



**pennsylvania**  
DEPARTMENT OF EDUCATION



**PENNSYLVANIA  
KEYSTONE EXAMS**

**BIOLOGY**

**ITEM AND SCORING SAMPLER**

**2014**

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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, assessment handbooks, and content-based item and scoring samplers. This 2014 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, and 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 they may also be copied and used as part of a local instructional program.<sup>1</sup> 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, fulfill the state's service-learning and attendance requirements, 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 Web site at <http://www.education.state.pa.us>. Click on the green check mark and select "Keystone Exams."

### Alignment

The Biology Keystone Exam consists of exam 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.

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<sup>1</sup> 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 Web Site at [http://static.pdesas.org/Content/Documents/Keystone\\_Exams\\_Understanding\\_Depth\\_of\\_Knowledge\\_and\\_Cognitive\\_Complexity.pdf](http://static.pdesas.org/Content/Documents/Keystone_Exams_Understanding_Depth_of_Knowledge_and_Cognitive_Complexity.pdf).

### Exam Format

The Keystone Exams are delivered in a paper-and-pencil format as well as in a computer-based online format. The multiple-choice items require students to select the best answer from four possible answer options and record their answers in the spaces provided. The correct answer for each multiple-choice item is worth one point. The constructed-response items require students to develop and write (or construct) their responses. Constructed-response items in Biology are scored using item-specific scoring guidelines based on a 0–3-point scale. Each multiple-choice item is designed to take about one 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 percentage<sup>2</sup> 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			
<b>Alignment</b>		Assigned AAEC		Brief answer option analysis or rationale			
<b>Answer Key</b>		Correct Answer					
<b>Depth of Knowledge</b>		Assigned DOK					
<b><i>p</i>-values</b>							
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>				
Percentage of students who selected each option							

**Example Constructed-Response Item Information Table**

Alignment	Assigned AAEC	Depth of Knowledge	Assigned DOK	Mean Score	

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

## BIOLOGY EXAM DIRECTIONS

Below are the exam directions available to students in their test booklets. 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

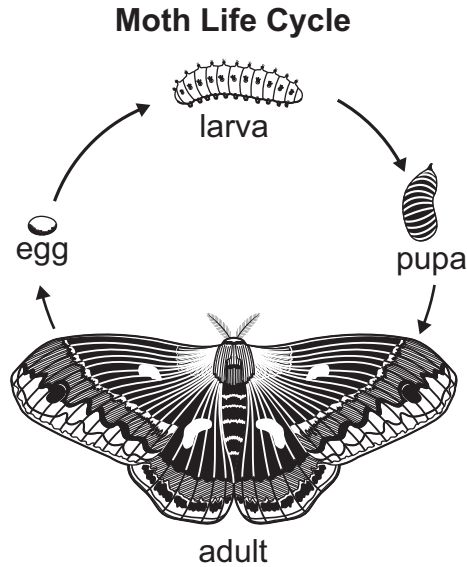
- The response demonstrates a *minimal* understanding of the scientific content, concepts, and/or procedures required by the task(s).
- The response is somewhat correct with *minimal* understanding of the required scientific content, concepts, and/or procedures demonstrated and/or explained. The response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

Use the diagram below to answer question 1.



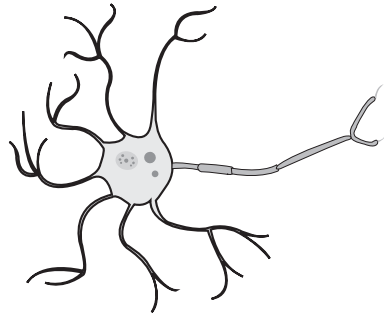
1. Which characteristic of life is **best** shown by this diagram?
- A. DNA is the genetic code in an organism.
  - B. An organism is made of one or more cells.
  - C. An organism responds to changes in its environment.
  - D. Changes occur in an organism as it grows and develops.

Item Information				Option Annotations
<b>Alignment</b>		BIO.A.1.1.1		A. A life cycle diagram does not represent the role of DNA. B. A life cycle diagram does not represent the cell theory. C. A life cycle diagram does not represent the ability of an organism to respond to environmental changes. D. Key: The life cycle diagram shows four stages in the life of a moth. The growth and development of this organism is best represented by this diagram.
<b>Answer Key</b>		D		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
4%	3%	6%	86%	

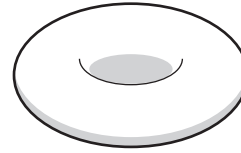


Use the illustrations below to answer question 2.

Body Cells



nerve cell



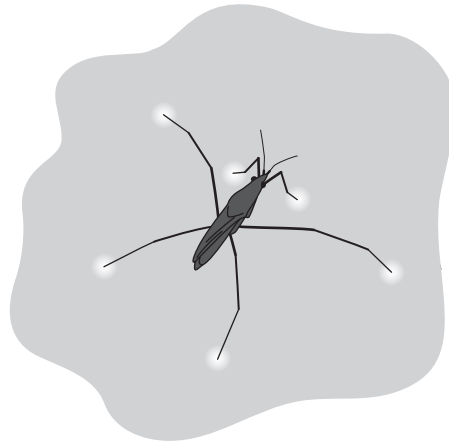
red blood cell

2. Which statement **best** explains why these cells have structural differences?
- A. The cells have different functions.
  - B. The cells evolved in different organisms.
  - C. One of the cells develops into the other type of cell.
  - D. One of the cells is more primitive than the other cell.

Item Information				Option Annotations
<b>Alignment</b>		BIO.A.1.2.2		A. Key: The differences in cellular structure between each cell type are directly related to the specific functions of each cell type. B. The two cells shown are common in some multicellular organisms; their differences are based on performing certain functions. C. Neither cell develops into the other; a cell's location in an organism and the required functions determine cell differentiation. D. Neither the nerve cell nor the red blood cell is primitive, but rather they are differentiated cells within complex multicellular organisms.
<b>Answer Key</b>		A		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
83%	6%	5%	6%	

Use the illustration below to answer question 3.

Water Strider



3. Which of the following is a property of water that allows a water strider to walk on the surface of water?
- A. solubility
  - B. cohesion
  - C. high specific heat
  - D. low freezing point

Item Information				Option Annotations
<b>Alignment</b>		BIO.A.2.1.1		A. Water, as a solvent, can dissolve many compounds, but being solvent does not allow a water strider to walk on the surface of water. B. Key: Cohesion is a property of water that describes the attraction of water molecules to one another, which creates high surface tension that keeps a water strider on top of the water. C. High specific heat refers to the amount of heat required to raise water temperature, which results in water being able to regulate environmental extremes but does not allow a water strider to walk on the surface of water. D. The low freezing point of water is not associated with the cohesive properties of liquid water.
<b>Answer Key</b>		B		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
27%	62%	5%	5%	

4. Which statement describes the formation of a protein molecule?
- A. Amino acids combine to form a protein chain.
  - B. Fatty acid monomers dissolve to form a protein chain.
  - C. Fatty acid monomers combine to form a protein chain.
  - D. Amino acids dissolve monomers to form a protein chain.

Item Information				Option Annotations
Alignment		BIO.A.2.2.2		A. Key: Proteins are biological macromolecules that form when multiple amino acid monomers are linked together with peptide bonds. B. Protein chains form when amino acid monomers combine, not through dissolution of fatty acid monomers. C. Three fatty acid monomers combine with a glycerol molecule to form a triglyceride, which is a type of lipid. D. Protein chains are polymers formed when amino acid monomers combine, not dissolve.
Answer Key		A		
Depth of Knowledge		2		
<i>p-values</i>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
61%	9%	19%	11%	

Use the table below to answer question 5.

