestion.

7. Use the lists below to answer the question.

Cell Structures Observed in Two Organisms

Cell Structures in Organism 1		Cell Structures in Organism 2	
- cell wall - endoplasmic reticulum - Golgi body - chloroplasts	- mitochondria - nucleus - ribosomes - vacuole	- cell membrane - endoplasmic reticulum - Golgi body	- mitochondria - nucleus - ribosomes

A student made lists of structures observed in cells from two different organisms. Which statement describes the **most likely** difference in the way that organism 1 and organism 2 obtain energy?

- A. Only organism 1 uses solar energy to make energy-rich compounds.
- B. Only organism 1 stores solar energy until it is needed for its life processes.
- C. Only organism 2 produces molecules for long-term energy storage.
- D. Only organism 2 transforms food energy into ATP during cellular respiration.

Item Information	
Alignment	BIO.A.3.1.1
Answer Key	A
Depth of Knowledge	2
p-value A	46% (correct answer)
p-value B	21%
p-value C	10%
p-value D	23%
Option Annotations	A. Key: Organism 1 has chloroplasts, which are used to convert solar energy into chemical energy. B. Neither organism 1 nor 2 has the capacity to store solar energy. C. The endoplasmic reticulum, present in organisms 1 and 2, is associated with the production of lipids for long-term energy storage. D. Mitochondria, present in organisms 1 and 2, perform cellular respiration.

8. A cell in the leaf of a green plant performs both photosynthesis and cellular respiration, often at the same time. Which statement **best** describes how these processes are related to each other?
- A. Both processes produce carbon dioxide.
 - B. Both processes require energy directly from the Sun.
 - C. Products of one process are used as some of the reactants for the other process.
 - D. Thermal energy from one process is used as the energy source for the other process.

Item Information	
Alignment	BIO.A.3.2.1
Answer Key	C
Depth of Knowledge	2
p-value A	8%
p-value B	25%
p-value C	58% (correct answer)
p-value D	9%
Option Annotations	A. Only cellular respiration produces carbon dioxide. B. Only photosynthesis requires energy directly from the Sun. C. Key: Photosynthesis uses carbon dioxide produced during cellular respiration, and cellular respiration uses oxygen produced during photosynthesis. D. Solar energy is used during photosynthesis, and glucose is used in cellular respiration.

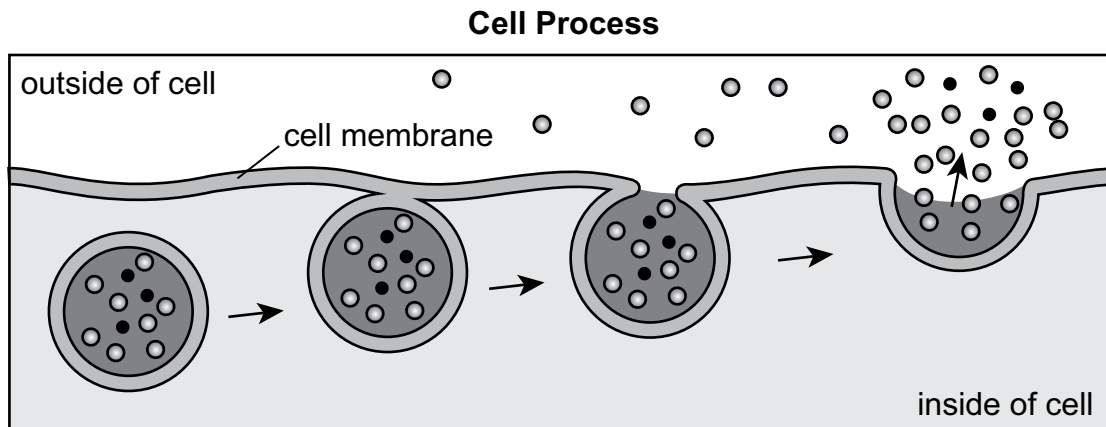
9. A scientist observed that during the course of a chemical reaction the number of ATP molecules was reduced. What did the scientist **most likely** learn from the observation?
- A. The reaction produced water.
 - B. The reaction consumed water.
 - C. The reaction caused an output of energy.
 - D. The reaction required an input of energy.

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

10. Which statement **best** describes how channel and carrier proteins in the plasma membrane are similar?
- A. Both allow for the flow of molecules into and out of a cell.
 - B. Both directly connect the membrane to the nucleus of a cell.
 - C. Both use energy to continuously move water molecules out of a cell.
 - D. Both cause the phospholipid bilayer to form a rigid membrane for a cell.

Item Information	
Alignment	BIO.A.4.1.1
Answer Key	A
Depth of Knowledge	2
p-value A	60% (correct answer)
p-value B	11%
p-value C	19%
p-value D	10%
Option Annotations	A. Key: Channel and carrier proteins form pathways across the lipid bilayer. B. These proteins provide pathways across the lipid bilayer, not to the nucleus. C. All channel proteins and some carrier proteins move water without energy. D. These proteins create openings in the phospholipid bilayer, they do not make it rigid.

