PENNSYLVANIA
KEYSTONE EXAMS

Biology

Item Sampler Scoring Guide

2025–2026

Pennsylvania
Department of Education

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INFORMATION ABOUT BIOLOGY

Introduction

General Introduction

The Pennsylvania Department of Education (PDE) provides districts and schools with tools to assist in delivering focused instructional programs aligned with the Pennsylvania Standards. These tools include STEELS Standards, STEELS Foundation Boxes, content-based online Item Samplers, and a Sampler Guide. The online Item Sampler is intended to be used in conjunction with this Sampler Guide as a useful tool for Pennsylvania educators in preparing local instructional programs by providing samples of test item types and scored student responses. The online Item Sampler and this Sampler Guide are not designed to be used as a pretest, a curriculum, or any other benchmark for operational testing.

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

Pennsylvania STEELS Standards

The online Item Sampler and this Sampler Guide contain examples of exam questions designed to assess the Pennsylvania STEELS standards.

What Is Included

The online Item Sampler contains exam questions, or exam “items,” that have been written to align to the STEELS standards. The sample exam questions model the types of items that may appear on an operational Keystone. Each sample exam question has been through a rigorous review process to ensure alignment with the STEELS standards prior to being piloted in an embedded field test within a Keystone assessment. Answer keys, scoring guidelines, and any related stimulus materials are also included. To access the Online Item Sampler, go to https://portal.te.drcedirect.com/PA. Select Item Samplers. Then, select the subject and grade levels as needed. Additionally, this Sampler Guide PDF provides sample student responses for each constructed-response (CR) item to demonstrate the range of responses that students provided in response to these items.

Purpose and Uses

The items in the online Item Sampler may be used[1] as examples for creating assessment items at the classroom level. Classroom teachers may find it beneficial to have students respond to the constructed-response items in the online Item Sampler. Educators may then use this Sampler Guide as a model to score the responses either independently or together with colleagues within a school or district. This Sampler Guide also includes the *General Description of Scoring Guidelines for Biology Constructed-Response Questions* that students will have access to during a Keystone Biology administration. The general description of scoring guidelines may be distributed to students for use during local assessments and may also be used by educators when scoring local assessments.

Item Format and Scoring Guidelines

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.

Item Alignment

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

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

Testing Time and Mode of Exam Delivery for the Keystone

The Keystone is delivered in an online format. The estimated response time for each item type is listed below.

- **Multiple-Choice:** 1 to 1 1/2 minutes
- **Constructed-Response:** 8 minutes

During an official exam administration, students are given as much additional time as is necessary to complete the exam.

Item and Scoring Sampler Format

The online Item Sampler and this Sampler Guide include the test directions and scoring guidelines that appear in the Keystone Exams. Each MC item contains a table that includes the item alignment, the answer key, the depth of knowledge (DOK) level, points possible, and a brief answer-option analysis or rationale[2]. Each CR item contains a table that includes the item alignment, the DOK level, points possible, and the mean student score[3]. Additionally, every item-specific scoring guideline included in this Sampler Guide 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 Constructed-Response Questions* used to develop the item-specific scoring guidelines should be used if any additional item-specific scoring guidelines are created for use within local instructional programs. The student responses in this Sampler Guide are actual student responses.

Example Multiple-Choice Item Information Table

Item-Specific Information
Alignment:
Answer Key:
Depth of Knowledge:
Points Possible:

Option Annotations
Brief answer-option analysis or rationale.

Example Constructed-Response Item Information Table

Category	Item-Specific Information
Alignment	Assigned AAEC
Depth of Knowledge	Assigned DOK
Points Possible	Number of Points
Mean Score	Average Score

[2] The *p*-values are not included for the MC items in the 2025 Item Sampler.
[3] The mean student scores are not included for the CR items in the 2025 Item Sampler.

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.

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BIOLOGY MODULE 1

Biology Module 1—Summary Data

Multiple-Choice

Sample Number	Alignment	Answer Key	Depth of Knowledge	Points
1	3.1.9-12.A	B	2	1
2	3.1.9-12.B	D	2	1
3	3.1.9-12.C	C	2	1
4	3.1.9-12.E	B	2	1
5	3.1.9-12.G	A	3	1
6	3.1.9-12.H	C	2	1
7	3.1.9-12.J	B	2	1
8	3.1.9-12.I	D	2	1
9	3.1.9-12.M	D	3	1
10	3.1.9-12.E	B	2	1
11	3.1.9-12.G	A	2	1
12	3.1.9-12.H	B	2	1
13	3.1.9-12.I	A	2	1

Constructed Response

Sample Number	Alignment	Depth of Knowledge	Points
14	3.1.9-12.A	2	3
15	3.1.9-12.C	2	3

Biology Test Directions

Read these directions carefully before beginning the assessment. To look at these directions again, select the **? [Help]** button and choose the **Test Directions** tab.

This test has multiple-choice questions and constructed-response questions. Each multiple-choice question has four answer choices. Each constructed-response question has one or more areas in which to enter your response(s). The constructed-response questions may have multiple pages. These page numbers will be shown below the question number, for example, "Page 1 of 3."

Answering Questions

Read each question carefully and choose your answer or enter your response.