**Students' Descriptions of Four Organic Compounds**

Student	Organic Compounds	Description
1	carbohydrates	complex compounds made of purines and pyrimidines that function as data-storage molecules
2	lipids	use the relatively high energy contained in carbon-hydrogen bonds to perform their primary function
3	proteins	chains of amino acids that can function as enzymes, hormones, or antibodies
4	nucleic acids	compounds, produced by photosynthetic plants, that contain only carbon, hydrogen, and oxygen

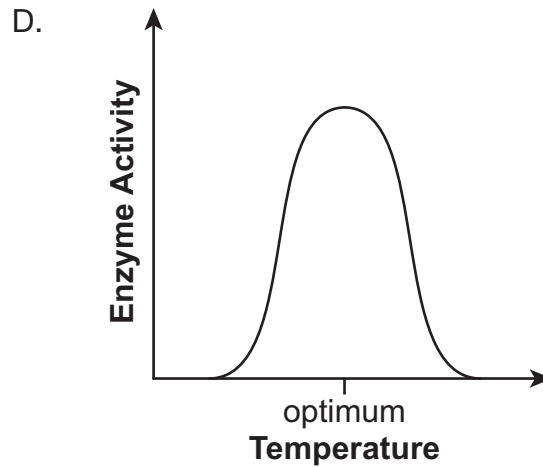
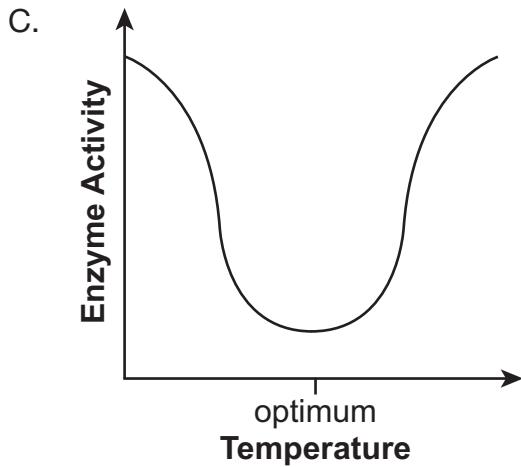
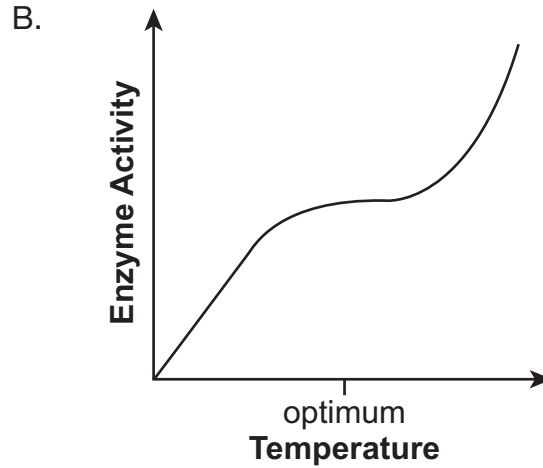
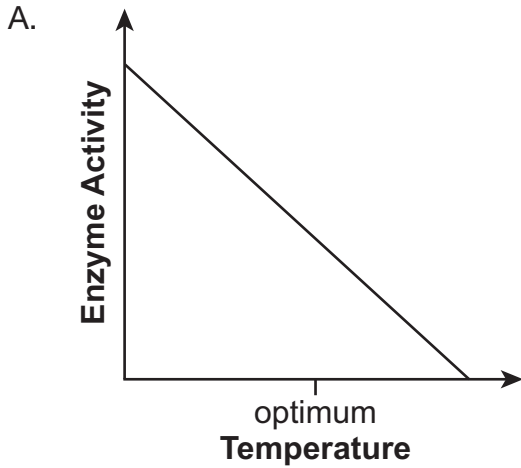
5. Which two students correctly described organic compounds?
- A. students 1 and 2
  - B. students 2 and 3
  - C. students 3 and 4
  - D. students 2 and 4

Item Information				Option Annotations
<b>Alignment</b>		BIO.A.2.2.3		<p>A. Student 1 described nitrogenous bases that form DNA and RNA, not carbohydrates; student 2 correctly described lipids.</p> <p>B. Key: Student 2 correctly described the structure and function of lipids, and student 3 correctly described the structure and functions of proteins.</p> <p>C. Student 3 correctly described proteins; student 4 described sugar monomers that combine to form carbohydrates, not nucleic acids.</p> <p>D. Student 2 correctly described lipids; student 4 described sugar monomers that combine to form carbohydrates, not nucleic acids.</p>
<b>Answer Key</b>		B		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
11%	41%	29%	19%	

6. Carbonic anhydrase is an enzyme involved in the reaction of carbon dioxide with water to form a molecule that dissolves well in the liquid part of blood. How does carbonic anhydrase affect this reaction?
- A. by making the reaction reversible
  - B. by changing chemical products of the reaction
  - C. by increasing the time needed for the reaction to occur
  - D. by decreasing the amount of energy needed to complete the reaction

Item Information				Option Annotations
<b>Alignment</b>		BIO.A.2.3.1		A. The direction of a reaction is determined by the amount of substrate or products present and the activation energy required in each direction, not by the enzyme. B. Carbonic anhydrase is functionally specific; it does not change the products of the reaction. C. Enzymes reduce, not increase, the time needed for a reaction to occur. D. Key: An enzyme can act as a catalyst that regulates specific biochemical reactions and decreases the amount of energy needed for a reaction to occur.
<b>Answer Key</b>		D		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
11%	37%	17%	35%	

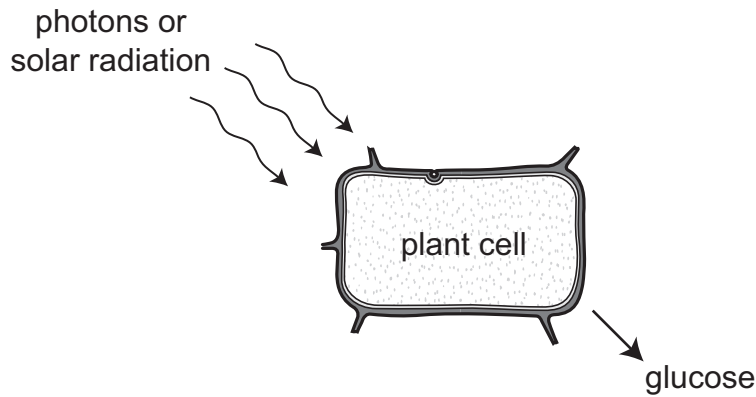
7. Which graph **best** shows how enzyme activity changes as the temperature is adjusted above and below the enzyme's optimum temperature?



Item Information				Option Annotations
<b>Alignment</b>		BIO.A.2.3.2		A. This graph incorrectly shows the greatest enzyme activity below the optimal temperature range of the enzyme. B. This graph shows that the greatest enzyme activity occurs at temperatures that exceed the optimal temperature. C. This graph shows the opposite effect of increasing temperature on enzyme activity. D. Key: Temperature is a factor that can influence the function of an enzyme. As temperature increases, the activity of the enzyme increases until the temperature exceeds the optimal enzyme temperature, causing the denatured enzyme to no longer function.
<b>Answer Key</b>		D		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
10%	30%	18%	42%	

Use the diagram below to answer question 8.

**Plant Cell Energy Transformation**



8. The diagram shows an energy transformation that typically occurs in plant cell plastids. Which statement **best** describes this role of plastids in the plant cell?
- A. Chloroplasts transform light energy into chemical energy.
  - B. Mitochondria transform light energy into chemical energy.
  - C. Chloroplasts transform chemical energy into electromagnetic energy.
  - D. Mitochondria transform chemical energy into electromagnetic energy.

Item Information				Option Annotations
<b>Alignment</b>		BIO.A.3.1.1		A. Key: Chloroplasts are plastids in plant cells that transform light energy into chemical energy in the form of glucose. B. Mitochondria convert chemical energy in organic molecules into ATP during cellular respiration; mitochondria do not transform light energy. C. Chloroplasts transform light energy into chemical energy that is stored in the molecular bonds of sugar. D. Mitochondria perform cellular respiration, which converts chemical energy in organic molecules into ATP, not electromagnetic energy.
<b>Answer Key</b>		A		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
62%	17%	15%	5%	

Use the list below to answer question 9.

1. Cellular respiration and photosynthesis both involve water.
2. Cellular respiration uses sugar, and photosynthesis produces sugar.
3. Cellular respiration and photosynthesis both use light to produce energy.
4. Cellular respiration requires light energy, and photosynthesis requires chemical energy.