11. Use the diagram below to answer the question.



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

- A. osmosis
- B. exocytosis
- C. passive transport
- D. facilitated diffusion

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

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

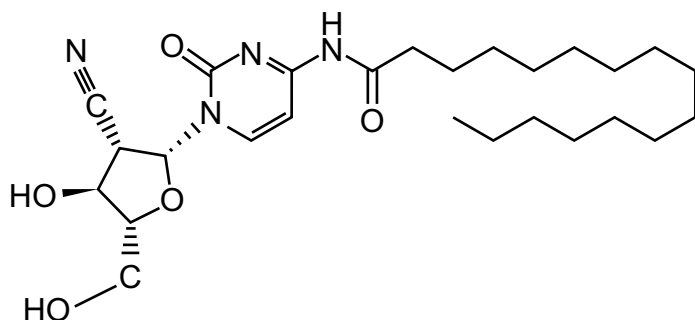
A New Type of Treatment

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

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

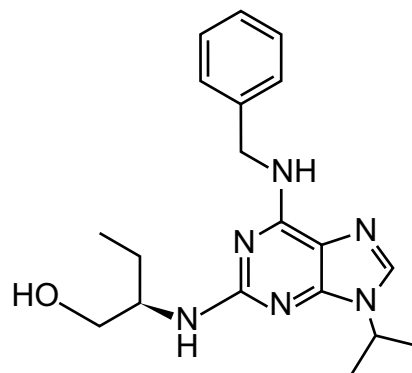
Characteristics of Medicine X

- large molecule
- damages DNA



Characteristics of Medicine Y

- large molecule
- decreases enzyme activity



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

12. In order for medicine X to produce the effects that the researchers observed, it must have entered into which part of the targeted cells?
- A. nucleus
 - B. ribosomes
 - C. Golgi apparatus
 - D. rough endoplasmic reticulum

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

13. Given the properties of the medicine Y molecule, which mechanism is **most likely** responsible for medicine Y's entry into cells?
- A. osmosis
 - B. exocytosis
 - C. active transport
 - D. simple diffusion

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

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CONSTRUCTED-RESPONSE ITEM

14. A group of students is given a sample of an unknown substance. The students are asked to gather evidence to determine whether the substance is living or nonliving. The students take a small sample of the substance and observe it using a microscope.

Part A: Describe two characteristics of the substance that could be observed to indicate whether it is living or nonliving.

Characteristic 1: _____

Characteristic 2: _____

Go to the next page to finish question 14.



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

Part B: Describe an investigation that could be performed to classify the substance as living or nonliving.

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



SCORING GUIDE

#14 Item Information

Alignment	BIO.A.1.1.1	Depth of Knowledge	3	Mean Score	1.30
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Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a <i>thorough</i> understanding of the characteristics of life shared by all prokaryotic and eukaryotic organisms by - Describing two characteristics of life that can be observed with a microscope AND - Describing an investigation to classify a substance as living or nonliving The response is clear, complete, and correct.
2	The response demonstrates a <i>partial</i> understanding of the characteristics of life shared by all prokaryotic and eukaryotic organisms by - Describing two characteristics of life that can be observed with a microscope OR - Describing one characteristic of life that can be observed with a microscope and describing an investigation to classify a substance as living or nonliving The response may contain some work that is incomplete or unclear.
1	The response demonstrates a <i>minimal</i> understanding of the characteristics of life shared by all prokaryotic and eukaryotic organisms by - Describing one characteristic of life that can be observed with a microscope OR - Describing an investigation to classify the substance as living or nonliving The response may contain some work that is incomplete or unclear.
0	The response provides <i>insufficient</i> evidence to demonstrate any understanding of the concept being tested.
Non-scorables	B – No response written or refusal to respond F – Foreign language K – Off task U – Unreadable

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

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

- The substance is made of cells / is multicellular
OR
- The substance contains genetic material (DNA)
OR
- The substance reproduces
OR
- The substance brings in nutrients for energy
OR
- The substance moves on its own and therefore uses energy
OR
- The substance responds to a stimulus
OR
- The substance grows and develops

Part B (1 point):

- Provide the substance with nutrients and check for growth (change in number or size of cells) over time
OR
- Provide the substance with sunlight and check for growth (change in number or size of cells) over time
OR
- Place the substance on a grid and check for movement over time
OR
- Count the number of cells in a small sample of the substance and check for an increase in cell number over time
OR
- Touch the substance and check for a response

Background Information:

- The criteria for life are generally 1) reproduction, 2) order (particularly that it is made of cells), 3) response to the environment, 4) regulation of the internal environment (homeostasis), 5) growth and development, 6) evolutionary adaptation, and 7) energy processing (which can be input of energy, or use of solar energy as with photosynthesis, or use/output of energy as in movement or biosynthesis).
- Some of these criteria are easily observable, others are not.

STUDENT RESPONSE

Response Score: 3 points

14. A group of students is given a sample of an unknown substance. The students are asked to gather evidence to determine whether the substance is living or nonliving. The students take a small sample of the substance and observe it using a microscope.

Part A: Describe two characteristics of the substance that could be observed to indicate whether it is living or nonliving.

Characteristic 1: If the substance is moving it would indicate life. Movement requires energy which can only occur in living things.

Characteristic 2: If the substance grows over time it is living. Growth requires cell reproduction which only occurs in living things.

Go to the next page to finish question 14.