9. Which two statements correctly describe one similarity and one difference between cellular respiration and photosynthesis?
- A. statements 1 and 2
  - B. statements 1 and 4
  - C. statements 2 and 3
  - D. statements 3 and 4

Item Information				Option Annotations
<b>Alignment</b>		BIO.A.3.2.1		A. Key: Cellular respiration and photosynthesis are similar because water is part of both reactions; they are different because the sugar produced during the energy transformations in photosynthesis is used as a reactant during the energy transformation in cellular respiration. B. Statement 1 is correct, but statement 4 is incorrect because cellular respiration uses chemical energy and photosynthesis uses light energy. C. Statement 2 is correct, but statement 3 is incorrect because cellular respiration uses chemical energy to produce ATP; it does not use light. D. Statements 3 and 4 are both incorrect because cellular respiration uses chemical energy and photosynthesis uses light energy.
<b>Answer Key</b>		A		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
36%	16%	31%	15%	



Use the list below to answer question 10.

**Functions of a Cell Structure**

- allows waste to exit the cell
- allows chemicals required for cellular respiration to enter the cell
- regulates movement of water into and out of the cell

10. The functions of which cell structure are described in this list?

- A. a lysosome
- B. a mitochondrion
- C. the plasma membrane
- D. the endoplasmic reticulum

Item Information				Option Annotations
<b>Alignment</b>		BIO.A.4.1.1		A. A lysosome contains enzymes that digest cellular wastes. B. A mitochondrion is the site where sugar is converted into ATP during cellular respiration. C. Key: The structure of the plasma membrane allows it to function in regulating the movement of water and other materials into and out of the cell. D. The endoplasmic reticulum helps facilitate protein synthesis and transport.
<b>Answer Key</b>		C		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
13%	12%	54%	20%	

11. A jackrabbit has large ears containing blood vessels that help it maintain a constant body temperature by adjusting heat exchange with the surrounding environment. Which characteristic of life is **best** described by this example?
- A. growth
  - B. energy use
  - C. organization
  - D. homeostasis

Item Information				Option Annotations
<b>Alignment</b>		BIO.A.4.2.1		A. Growth is best exhibited by cell division or a change in size. B. Energy use is best exhibited by cellular growth, maintenance, and repair. C. Organization in complex organisms is exhibited through the grouping of cells into tissues, organs, and organ systems. D. Key: The process of adjusting heat exchange is an example of maintaining a stable internal environment, which is homeostasis.
<b>Answer Key</b>		D		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
7%	28%	6%	59%	

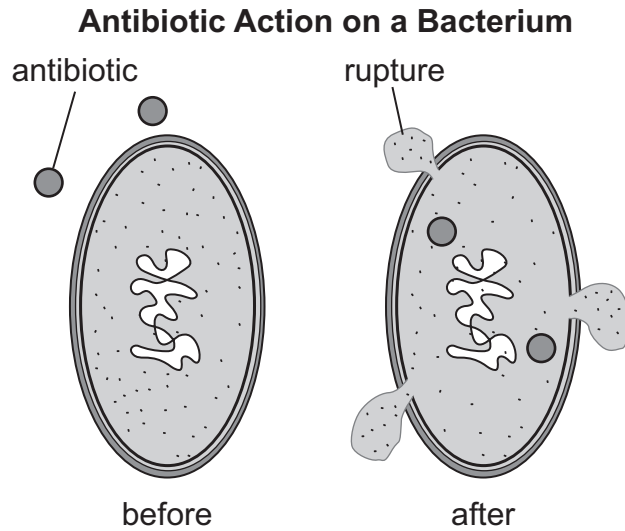


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Directions: Use the information presented on page 18 to answer questions 12 and 13.

### Bacteria and Antibiotics

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



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

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

Item Information				Option Annotations
<b>Alignment</b>		BIO.A.1.2.2		A. Key: The cell walls of bacteria act as regulatory structures similar to the skin of humans. B. The liver does not provide protection as a regulatory structure. C. The heart does not provide protection as a regulatory structure. D. The pancreas does not provide protection as a regulatory structure.
<b>Answer Key</b>		A		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
73%	13%	6%	7%	

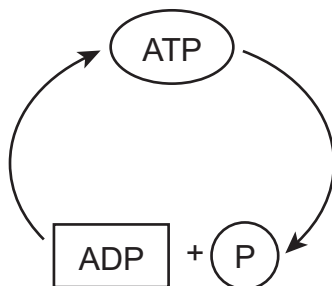
13. Which statement **best** describes how antibiotics affect cellular homeostasis?

- 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
<b>Alignment</b>		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.
<b>Answer Key</b>		B		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
11%	62%	18%	8%	

## CONSTRUCTED-RESPONSE ITEMS

Use the diagram below to answer question 14.



14.

**Part A:** Explain why ATP is important in biochemical reactions.

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Go to the next page to finish question 14.

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

**Part B:** Give two examples of biochemical reactions and explain how an organism uses ATP within the reactions.

Example	Explanation

## SCORING GUIDE

### #14 ITEM INFORMATION

Alignment	A.3.2.2	Depth of Knowledge	3	Mean Score	0.88
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### ITEM-SPECIFIC SCORING GUIDELINE

Score	Description
3	<p>The response demonstrates a <i>thorough</i> understanding of the role of ATP in biochemical reactions by</p> <ul style="list-style-type: none"> <li>explaining why ATP is important in biochemical reactions <b>and</b></li> <li>giving <b>two</b> examples of biochemical reactions <b>and</b></li> <li>explaining how an organism uses ATP within the reactions.</li> </ul> <p>The response is clear, complete, and correct.</p>
2	<p>The response demonstrates a <i>partial</i> understanding of the role of ATP in biochemical reactions by</p> <ul style="list-style-type: none"> <li>explaining why ATP is important in biochemical reactions <b>and</b></li> <li>giving <b>two</b> examples of biochemical reactions</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>explaining why ATP is important in biochemical reactions <b>and</b></li> <li>giving <b>one</b> example of a biochemical reaction and explaining how an organism uses ATP within the reaction</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>giving <b>two</b> examples of biochemical reactions and explaining how an organism uses ATP within the reactions.</li> </ul> <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 ATP in biochemical reactions by</p> <ul style="list-style-type: none"> <li>explaining why ATP is important in biochemical reactions</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>giving <b>two</b> examples of biochemical reactions</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>giving <b>one</b> example of a biochemical reaction and explaining how an organism uses ATP within the reaction.</li> </ul> <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>

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



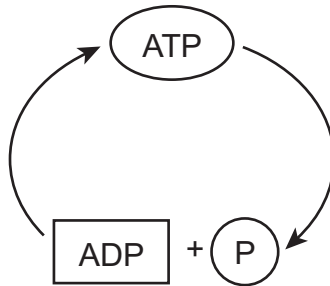


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## STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS

Use the diagram below to answer question 14.



14.

**Part A:** Explain why ATP is important in biochemical reactions.

It provides energy that cells need to carry out all other biochemical reactions.

Go to the next page to finish question 14.

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

**Part B:** Give two examples of biochemical reactions and explain how an organism uses ATP within the reactions.

Example	Explanation
digestion	ATP provides energy for digestive enzymes to break down food.
respiration	ATP provides energy for oxygen and glucose to be converted to energy which forms ATP and continues the cycle

This response demonstrates a thorough understanding of the role of ATP in biochemical reactions by fulfilling all three bullets outlined on the rubric. The student correctly states that ATP provides the energy for all biochemical reactions. Two examples of biochemical reactions are given and the explanations are correct. The student adequately explains ATP is used by digestive enzymes to break down food during digestion. Additionally, the explanation of respiration (respiration uses ATP to convert oxygen and glucose into energy which forms [additional] ATP and continues the cycle) is acceptable. The response is clear, complete, and correct.

STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS



Biology—Module 1

Question 14  
Page 1 of 2

Line Guide

Use the diagram below to answer the question.

**Part A:** Explain why ATP is important in biochemical reactions.

ATP is important in biochemical reactions, because ATP is energy. And energy is needed for biochemical reactions.

113 / 1000

Review/End Test

Pause

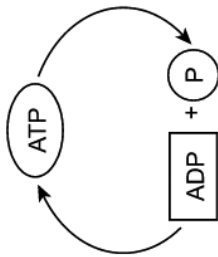
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Next



Use the diagram below to answer the question.



**Part B:** Give two examples of biochemical reactions and explain how an organism uses ATP within the reactions.

Example	Explanation
Eg Cellular respiration 20 / 1000	Eg Cells use ATP to make sugar and nutrients. 42 / 1000
Eg Photosynthesis 14 / 1000	Eg Cells turn sunlight into ATP. 29 / 1000

Review/End Test

Pause

Flag

Back

Next

This response demonstrates a partial understanding of the role of ATP in a biochemical reaction by explaining why ATP is important in biochemical reactions and giving two examples of biochemical reactions. The student correctly states that ATP helps the reactions to occur by providing energy. Two examples of biochemical reactions are given, but the explanations are incomplete and do not receive additional credit. This response contains some work that is incomplete and unclear.

STUDENT RESPONSE

RESPONSE SCORE: 1 POINT



Biology—Module 1

Question 14  
Page 1 of 2

Line Guide

Use the diagram below to answer the question.

**Part A:** Explain why ATP is important in biochemical reactions.

ATP is important in biochemical reactions. It is important because it is a type of energy. Without energy, a biochemical reaction wouldn't be able to happen.

157 / 1000

Review/End Test

Pause

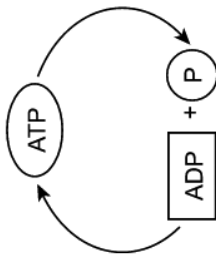
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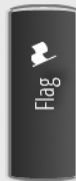


Use the diagram below to answer the question.



**Part B:** Give two examples of biochemical reactions and explain how an organism uses ATP within the reactions.

Example	Explanation
<p>ADP+P</p> <p>6 / 1000</p>	<p>A type of energy. When ADP and P combine, they form ATP.</p> <p>56 / 1000</p>
<p>ATP</p> <p>3 / 1000</p>	<p>ATP is an energy that is essential to biochemical reactions.</p> <p>60 / 1000</p>

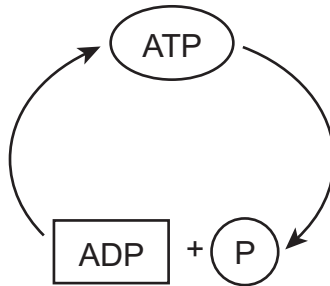


This response demonstrates a minimal understanding of the role of ATP in biochemical reactions by fulfilling one of three bullet points outlined on the rubric. The student correctly states that ATP is a type of energy and that without energy, a biochemical reaction would not occur. The examples given do not represent a correct response or demonstrate any additional understanding of the content being tested. The explanations provided restate information written in Part A and they do not receive credit. This response contains work that is incomplete and shows unclear understanding.

## STUDENT RESPONSE

RESPONSE SCORE: 0 POINTS

Use the diagram below to answer question 14.



14.

**Part A:** Explain why ATP is important in biochemical reactions.


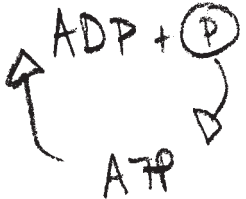
ATP is important because it is  
the thing in the biochemical reaction.

Go to the next page to finish question 14.



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

**Part B:** Give two examples of biochemical reactions and explain how an organism uses ATP within the reactions.

Example	Explanation
	<p>They need ATP to make ADP + P</p>
	<p>They need ADP + P to make ATP</p>

This response provides insufficient evidence to demonstrate any understanding of the role of ATP in biochemical reactions. The student response, "it is the thing in the biochemical reaction," does not explain why ATP is important in biochemical reactions. The student fails to provide two examples of biochemical reactions, and the explanations given do not demonstrate any understanding of the concept being tested.

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

**Changes Experienced**

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

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

**Change 1:** \_\_\_\_\_

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**Go to the next page to finish question 15.**

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

**Change 2:** \_\_\_\_\_

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**Change 3:** \_\_\_\_\_

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## SCORING GUIDE

### #15 ITEM INFORMATION

<b>Alignment</b>	A.4.2.1	<b>Depth of Knowledge</b>	3	<b>Mean Score</b>	0.96
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### ITEM-SPECIFIC SCORING GUIDELINE

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

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



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**STUDENT RESPONSE****RESPONSE SCORE: 3 POINTS**

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

**Changes Experienced**

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

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

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

**Go to the next page to finish question 15.**

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

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

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

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

**STUDENT RESPONSE****RESPONSE SCORE: 2 POINTS**

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

**Changes Experienced**

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

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

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

Go to the next page to finish question 15.



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

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

Change 3: decreased energy, because when you exercise your body uses all of its energy to do so, so you lose your energy and become tired until your body regains it.

This response demonstrates a partial understanding of how organisms maintain homeostasis by explaining how two changes experienced represent a homeostatic mechanism. The student correctly describes how sweating represents a homeostatic mechanism. "As your body heats up you need to cool down so you start to sweat." The student also describes how decreased energy represents a homeostatic mechanism. "Your body uses all of its energy to [exercise], so you lose your energy and become tired [until] your body regains it." The response describing how muscle cramps represent a homeostatic mechanism is incomplete.

**STUDENT RESPONSE****RESPONSE SCORE: 1 POINT**

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

**Changes Experienced**

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

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

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

Go to the next page to finish question 15.

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

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

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

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

**STUDENT RESPONSE****RESPONSE SCORE: 0 POINTS**

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

**Changes Experienced**

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

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

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

**Go to the next page to finish question 15.**

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

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

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

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

## 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	D	2	4%	3%	6%	86%
2	BIO.A.1.2.2	A	2	83%	6%	5%	6%
3	BIO.A.2.1.1	B	2	27%	62%	5%	5%
4	BIO.A.2.2.2	A	2	61%	9%	19%	11%
5	BIO.A.2.2.3	B	2	11%	41%	29%	19%
6	BIO.A.2.3.1	D	2	11%	37%	17%	35%
7	BIO.A.2.3.2	D	2	10%	30%	18%	42%
8	BIO.A.3.1.1	A	2	62%	17%	15%	5%
9	BIO.A.3.2.1	A	2	36%	16%	31%	15%
10	BIO.A.4.1.1	C	2	13%	12%	54%	20%
11	BIO.A.4.2.1	D	2	7%	28%	6%	59%
12	BIO.A.1.2.2	A	2	73%	13%	6%	7%
13	BIO.A.4.2.1	B	2	11%	62%	18%	8%

## CONSTRUCTED-RESPONSE

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
14	BIO.A.3.2.2	3	3	0.88
15	BIO.A.4.2.1	3	3	0.96

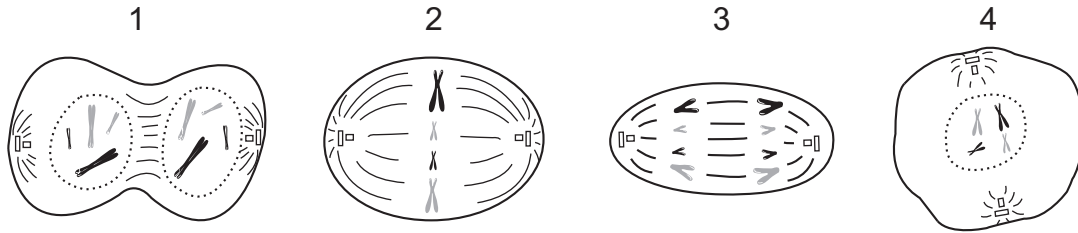


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**BIOLOGY MODULE 2**  
**MULTIPLE-CHOICE ITEMS**

Use the illustrations below to answer question 1.