GO ON 

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

Part B: Describe an investigation that could be performed to classify the substance as living or nonliving.

The students could divide the substance up into equal parts and put each part in a different container. If, when provided with time and proper conditions, the substance grew in size, it would be living. This growth would be due to the reproduction of cells through either meiosis or mitosis. This cell reproduction only occurs in living plants or animal cells. However, if it did not grow, it could be classified as nonliving. This is due to the fact that all living things grow.

The response demonstrates a *thorough* understanding of the characteristics of life shared by all prokaryotic and eukaryotic organisms. In Part A, the response correctly describes two characteristics of life that can be observed with a microscope. Characteristic 1: "If the substance is moving ... Movement requires energy ..." Characteristic 2: "If the substance grows ... Growth requires cell reproduction ..." In Part B, the response correctly describes an investigation to classify a substance as living or nonliving, "... divide the substance into equal parts and put each part in a separate container. If, when provided with time and proper conditions, the substance grew in size, it would be living." The response is clear, complete, and correct.

STUDENT RESPONSE

Response Score: 2 points



Part A

Question 14
Page 1 of 2

Item ID

A group of students is given a sample of an unknown substance. The students are asked to gather evidence to determine whether the substance is living or nonliving. The students take a small sample of the substance and observe it using a microscope.

Part A: Describe two characteristics of the substance that could be observed to indicate whether it is living or nonliving.

Characteristic 1:

147 / 1000

One characteristic would be if the students can see working cells. If they see working cells then it is living, if they don't then it is nonliving.

Characteristic 2:

61 / 1000

Another characteristic would be if the student saw a membrane.

Next

Options

Flag

Pause

Review/End Test

STUDENT RESPONSE

Part B

Question 14
Page 2 of 2

Item ID

Line Guide

EQ

155 / 1000

A group of students is given a sample of an unknown substance. The students are asked to gather evidence to determine whether the substance is living or nonliving. The students take a small sample of the substance and observe it using a microscope.

Part B: Describe an investigation that could be performed to classify the substance as living or nonliving.

An investigation would be to put the substance in sunlight and give it water (like a plant) and see if it grows/moves or changes in anyway, shpae, or form.

Review/End Test

Pause

Flag

Options

Back

Next

The response demonstrates a *partial* understanding of the characteristics of life shared by all prokaryotic and eukaryotic organisms. In Part A, the response correctly describes only one characteristic of life that can be observed with a microscope. Characteristic 1: "... if the students can see *working cells*." The response for Characteristic 2 in Part A "... if the student saw a *membrane*." is incorrect and receives no credit. In Part B, the response correctly describes an investigation to classify a substance as living or nonliving: "... put the substance in *sunlight* and give it water (like a plant) and see if it grows/moves or changes in anyway ...". The response contains work that is incomplete or unclear.

STUDENT RESPONSE

Response Score: 1 point

14. A group of students is given a sample of an unknown substance. The students are asked to gather evidence to determine whether the substance is living or nonliving. The students take a small sample of the substance and observe it using a microscope.

Part A: Describe two characteristics of the substance that could be observed to indicate whether it is living or nonliving.

Characteristic 1: Look at it very closely and see if it got cells if it does then its living.

Characteristic 2: If it don't have cells or not showing that its living then its nonliving.

Go to the next page to finish question 14.

GO ON 

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

Part B: Describe an investigation that could be performed to classify the substance as living or nonliving.

Grab a microscope and observed it
very closely

The response demonstrates a *minimal* understanding of the characteristics of life shared by all prokaryotic and eukaryotic organisms. In Part A, the response correctly describes only one characteristic of life that can be observed with a microscope. Characteristic 1: "... see if it got cells..." The response for Characteristic 2 in Part A is a continuation of the response for Characteristic 1; it does not describe a second characteristic. The response for Characteristic 2 does not receive any credit. In Part B, the response "Grab a microscope and observed it very closely" does not describe an investigation to classify a substance as living or nonliving. It is too general and does not receive any credit. The response contains work that is incomplete or unclear.

STUDENT RESPONSE

Response Score: 0 points



Part A

Question 14
Page 1 of 2

Item ID

?

A group of students is given a sample of an unknown substance. The students are asked to gather evidence to determine whether the substance is living or nonliving. The students take a small sample of the substance and observe it using a microscope.

Part A: Describe two characteristics of the substance that could be observed to indicate whether it is living or nonliving.

Characteristic 1:

Eq

If it was a living substance then it would have living organisms.

65 / 1000

Characteristic 2:

Eq

If it weren't living it wouldn't have organisms.

48 / 1000

Next

Options

Flag

Pause

Review/End Test

STUDENT RESPONSE

Part B

Question 14
Page 2 of 2

Item ID

Line Guide

Eq

34 / 1000

A group of students is given a sample of an unknown substance. The students are asked to gather evidence to determine whether the substance is living or nonliving. The students take a small sample of the substance and observe it using a microscope.

Part B: Describe an investigation that could be performed to classify the substance as living or nonliving.

check to see what's living inside.