**Cell Images**

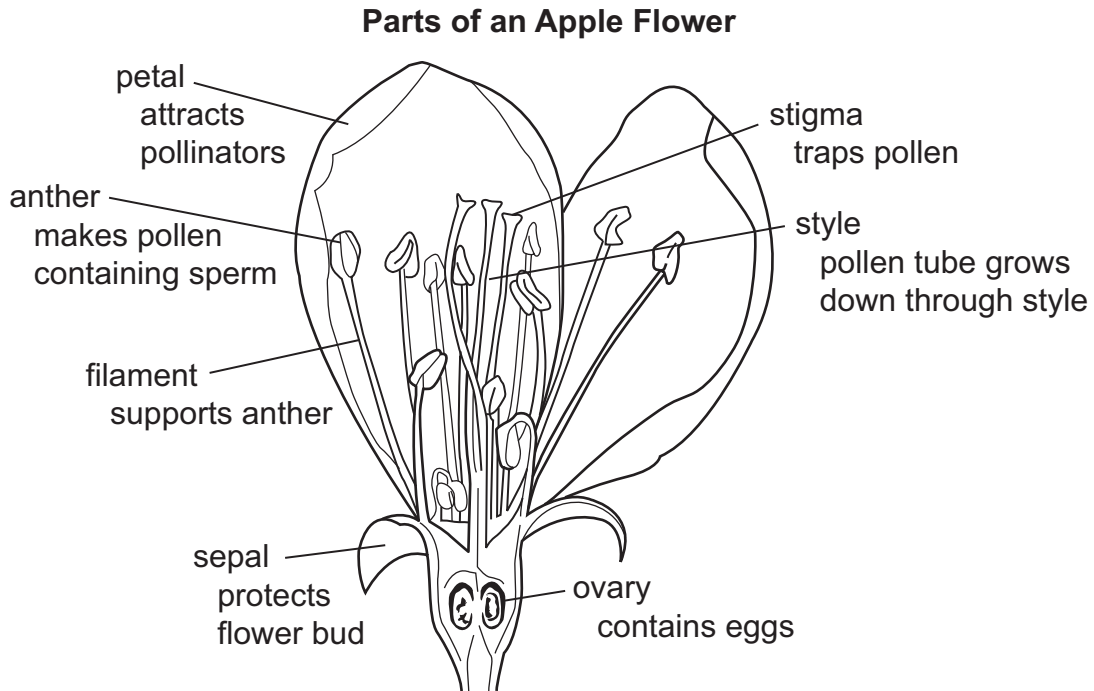


1. Which sequence lists the cell images in chronological order for mitosis?
- A. 1, 2, 3, 4
  - B. 4, 3, 2, 1
  - C. 1, 4, 3, 2
  - D. 4, 2, 3, 1

Item Information				Option Annotations
<b>Alignment</b>		BIO.B.1.1.1		A. The sequence shown incorrectly orders the events during mitosis as telophase, metaphase, anaphase, and prophase. B. The sequence shown correctly identifies prophase as the first event and telophase as the last event during mitosis, but reverses the order of metaphase and anaphase. C. The sequence shown incorrectly orders the events during mitosis as telophase, prophase, anaphase, and metaphase. D. Key: The sequence shown correctly orders the events during mitosis: prophase, metaphase, anaphase, and telophase.
<b>Answer Key</b>		D		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
6%	13%	8%	73%	



Use the diagram below to answer question 2.



2. Which part of the apple flower produces cells by meiosis?
- A. style
  - B. anther
  - C. stigma
  - D. filament

Item Information				Option Annotations
<b>Alignment</b>		BIO.B.1.1.2		A. The style produces cells by mitosis. B. Key: The outcome of meiotic cellular division is haploid cells. The anther produces pollen, which are male reproductive cells formed by meiosis. C. The stigma produces cells by mitosis. D. The filament produces cells by mitosis.
<b>Answer Key</b>		B		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
11%	53%	25%	10%	

3. Which statement **best** describes the relationship between an allele and a gene?
- A. An allele is a variation of a gene that can be expressed as a phenotype.
  - B. An allele is the part of a gene that attaches to messenger RNA molecules.
  - C. An allele is a segment of a DNA molecule that controls replication of a gene.
  - D. An allele is the primary protein made by a gene found in a developing embryo.

Item Information				Option Annotations
Alignment		BIO.B.1.2.2		<p>A. Key: An allele is any form of a particular gene, located at a specific position on a chromosome, which can be expressed as a phenotype.</p> <p>B. A ribosome attaches and moves along messenger RNA adding amino acids to the growing polypeptide chain.</p> <p>C. Enzymes influence DNA replication.</p> <p>D. An allele is a variation of a gene, not a primary protein.</p>
Answer Key		A		
Depth of Knowledge		2		
<i>p</i> -values				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
50%	16%	23%	10%	

4. A trait in cows is determined by two alleles of a single gene: allele R is dominant, and allele r is recessive. What is the probability of the dominant trait being expressed in the offspring of one RR parent and one rr parent?
- A. 25%
- B. 50%
- C. 75%
- D. 100%

Item Information				Option Annotations
<b>Alignment</b>		BIO.B.2.1.1		<p>A. A cross between two heterozygous (Rr) parents would predict 25% of the offspring exhibiting the recessive trait.</p> <p>B. A cross between a heterozygous (Rr) parent and a homozygous recessive (rr) parent would predict 50% of the offspring exhibiting the dominant trait.</p> <p>C. A cross between two heterozygous (Rr) parents would predict 75% of offspring exhibiting the dominant trait.</p> <p>D. Key: Based on a dominant-recessive inheritance pattern, a cross between a homozygous dominant (RR) parent and a homozygous recessive (rr) parent would predict a result of 100% of offspring exhibiting the dominant trait.</p>
<b>Answer Key</b>		D		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
11%	25%	12%	52%	

5. Which form of genetic engineering was used by humans for many years before the discovery of DNA?
- A. gene splicing
  - B. gene insertion
  - C. animal cloning
  - D. selective breeding

Item Information				Option Annotations
<b>Alignment</b>		BIO.B.2.4.1		<p>A. Gene splicing is cutting a gene from one organism and putting it into another organism. This requires knowledge of DNA.</p> <p>B. Gene insertion is a process of inserting genes from one organism into another. This requires knowledge of DNA.</p> <p>C. Animal cloning is a process of transferring genetic material from the nucleus of an adult cell to an egg cell. This requires knowledge of DNA.</p> <p>D. Key: Selective breeding is based on the concept that offspring inherit traits from their parents. Selective breeding results in offspring with desired genetic traits. The knowledge of DNA as the genetic molecule of inheritance is unnecessary.</p>
<b>Answer Key</b>		D		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
16%	11%	9%	62%	

6. Overuse of antibiotics has caused antibiotic resistance in some bacteria in a population. Which statement describes the **most likely** impact of natural selection on the bacterial population?
- Beneficial mutations have decreased, resulting in a larger population than normal.
  - Only the genes for antibiotic resistance are now expressed, eliminating other genes.
  - More antibiotic-resistant bacteria have survived, resulting in more offspring with this trait.
  - The bacteria have become genetically isolated, resulting in decreased reproductive rates.

Item Information				Option Annotations
<b>Alignment</b>		BIO.B.3.1.1		A. Natural selection suggests that beneficial mutations will increase, not decrease. B. Natural selection would favor organisms with antibiotic resistance, but organisms would still have other genes involved in other cellular functions that are expressed. C. Key: Natural selection suggests that a beneficial trait, like antibiotic resistance, will allow bacteria with this trait to survive in greater numbers and pass on this trait to their offspring. D. Antibiotic resistance is unlikely to cause genetic isolation in a population given its benefit to the population.
<b>Answer Key</b>		C		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
10%	16%	62%	11%	

7. Which statement is a hypothesis?
- A. The presence of an enzyme increased the reaction rate.
  - B. The reaction rate increased 100% once the enzyme was introduced.
  - C. Introducing an enzyme into a reaction did not increase the rate of the reaction.
  - D. When an enzyme is introduced into a reaction the reaction rate will increase by 100%.

Item Information				Option Annotations
<b>Alignment</b>		BIO.B.3.3.1		A. This is a conclusive statement that would be made upon examination of results following an experiment. B. This is a conclusive statement that would be made upon comparison of initial and final results. C. This is a conclusive statement that would be made upon examination of results following an experiment. D. Key: This is a hypothesis, because the action can be observed and experimentally tested to support or disprove the statement.
<b>Answer Key</b>		D		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
9%	7%	11%	74%	

8. A student studying the biosphere makes a list of biotic and abiotic characteristics of various biomes. Which characteristic is considered a biotic factor?
- A. dry, sandy, nutrient-poor soil in a desert
  - B. less than 25 cm of precipitation in a desert
  - C. evergreen trees present in a coniferous forest
  - D. temperature range of  $-40$  to  $40^{\circ}\text{C}$  in a grassland

Item Information				Option Annotations
<b>Alignment</b>		BIO.B.4.1.2		A. Soil is an abiotic component in a desert. B. Precipitation is an abiotic component in a desert. C. Key: Evergreen trees are biotic components in a forest. D. Temperature is an abiotic characteristic of a grassland.
<b>Answer Key</b>		C		
<b>Depth of Knowledge</b>		2		
<b><i>p</i>-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
25%	14%	46%	14%	

9. Which example describes a mutualistic relationship between organisms?
- A. Young wasps prey on caterpillars.
  - B. Crabs eat the remains of dead fish.
  - C. Ants protect a tree on which they feed.
  - D. Tapeworms feed on food in the intestines of cats.

Item Information				Option Annotations
<b>Alignment</b>		BIO.B.4.2.2		A. Young wasps and caterpillars exhibit a predator and prey relationship. B. A mutualistic relationship occurs between living organisms. C. Key: Ants protecting the tree that provides them with food describes a mutualistic relationship in which both species benefit. D. The tapeworms have a parasitic relationship with cats.
<b>Answer Key</b>		C		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
10%	16%	58%	15%	



10. Most of the water on Earth is located in the oceans and has a salinity of about 3.5%. Which statement **best** explains why rain is fresh water and has a very low salinity?
- A. When water precipitates from oceans, most of the salt remains in the oceans.
  - B. When water evaporates from oceans, most of the salt remains in the oceans.
  - C. When water precipitates from clouds, most of the salt remains in the clouds.
  - D. When water evaporates from clouds, most of the salt remains in the clouds.

Item Information				Option Annotations
<b>Alignment</b>		BIO.B.4.2.3		A. Water precipitates directly from the atmosphere, not the oceans. B. Key: Water is matter that is recycled; liquid water changes to a gas (water vapor) by evaporating into the atmosphere. This water vapor condenses and eventually precipitates to Earth as fresh water, but most dissolved salts remain in the ocean. C. Water precipitates from clouds, but salt does not remain in the clouds. D. Water precipitates, not evaporates, from clouds.
<b>Answer Key</b>		B		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
11%	69%	13%	6%	

11. Why are nonnative species often considered a disturbance in an ecosystem?

- A. They increase mutations.
- B. They compete for resources.
- C. They have special growth needs.
- D. They cause increased biodiversity.

Item Information				Option Annotations
<b>Alignment</b>		BIO.B.4.2.4		A. Nonnative species are not directly associated with mutations among organisms in an ecosystem. B. Key: Nonnative species compete with native species for resources, and the nonnative species often lack natural enemies or pests to help control their populations. C. Nonnative species that disrupt ecosystems often tolerate a variety of habitat conditions rather than have specific growth needs. D. Nonnative species that disrupt an ecosystem often decrease biodiversity by outcompeting and reducing the presence of native species.
<b>Answer Key</b>		B		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
19%	50%	11%	20%	



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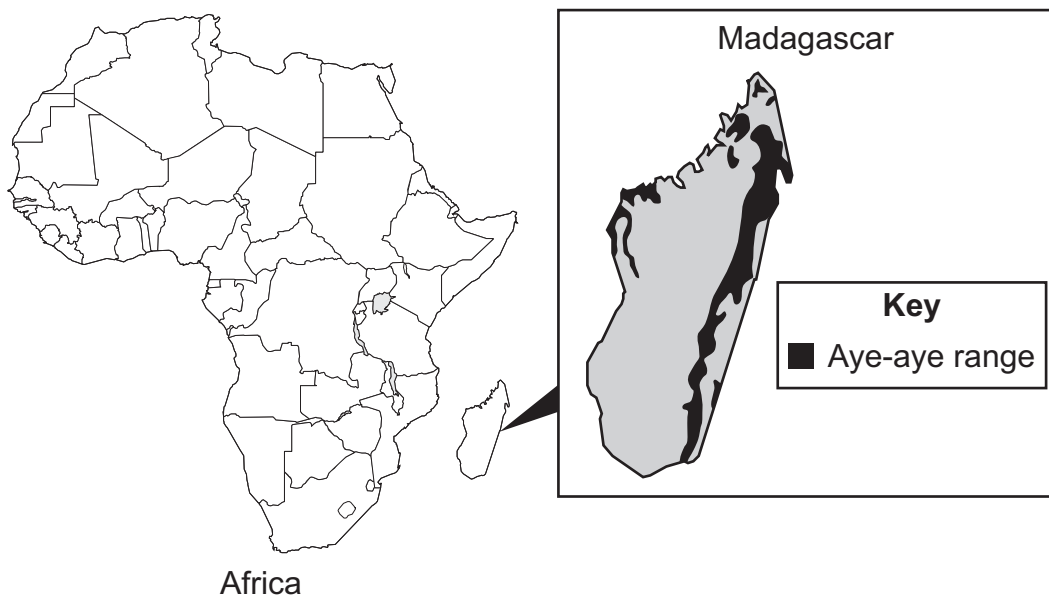
Directions: Use the information presented on page 58 to answer questions 12 and 13.

### Aye-aye



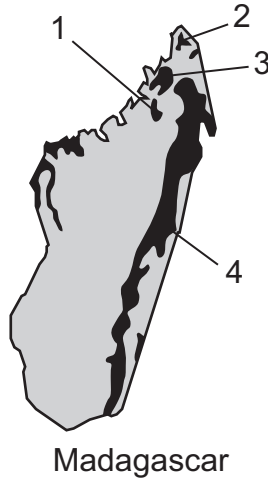
An aye-aye is a small nocturnal lemur that weighs about four pounds. This endangered species is found in Madagascar, a large island off the east coast of southern Africa. The main food for aye-ayes is larvae that live in wood. Aye-ayes find the larvae by tapping on tree branches. They also eat nuts and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

### Aye-aye Range



Use the map below to answer question 12.

Four Locations of Aye-Ayes



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
<b>Alignment</b>		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.
<b>Answer Key</b>		D		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
5%	8%	6%	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
<b>Alignment</b>		BIO.B.4.2.2		<p>A. A population with individuals living alone likely requires more habitat space rather than less.</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>
<b>Answer Key</b>		C		
<b>Depth of Knowledge</b>		2		
<b>p-values</b>				
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	
11%	17%	64%	8%	

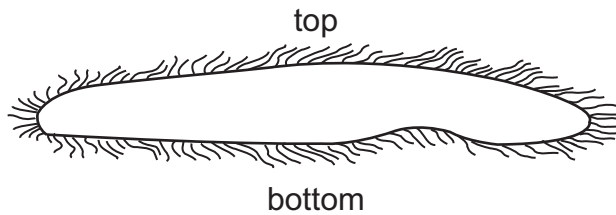


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**CONSTRUCTED-RESPONSE ITEMS**

Use the illustration below to complete question 14.

**Side View of *Trichoplax***



14. A *Trichoplax* is a simple multicellular animal that lives in water. This animal can reproduce asexually by simply dividing into two organisms.