Review/End Test

Pause

Flag

Options

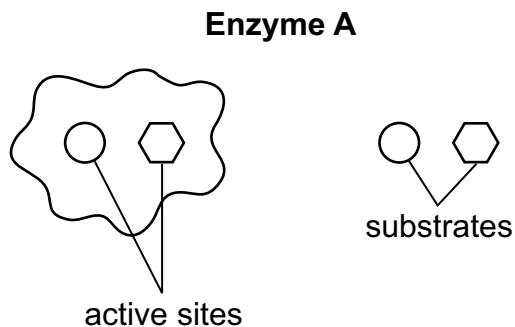
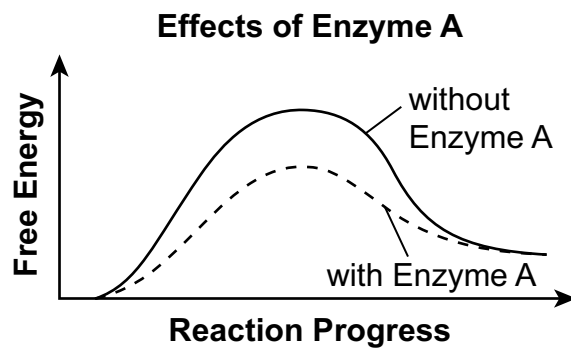
Back

Next

The response provides *insufficient* evidence to demonstrate any understanding of the characteristics of life shared by all prokaryotic and eukaryotic organisms. In Part A, the response does not describe any characteristics of life that can be observed with a microscope. The response for Characteristic 1 does not give a valid characteristic and the response for Characteristic 2 is an inverse of Characteristic 1. Part A does not receive any credit. In Part B, the response “check to see what’s living inside” does not describe an investigation to classify a substance as living or nonliving. It is too general and does not receive any credit. The response contains work that is incomplete or unclear.

CONSTRUCTED-RESPONSE ITEM

15. Use the graph and diagram below to answer the question.



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.

GO ON 

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.

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



SCORING GUIDE

#15 Item Information

Alignment	BIO.A.2.3.1	Depth of Knowledge	3	Mean Score	0.89
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Item-Specific Scoring Guideline

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

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

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

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

Part B (1 point):

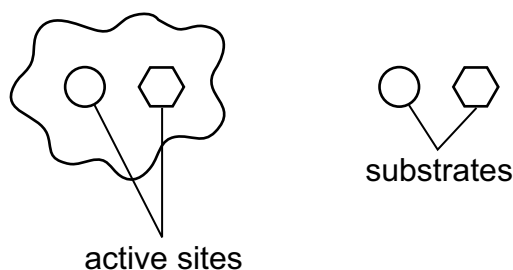
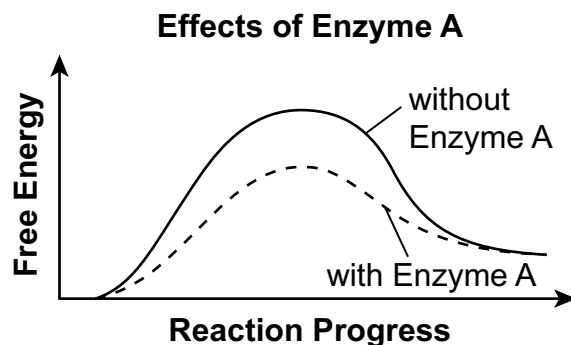
- When the shape of an enzyme's active site is changed, the substrate cannot attach to the active site; it will not "fit." The enzyme would not be able to catalyze the reaction.
- When the shape of the enzyme's active site is slightly changed (caused by a change in pH, for example), the enzyme activity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

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

STUDENT RESPONSE

Response Score: 3 points

15. Use the graph and diagram below to answer the question.

**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.

GO ON

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.

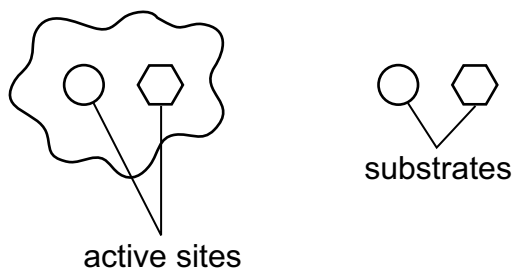
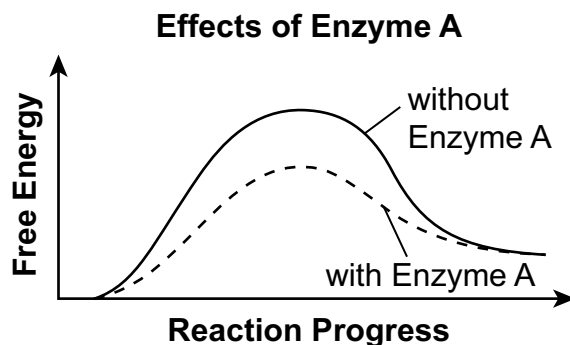
It would affect the enzyme's ability to catalyze the reaction because they might not react right. The active sites could change, and then they wouldn't fit like a lock and key anymore, so therefore, the enzyme would no longer act as a catalyst.

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

15. Use the graph and diagram below to answer the question.



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.

GO ON 

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.

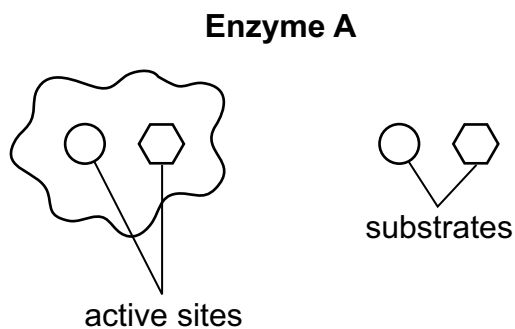
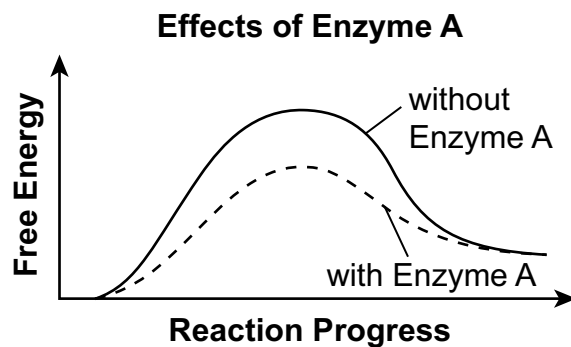
The enzyme may cause the opposite effects
with the catalyze being used.

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

STUDENT RESPONSE

Response Score: 1 point

15. Use the graph and diagram below to answer the question.



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.

GO ON 

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.

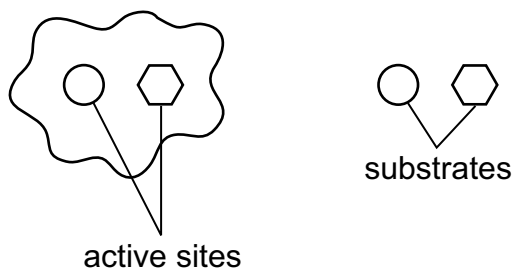
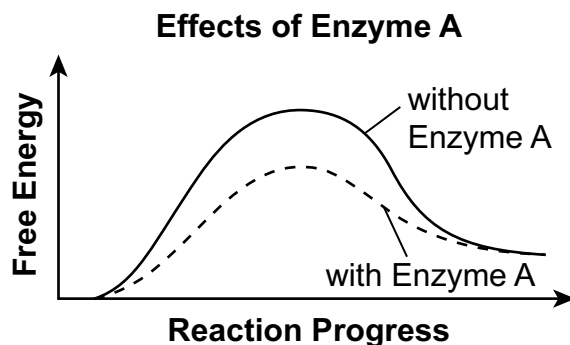
Its ability would be to speed up the
reaction by reducing the activation energy.

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

15. Use the graph and diagram below to answer the question.



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.

GO ON 

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-value A	p-value B	p-value C	p-value D
1	BIO.A.1.1.1	C	2	12%	13%	66%	9%
2	BIO.A.2.2.1	C	2	9%	4%	73%	14%
3	BIO.A.2.2.2	B	2	4%	58%	9%	29%
4	BIO.A.2.2.3	A	2	48%	17%	23%	12%
5	BIO.A.2.3.1	B	2	14%	65%	11%	10%
6	BIO.A.2.3.2	B	2	20%	36%	24%	20%
7	BIO.A.3.1.1	A	2	46%	21%	10%	23%
8	BIO.A.3.2.1	C	2	8%	25%	58%	9%
9	BIO.A.3.2.2	D	2	7%	10%	39%	44%
10	BIO.A.4.1.1	A	2	60%	11%	19%	10%
11	BIO.A.4.1.2	B	2	8%	49%	26%	17%
12 (P)	BIO.A.1.2.1	A	2	73%	11%	10%	6%
13 (P)	BIO.A.4.1.2	C	2	11%	11%	60%	18%

CONSTRUCTED-RESPONSE

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
14	BIO.A.1.1.1	3	3	1.30
15	BIO.A.2.3.1	3	3	0.89

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BIOLOGY MODULE 2

MULTIPLE-CHOICE QUESTIONS

1. At a point in the cell cycle, chromosomes have aligned near the middle of a cell. Which sequence of events will the cell need to complete to produce two identical daughter cells?
- A. anaphase → telophase → cytokinesis
 - B. anaphase II → telophase II → cytokinesis II
 - C. prophase → metaphase → anaphase
 - D. metaphase II → anaphase II → telophase II

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

2. Which statement **best** describes the outcomes of both meiosis and mitosis?
- A. Cell division results in daughter cells that contain DNA.
 - B. Each daughter cell has two complete sets of chromosomes.
 - C. Within a cell, two chromosomes pair up and exchange segments of genetic material.
 - D. Genetically identical daughter cells are produced that can function as body cells or sex cells.

Item Information	
Alignment	BIO.B.1.1.2
Answer Key	A
Depth of Knowledge	2
p-value A	43% (correct answer)
p-value B	16%
p-value C	16%
p-value D	25%
Option Annotations	A. Key: Both meiosis and mitosis result in daughter cells containing DNA. B. In mitosis, each daughter cell has two complete sets of chromosomes. C. Recombination (or crossing over) occurs exclusively in meiosis. D. Mitosis produces genetically identical body cells, not sex cells.

3. In order to study genetic mutations, scientists must study genetic material. Which statement describes the genetic material scientists are **most likely** studying?
- A. They study alleles that contain chromosomes, which are RNA.
 - B. They study alleles that contain genes, which are chromosomes.
 - C. They study chromosomes that contain DNA segments, which are RNA.
 - D. They study chromosomes that contain genes, which are DNA segments.