**Part A:** Describe a cellular division process that could be used by *Trichoplax* when it reproduces asexually.

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**Go to the next page to finish question 14.**



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

**Part B:** Describe one benefit and one limitation of how the *Trichoplax* can reproduce by simply dividing.

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## SCORING GUIDE

### #14 ITEM INFORMATION

<b>Alignment</b>	B.1.1.2	<b>Depth of Knowledge</b>	3	<b>Mean Score</b>	1.32
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### ITEM-SPECIFIC SCORING GUIDELINE

<b>Score</b>	<b>Description</b>
<b>3</b>	<p>The response demonstrates a <i>thorough</i> understanding of cellular division by</p> <ul style="list-style-type: none"> <li>describing the cellular process used by the <i>Trichoplax</i> when it reproduces asexually <b>and</b></li> <li>describing <b>one</b> benefit of how the <i>Trichoplax</i> reproduces <b>and</b></li> <li>describing <b>one</b> limitation of how the <i>Trichoplax</i> reproduces.</li> </ul> <p>The response is clear, complete, and correct.</p>
<b>2</b>	<p>The response demonstrates a <i>partial</i> understanding of cellular division by fulfilling <b>two</b> of the three bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.</p>
<b>1</b>	<p>The response demonstrates a <i>minimal</i> understanding of cellular division by fulfilling <b>one</b> of the three bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.</p>
<b>0</b>	<p>The response provides <i>insufficient</i> evidence to demonstrate any understanding of the concept being tested.</p>

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

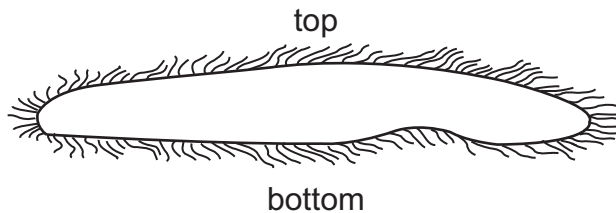


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## STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS

Use the illustration below to complete question 14.

Side View of *Trichoplax*

14. A *Trichoplax* is a simple multicellular animal that lives in water. This animal can reproduce asexually by simply dividing into two organisms.

**Part A:** Describe a cellular division process that could be used by *Trichoplax* when it reproduces asexually.

The cellular division process called binary fission, starts with one organism. It then completely replicates itself, and then divides into 2 organisms, both of which are completely alike.

Go to the next page to finish question 14.

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

**Part B:** Describe one benefit and one limitation of how the *Trichoplax* can reproduce by simply dividing.

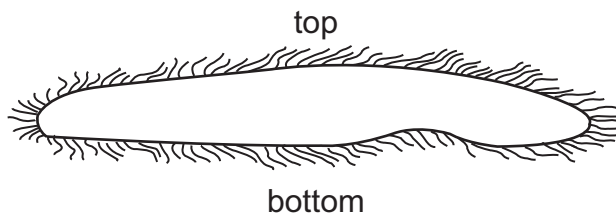
One benefit is that it can reproduce by itself, increasing its population rapidly. A limitation is that there will be no genetic variation if each offspring is an exact copy of itself.

This response demonstrates a thorough understanding of cellular division by fulfilling all three of the bullets listed on the rubric. The student identifies binary fission and briefly describes how the *Trichoplax* reproduces using that process. The student correctly states that a benefit of asexual mitotic reproduction is being able to reproduce by itself. Finally, the student describes a limitation, no genetic variation if each offspring is an exact copy of itself, to demonstrate thorough understanding of the concept tested. This response is clear, complete, and correct.

## STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS

Use the illustration below to complete question 14.

Side View of *Trichoplax*

14. A *Trichoplax* is a simple multicellular animal that lives in water. This animal can reproduce asexually by simply dividing into two organisms.

**Part A:** Describe a cellular division process that could be used by *Trichoplax* when it reproduces asexually.

FIRST, THE NUCLEUS DISAPPEARS. NEXT, THE CHROMOSOMES LINE UP AND SPINDLE FIBERS ATTACH TO THEM. THE CHROMOSOMES ARE PULLED APART AND THE CELL PINCHES OFF AND FORMS TWO NEW CELLS. LASTLY, THE NUCLEUS COMES BACK IN BOTH NEW CELLS.

Go to the next page to finish question 14.

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

**Part B:** Describe one benefit and one limitation of how the *Trichoplax* can reproduce by simply dividing.

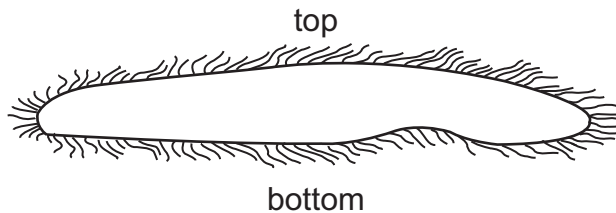
ONE BENEFIT COULD BE THAT THE CELL DOESN'T  
HAVE TO FIND A MATE WHEN REPRODUCING. A LIMITATION  
COULD BE THAT IT ALWAYS HAS TO SPLIT TO MAKE MORE  
OF ITSELF.

This response demonstrates a partial understanding of cellular division. The student adequately describes the cellular process used by the *Trichoplax* when it reproduces asexually by outlining the steps of mitosis. The description of one benefit, "doesn't have to find a mate when reproducing," though containing some unclear work (identifying the *Trichoplax* as a cell), shows understanding of the concept tested. Lastly, the description of the limitation of how the *Trichoplax* reproduces, "it always has to split to make more of itself," is not clear and does not earn the student additional credit. The student response has fulfilled two of the bullet points listed and contains work that is incomplete and unclear.

## STUDENT RESPONSE

RESPONSE SCORE: 1 POINT

Use the illustration below to complete question 14.

Side View of *Trichoplax*

14. A *Trichoplax* is a simple multicellular animal that lives in water. This animal can reproduce asexually by simply dividing into two organisms.

**Part A:** Describe a cellular division process that could be used by *Trichoplax* when it reproduces asexually.

*It goes through the 4 phases.*

*Prophase then Anaphase then Metaphase then Telephase*

*It then splits and goes on when its ready  
it goes through the same process.*

Go to the next page to finish question 14.



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

**Part B:** Describe one benefit and one limitation of how the *Trichoplax* can reproduce by simply dividing.

*It increases the diversity of its population.*

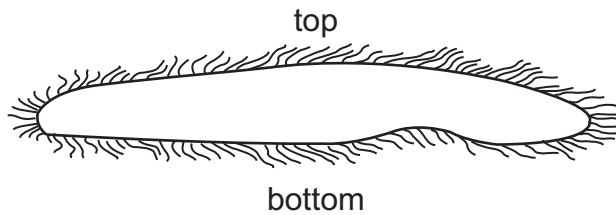
*But, it might have more risks of having adaptations due to the fact of how quick it reproduces/splits making more.*

This response demonstrates a minimal understanding of cellular division by fulfilling one of the three bullet points listed on the rubric. The student provides a description of the cellular division process by listing the four stages of mitosis (though listed in the incorrect order, all are present). The benefit listed is too general and not specific to asexual reproduction. The limitation described, "more risks of having adaptations," does not demonstrate understanding of contrasting mitotic and meiotic nuclear divisions. This response contains some work that is incomplete and unclear.

## STUDENT RESPONSE

RESPONSE SCORE: 0 POINTS

Use the illustration below to complete question 14.

Side View of *Trichoplax*

14. A *Trichoplax* is a simple multicellular animal that lives in water. This animal can reproduce asexually by simply dividing into two organisms.

**Part A:** Describe a cellular division process that could be used by *Trichoplax* when it reproduces asexually.

The cellular division process used by *Trichoplax*, is also known as multiplying.

Go to the next page to finish question 14.

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

**Part B:** Describe one benefit and one limitation of how the *Trichoplax* can reproduce by simply dividing.

One benefit is that this organism will never become extinct, because it is able to reproduce without restrictions. One limitation is, they can become very annoying because they reproduce at a fast rate.

This response provides insufficient evidence to demonstrate any understanding of cellular division. The student identifies the process of “multiplying” but does not add any additional description to demonstrate further understanding. The benefit provided, “this organism will never become extinct,” is not an acceptable benefit of mitotic cell division. In addition, the limitation of the organism being annoying because of very fast reproduction is insufficient to demonstrate understanding of the concept being tested.

Use the table below to complete question 15.

**Organism Relationships in an Ecosystem**

<b>Animal</b>	<b>Food Sources</b>	<b>Predators</b>
beaver	tree bark, twigs, leaves, and roots; pond lilies	coyote, wolf, eagle, black bear
warbler birds	insects, earthworms, fruit	eagle, coyote, hawk
black bear	fish, insects, fruit, small mammals, eggs, carrion	brown bear, wolf

15. An ecosystem includes the organisms listed in the table.

**Part A:** Identify the initial source of energy for the ecosystem.

\_\_\_\_\_

**Part B:** Using the table, complete a food chain that includes a producer, a primary consumer, and a secondary consumer.