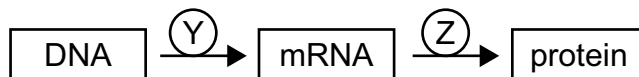
Item Information	
Alignment	BIO.B.1.2.2
Answer Key	D
Depth of Knowledge	2
p-value A	7%
p-value B	20%
p-value C	18%
p-value D	55% (correct answer)
Option Annotations	A. Alleles are different forms of a gene, and genes contain DNA. B. Alleles are different forms of a gene, and genes make up chromosomes. C. Chromosomes are made up of genes, and genes contain DNA segments. D. Key: Chromosomes are made up of genes, and genes contain DNA segments.

4. An inversion occurs along part of a chromosome. How does the inversion **most likely** affect the region in which it occurs?
- A. Recessive alleles in the region become dominant alleles.
 - B. The information in the region is read differently during transcription.
 - C. The coding sequence in the region disappears entirely from the cell.
 - D. Multiple frame-shift errors in the region are triggered after translation.

Item Information	
Alignment	BIO.B.2.1.2
Answer Key	B
Depth of Knowledge	2
p-value A	17%
p-value B	46% (correct answer)
p-value C	13%
p-value D	24%
Option Annotations	A. Dominant or recessive alleles cannot change their phenotypic expression. B. Key: An inversion occurs when a chromosomal segment is rotated and reinserted in the same location, which causes the region to be read differently. C. A deletion mutation causes part of the coding sequence to disappear. D. Frame-shift errors are caused by insertions or deletions, not inversions.

5. Use the diagram below to answer the question.

Biological Process



Which labels correctly complete the diagram?

- A. Y is replication, and Z is translation.
- B. Y is translation, and Z is replication.
- C. Y is transcription, and Z is translation.
- D. Y is translation, and Z is transcription.

Item Information	
Alignment	BIO.B.2.2.1
Answer Key	C
Depth of Knowledge	2
p-value A	19%
p-value B	13%
p-value C	40% (correct answer)
p-value D	28%
Option Annotations	A. Process Y is transcription, and process Z is translation. B. Process Y is transcription, and process Z is translation. C. Key: Process Y is transcription, and process Z is translation. D. Process Y is transcription, and process Z is translation.

6. Which statement **best** describes how geographic isolation can contribute to land animal speciation?
- A. Geographic isolation physically separates populations but allows them to interact.
 - B. Geographic isolation physically separates populations and prevents them from interacting.
 - C. Geographic isolation causes genetic changes in individual organisms but allows them to interact.
 - D. Geographic isolation causes genetic changes in individual organisms and prevents them from interacting.

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

7. Which condition would **most likely** result in an increase in the phenotypic variation within a population?
- A. The variety of food available in the habitat decreases.
 - B. A mutation leads to individuals with genetic differences.
 - C. Competition is reduced for all individuals during the winter.
 - D. Climate remains unchanged in the population's ecosystem.

Item Information	
Alignment	BIO.B.3.1.3
Answer Key	B
Depth of Knowledge	2
p-value A	14%
p-value B	63% (correct answer)
p-value C	12%
p-value D	11%
Option Annotations	A. Phenotypic variation related to environmental factors is not heritable. B. Key: Mutations are the key source of genetic variation leading to phenotypic variation in a population. C. Reduced competition is unlikely to promote differential reproduction. D. Climate consistency is unlikely to promote differential reproduction.

8. Many scientists have concluded that whales and dolphins have a more recent, common ancestor than do whales and sharks. Which characteristic **most likely** allowed scientists to make this conclusion?
- A. species niche
 - B. predation behavior
 - C. anatomical structure
 - D. geographical distribution

Item Information	
Alignment	BIO.B.3.2.1
Answer Key	C
Depth of Knowledge	2
p-value A	16%
p-value B	15%
p-value C	59% (correct answer)
p-value D	10%
Option Annotations	A. Studying species niche allows scientists to understand species' ecological roles in relation to their habitat conditions, resources, and interactions. B. Studying predation behavior provides understanding related to nutrition. C. Key: Comparative anatomy has long been used to determine common ancestry among organisms. D. Whales, dolphins, and sharks share their environments with many organisms; this is not sufficient information to determine common ancestry.

9. Which set of ecological organization levels is **most likely** to contain the largest variety of species?
- A. multiple biomes in a biosphere
 - B. multiple ecosystems in a biome
 - C. multiple individuals in a population
 - D. multiple populations in a community

Item Information	
Alignment	BIO.B.4.1.1
Answer Key	A
Depth of Knowledge	2
p-value A	55% (correct answer)
p-value B	18%
p-value C	9%
p-value D	18%
Option Annotations	A. Key: A biome is the most inclusive level of biological organization within a biosphere and represents more variety than any other ecological level. B. Ecosystems are components of biomes within the biosphere. C. Individuals within the same population are the same species. D. Multiple populations represent less variety than that found in a biome.

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

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

11. Ash from a volcanic eruption decreases the amount of available solar energy for a region. Which statement describes how a decrease in available sunlight will **most likely** affect ecosystems of this region?
- A. Producer populations will decrease, causing a decrease in consumer populations.
 - B. Producer populations will decrease, causing an increase in consumer populations.
 - C. Decomposer populations will increase, causing a decrease in consumer populations.
 - D. Decomposer populations will increase, causing an increase in consumer populations.

Item Information	
Alignment	BIO.B.4.2.5
Answer Key	A
Depth of Knowledge	2
p-value A	75% (correct answer)
p-value B	10%
p-value C	11%
p-value D	4%
Option Annotations	A. Key: Reduced sunlight will harm producers and consumers in the ecosystem. B. If producer populations decrease, consumer populations will also decrease. C. Decomposer populations do not directly affect consumer populations. D. Decomposer populations do not directly affect consumer populations.

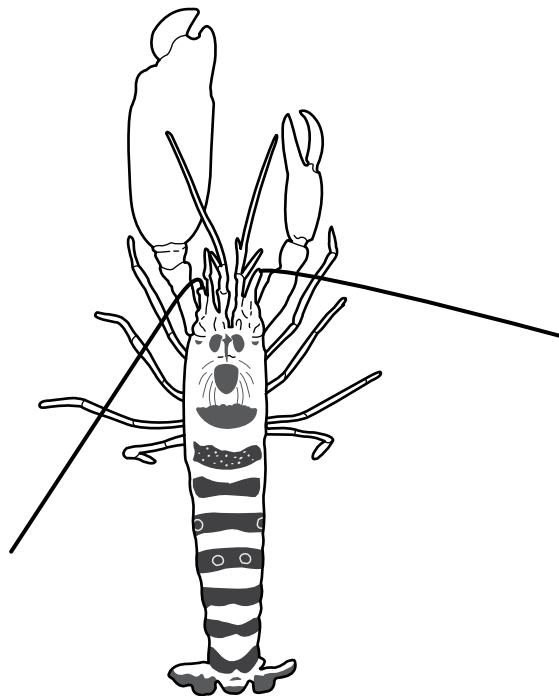
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Directions: Use the information presented on page 60 to answer questions 12 and 13.

A Stunning Adaptation

Pistol shrimp are a group of small crustaceans with one claw that is much larger than the other. When pistol shrimp snap the larger claw shut, a sharp cracking sound is produced. A pistol shrimp can use this sound to stun its prey, such as small fish. Some pistol shrimp even have pockets of tissue that cover their eyes for protection from the sound waves. The drawing shows an example of one species of pistol shrimp.

Pistol Shrimp



Scientists investigating this noise production have determined that it is not the snapping together of the two sides of the claw that results in the loud sound. The process is far more complex. As the two sides of the claw snap shut, a jet of water comes from the claw at a speed of up to 62 miles per hour. The moving water forms a low-pressure bubble behind it. As the pressure around the moving water stabilizes, the bubble pops, resulting in a loud bang.

12. A male pistol shrimp with protective eye tissue pockets mates with a female shrimp without protective eye tissue pockets. All of the offspring have eye tissue pockets. Which statement is the **most likely** conclusion that can be made about the eye tissue pocket trait in pistol shrimp?
- A. It is a recessive, autosomal trait.
 - B. It is a dominant, autosomal trait.
 - C. It is a trait that results from multiple alleles.
 - D. It is a trait that results from incomplete dominance.

Item Information	
Alignment	BIO.B.2.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	8%
p-value B	78% (correct answer)
p-value C	8%
p-value D	6%
Option Annotations	A. This trait is dominant, not recessive. B. Key: The eye tissue pocket trait is dominant and will result in offspring with at least one allele for the trait. C. A dominant trait will result in offspring with at least one allele for the trait. D. This trait has two forms; it does not produce a third phenotype.

13. Some pistol shrimp within a population do not have eye tissue pockets. What role will natural selection **most likely** have in the frequency of the alleles responsible for the presence of tissue pockets in the shrimp population over time?
- A. Natural selection will increase the allele frequency for tissue pockets because they are beneficial to the shrimp.
 - B. Natural selection will decrease the allele frequency for tissue pockets because they are beneficial to the shrimp.
 - C. Natural selection will not affect the allele frequency for tissue pockets because the trait is only in a few organisms.
 - D. Natural selection will lead to the extinction of the shrimp species over time because the tissue pockets could cause poor vision.

Item Information	
Alignment	BIO.B.3.1.1
Answer Key	A
Depth of Knowledge	2
p-value A	65% (correct answer)
p-value B	10%
p-value C	16%
p-value D	9%
Option Annotations	A. Key: Beneficial traits will increase in allele frequency as organisms with these traits successfully reproduce and pass the traits to offspring. B. Natural selection will increase the allele frequency of beneficial traits. C. Natural selection will increase the allele frequency of beneficial traits. D. Tissue pockets benefit shrimp by protecting their eyes.

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CONSTRUCTED-RESPONSE ITEM

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

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

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

Go to the next page to finish question 14.