\_\_\_\_\_ → \_\_\_\_\_ → \_\_\_\_\_

Go to the next page to finish question 15.

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

**Part C:** The number of beavers in this ecosystem suddenly decreases. Describe the effect this may have on one other organism.

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## SCORING GUIDE

### #15 ITEM INFORMATION

Alignment	B.4.2.1	Depth of Knowledge	3	Mean Score	1.26
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### ITEM-SPECIFIC SCORING GUIDELINE

Score	Description
3	<p>The response demonstrates a <i>thorough</i> understanding of how energy flows through an ecosystem (e.g., food chains, food webs, energy pyramids) by:</p> <ul style="list-style-type: none"> <li>identifying the initial energy source as the Sun <b>and</b></li> <li>completing a food chain that includes a producer, a primary consumer, and a secondary consumer from one row of the table <b>and</b></li> <li>describing the effect on one other organism if the number of beavers in this ecosystem suddenly decreases.</li> </ul> <p>The response is clear, complete, and correct.</p>
2	<p>The response demonstrates a <i>partial</i> understanding of how energy flows through an ecosystem (e.g., food chains, food webs, energy pyramids) by fulfilling <b>two</b> of the three bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.</p>
1	<p>The response demonstrates a <i>minimal</i> understanding of how energy flows through an ecosystem (e.g., food chains, food webs, energy pyramids) by fulfilling <b>one</b> of the three bullets listed under the 3-point response. 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>

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



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**STUDENT RESPONSE****RESPONSE SCORE: 3 POINTS**

Use the table below to complete question 15.

**Organism Relationships in an Ecosystem**

<b>Animal</b>	<b>Food Sources</b>	<b>Predators</b>
beaver	tree bark, twigs, leaves, and roots; pond lilies	coyote, wolf, eagle, black bear
warbler birds	insects, earthworms, fruit	eagle, coyote, hawk
black bear	fish, insects, fruit, small mammals, eggs, carrion	brown bear, wolf

**15.** An ecosystem includes the organisms listed in the table.**Part A:** Identify the initial source of energy for the ecosystem.sunlight**Part B:** Using the table, complete a food chain that includes a producer, a primary consumer, and a secondary consumer.pond lilies → beaver → black bear

Go to the next page to finish question 15.



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

**Part C:** The number of beavers in this ecosystem suddenly decreases. Describe the effect this may have on one other organism.

This may cause the population of water lilies to increase since there are less beavers around to eat them.

The response demonstrates a thorough understanding of how energy flows through an ecosystem by fulfilling all three bullet points. Sunlight is identified as the initial source of energy for the ecosystem. The completed food chain shows a correct relationship given in the table and contains a producer, primary consumer, and secondary consumer. Additionally, the student describes a correct effect that a decrease in the number of beavers would have on one other organism, "population of water lilies to increase since there are less beavers around to eat them." This response is clear, complete, and correct.

## STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS

Use the table below to complete question 15.

Organism Relationships in an Ecosystem

Animal	Food Sources	Predators
beaver	tree bark, twigs, leaves, and roots; pond lilies	coyote, wolf, eagle, black bear
warbler birds	insects, earthworms, fruit	eagle, coyote, hawk
black bear	fish, insects, fruit, small mammals, eggs, carrion	brown bear, wolf

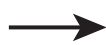
15. An ecosystem includes the organisms listed in the table.

**Part A:** Identify the initial source of energy for the ecosystem.

sun

**Part B:** Using the table, complete a food chain that includes a producer, a primary consumer, and a secondary consumer.

beaver



black black



brown bear

Go to the next page to finish question 15.

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

**Part C:** The number of beavers in this ecosystem suddenly decreases. Describe the effect this may have on one other organism.

A predator of a beaver may decrease because  
it is losing a food source.

This student demonstrates a partial understanding of how energy flows through an ecosystem by fulfilling two of the bullet points described on the rubric. The Sun is correctly identified as the initial source of the energy in the ecosystem. No additional credit is earned for the food chain provided because it does not include a producer. The student correctly describes the effect a decrease in the number of beavers would have on one other organism (a predator may decrease because it is losing a food source).

**STUDENT RESPONSE****RESPONSE SCORE: 1 POINT**

Use the table below to complete question 15.

**Organism Relationships in an Ecosystem**

Animal	Food Sources	Predators
beaver	tree bark, twigs, leaves, and roots; pond lilies	coyote, wolf, eagle, black bear
warbler birds	insects, earthworms, fruit	eagle, coyote, hawk
black bear	fish, insects, fruit, small mammals, eggs, carrion	brown bear, wolf

15. An ecosystem includes the organisms listed in the table.

**Part A:** Identify the initial source of energy for the ecosystem.

insects, fruit, plants

**Part B:** Using the table, complete a food chain that includes a producer, a primary consumer, and a secondary consumer.

coyote → Beaver → Tree bark

Go to the next page to finish question 15.

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

**Part C:** The number of beavers in this ecosystem suddenly decreases. Describe the effect this may have on one other organism.

Its predators could starve. A coyote for instance  
it could die with no food.

This response demonstrates a minimal understanding of how energy flows through an ecosystem. The student identifies various food sources as the initial source of energy for the ecosystem instead of the Sun. Though the student includes a producer, primary consumer, and secondary consumer in the food chain, the direction of the flow of energy is incorrect. The student describes a correct effect on the predator of the beaver (coyote could starve and die with no food) if the population of beavers decreased. This student has fulfilled one of three bullet points listed on the rubric.

**STUDENT RESPONSE****RESPONSE SCORE: 0 POINTS**

Use the table below to complete question 15.

**Organism Relationships in an Ecosystem**

<b>Animal</b>	<b>Food Sources</b>	<b>Predators</b>
beaver	tree bark, twigs, leaves, and roots; pond lilies	coyote, wolf, eagle, black bear
warbler birds	insects, earthworms, fruit	eagle, coyote, hawk
black bear	fish, insects, fruit, small mammals, eggs, carrion	brown bear, wolf

**15.** An ecosystem includes the organisms listed in the table.**Part A:** Identify the initial source of energy for the ecosystem.

fruit, and insects, and trees

**Part B:** Using the table, complete a food chain that includes a producer, a primary consumer, and a secondary consumer.

warbler bird → beaver → black bear

**Go to the next page to finish question 15.**

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

**Part C:** The number of beavers in this ecosystem suddenly decreases. Describe the effect this may have on one other organism.

They want have most  
of their resources if  
one were to die out.  
When it would go what  
it does to help the others  
out doesn't work without  
it.

This response provides insufficient evidence to demonstrate any understanding of the concept being tested. The student identifies various food sources (fruit, insects, and trees) as the initial source of energy for the ecosystem instead of the Sun. The completed food chain does not follow the relationships given in the table and does not contain a producer. The response in Part C does not clearly define the effect a decrease in the number of beavers would have on one other organism. "They" is not further defined within the response.

## 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.1.1.1	D	2	6%	13%	8%	73%
2	BIO.B.1.1.2	B	2	11%	53%	25%	10%
3	BIO.B.1.2.2	A	2	50%	16%	23%	10%
4	BIO.B.2.1.1	D	2	11%	25%	12%	52%
5	BIO.B.2.4.1	D	2	16%	11%	9%	62%
6	BIO.B.3.1.1	C	2	10%	16%	62%	11%
7	BIO.B.3.3.1	D	2	9%	7%	11%	74%
8	BIO.B.4.1.2	C	2	25%	14%	46%	14%
9	BIO.B.4.2.2	C	2	10%	16%	58%	15%
10	BIO.B.4.2.3	B	2	11%	69%	13%	6%
11	BIO.B.4.2.4	B	2	19%	50%	11%	20%
12	BIO.B.3.1.1	D	2	5%	8%	6%	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.1.1.2	3	3	1.32
15	BIO.B.4.2.1	3	3	1.26





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KEYSTONE EXAMS  
BIOLOGY

ITEM AND SCORING SAMPLER 2014

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