GO ON 

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

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

Example 1: _____

Example 2: _____

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



SCORING GUIDE

#14 Item Information

Alignment	BIO.B.2.1.1	Depth of Knowledge	3	Mean Score	1.26
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Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a <i>thorough</i> understanding of describing and/or predicting observed patterns of inheritance by - Describing how one part of Mendel's conclusions is consistent with current scientific knowledge of inheritance OR - Describing an example of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered OR - Describing a second example of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered. The response is clear, complete, and correct.
2	The response demonstrates a <i>partial</i> understanding of describing and/or predicting observed patterns of inheritance by fulfilling two of the bullets. The response may contain some work that is incomplete or unclear. - Describing how one part of Mendel's conclusions is consistent with current scientific knowledge of inheritance OR - Describing an example of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered OR - Describing a second example of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered.
1	The response demonstrates a <i>minimal</i> understanding of describing and/or predicting observed patterns of inheritance by fulfilling one of the bullets. The response may contain some work that is incomplete or unclear. - Describing how one part of Mendel's conclusions is consistent with current scientific knowledge of inheritance OR - Describing an example of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered OR - Describing a second example of how Mendel's conclusions do not fully explain other forms of inheritance that have been discovered.
0	The response provides <i>insufficient</i> evidence to demonstrate any understanding of the concept being tested.
Non-scorables	B – No response written or refusal to respond F – Foreign language K – Off task U – Unreadable

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

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

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

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

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

Background Information:

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

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STUDENT RESPONSE**Response Score: 3 points**

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

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

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

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

Go to the next page to finish question 14.

GO ON 

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

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

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

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

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

STUDENT RESPONSE

Response Score: 2 points



Part A

Question 14
Page 1 of 2

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

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

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

EQ

Mendel's conclusion is consistent with current information because organisms today inherit alleles from both their parents.

123 / 1000

Next

Options

Flag

Pause

Review/End Test

STUDENT RESPONSE

Part B

Question 14
Page 2 of 2

Item ID

?

Line Guide

76 / 1000

Example 1:

Genetic mutations can occur causing a new trait that neither parent carried.

Example 2:

Natural Selection states that traits occur at random meaning that the recessive trait can be shown through too.

111 / 1000

Review/End Test

Pause

Flag

Options

Back

Next

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

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

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

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

STUDENT RESPONSE**Response Score: 1 point**

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

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

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

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

Go to the next page to finish question 14.

GO ON 

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

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

Example 1: We could inherit a recessive trait

Example 2: Don't always display that trait

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

STUDENT RESPONSE

Response Score: 0 points



Part A

Question 14
Page 1 of 2

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

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

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

EQ

Because the pea plant never changed it's form. Only the way grows has been modified.

84 / 1000

Next

Options

Flag

Pause

Review/End Test

STUDENT RESPONSE

Part B

Question 14
Page 2 of 2

Item ID

Line Guide

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

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

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

Example 1:

He never really explained how traits have two possible forms.

65 / 1000

Example 2:

Mendel should've explained the process more clearly than he did.

64 / 1000

Review/End Test

Pause

Flag

Options

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

CONSTRUCTED-RESPONSE ITEM

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

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

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

Go to the next page to finish question 15.



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

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

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



SCORING GUIDE

#15 Item Information

Alignment	BIO.B.2.4.1	Depth of Knowledge	3	Mean Score	1.26
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Item-Specific Scoring Guideline

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

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

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

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

Part B (1 point):

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

Part C (1 point):

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

STUDENT RESPONSE

Response Score: 3 points

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

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

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

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

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

Go to the next page to finish question 15.

GO ON 

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

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

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

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

STUDENT RESPONSE

Response Score: 2 points

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

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

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

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

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

Go to the next page to finish question 15.

GO ON 

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

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

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

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

STUDENT RESPONSE

Response Score: 1 point

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

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

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

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

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

Go to the next page to finish question 15.

GO ON 

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

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

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

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

STUDENT RESPONSE

Response Score: 0 points

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

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

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

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

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

Go to the next page to finish question 15.



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

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

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

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

BIOLOGY MODULE 2—SUMMARY DATA

MULTIPLE-CHOICE

Sample Number	Alignment	Answer Key	Depth of Knowledge	p-value A	p-value B	p-value C	p-value D
1	BIO.B.1.1.1	A	2	48%	13%	25%	14%
2	BIO.B.1.1.2	A	2	43%	16%	16%	25%
3	BIO.B.1.2.2	D	2	7%	20%	18%	55%
4	BIO.B.2.1.2	B	2	17%	46%	13%	24%
5	BIO.B.2.2.1	C	2	19%	13%	40%	28%
6	BIO.B.3.1.2	B	2	11%	59%	12%	18%
7	BIO.B.3.1.3	B	2	14%	63%	12%	11%
8	BIO.B.3.2.1	C	2	16%	15%	59%	10%
9	BIO.B.4.1.1	A	2	55%	18%	9%	18%
10	BIO.B.4.2.2	C	2	9%	12%	72%	7%
11	BIO.B.4.2.5	A	2	75%	10%	11%	4%
12 (P)	BIO.B.2.1.1	B	2	8%	78%	8%	6%
13 (P)	BIO.B.3.1.1	A	2	65%	10%	16%	9%

CONSTRUCTED-RESPONSE

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
14	BIO.B.2.1.1	3	3	1.26
15	BIO.B.2.4.1	3	3	1.26

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Keystone Exams Biology

Item and Scoring Sampler 2017

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