1. For the multiple-choice questions, first, find the answer to the question. Then, choose the correct answer by clicking on the answer bubble using the **Pointer** tool.
   - Only one of the answer choices provided is correct.
   - If none of the choices matches your answer, go back and check your work for possible errors.
   - To change an answer, use the **Pointer** tool to choose a different answer.
   - Click on the '**Flag**' button if you are not sure of the answer to a question. It will mark the question so you know to go back and answer the question later.
2. For the constructed-response questions, use the keyboard, the **Equation Builder**, and other online tools to enter your response in the areas provided.
   - For questions that require using the **Equation Builder** or constructing a graph, click on the question mark icon **[?]** in the upper-right corner of those features. This will open **Help**, which offers descriptions on how to use these features.
   - An example of the scoring guidelines that professional scorers will use to evaluate your responses to constructed-response questions can be found by clicking on the **'?' [Help] button** and choosing the "**Scoring**" tab. You may refer to the Scoring Guidelines at any time while responding to constructed-response questions.
3. Use tools such as the **Cross-Off**, **Highlighter**, **Notepad**, **Magnifier**, **Line Guide**, and **Calculator** to assist you during the test.

Navigation

1. Use the **Next** and **Back** buttons to move from question to question or page to page.
2. Finally, when you have answered all the questions, click on the **Review/End Test** button at the top-right of the screen.
   - You may check your work by selecting questions from the list that appears on the screen.
   - When you have finished and have checked your answers, follow the directions on the screen to exit.

Helpful Hints

- There is no time limit to finish the test.
- If you need to take a break from the assessment, select the **Pause Test** button. Select the **Resume** button to continue. If you are away from the assessment for more than 20 minutes, you will need to log back in.
- To see your progress on the test, select the **Review/End Test** button. You may go to any question by selecting it from the list that appears on the screen.
- Select the **? [Help]** button to find more information.

#14 Constructed Response Item-Specific Scoring Guideline

#14 Item Information

Category	Item-Specific Information
Alignment	3.1.9-12.A
Depth of Knowledge	2
Points Possible	3

Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a *thorough* understanding of constructing an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells by • describing the substance in the cell that determines the order of amino acids in a protein **AND** • explaining how the order of amino acids affects the structure of a protein **AND** • explaining why having many types of proteins is important for a cell. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of constructing an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells by fulfilling **two** of the bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of constructing an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells by fulfilling **one** of the bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
0	The response provides *insufficient* evidence to demonstrate any understanding of the concept being tested.

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

Responses that will receive credit:

Part A (1 point):

- DNA in the cell determines the order of amino acids in a protein.
- The order of amino acids is determined by the mRNA sequence (which is determined by DNA).

Part B (1 point):

- Side chains of amino acids are variable (e.g., hydrophobic, hydrophilic, charged, polar, nonpolar, have disulfide bridges) and their physical and chemical properties determine the physical and chemical properties of the protein structure.
- The order of amino acids affects the structure of the protein by influencing how the protein folds, causing the final physical shape of the protein.
- The structure of the protein is affected by the size, shape, and/or characteristics of the side chains on amino acids, which interact and affect the process of protein folding.

Part C (1 point):

- A protein has a specific function, determined by its structure. Specific proteins cannot perform other functions, so the cell needs a variety of protein types in order to perform a variety of functions, such as catalysis, contraction, support, transport, communication, protection.
- Each different function in the cell (e.g., structure, support, storage, enzymes, transport, communication) requires a specific protein to perform that function.
- Proteins are specialized for their function. Therefore, the cell needs many different structures or types of proteins.

Sample Student Responses

Item 14 – 3 points

Part A – Student Response
The substance in the cell that determines the order of amino acids is DNA.

Part B – Student Response
The order of amino acids affects the structure of a protein because it dictates the folding pattern of the protein, which changes it's shape and function. Amino acids also determine the 3-dimensional structure of a protein, so the order will change that.

Part C – Student Response
Having many types of proteins is important for a cell because each serve a different unique function in the body. They are needed for biological processes like cell signaling and metabolism. Different proteins have different structures and functions, allowing them to carry out tasks effeciently in a cell.

Annotations
The response demonstrates a thorough understanding of constructing an explanation based on evidence for how the structure of DNA determines the structure of proteins that carry out the essential functions of life through systems of specialized cells. In Part A, the response correctly describes the substance in the cell that determines the order of amino acids in a protein (*DNA*). In Part B, the response correctly explains how the order of amino acids affects the structure of a protein (*because it dictates the folding pattern of the protein, which changes it's shape and function*). In Part C, the response correctly explains why having many types of proteins is important for a cell (*because each serve a different unique function in the body . . . Different proteins have different structures and functions*). The response is clear, complete, and correct.

Item 14 – 2 points

Part A – Student Response
the amino acids are determined by the mRNA sequence that comes from the DNA to the RNA.

Part B – Student Response
the stucture can be affected beause if there was a mutation in the sequence then the structure wouldnt be the same unless the mutation would be a silent mutation.

Part C – Student Response
it helps to build the cells up and crete the shapes of cells to build up the space provided by the groups of amino acids.

Annotations
The response demonstrates a partial understanding of constructing an explanation based on evidence for how the structure of DNA determines the structure of proteins that carry out the essential functions of life through systems of specialized cells. In Part A, the response correctly describes the substance in the cell that determines the order of amino acids in a protein (*DNA to the RNA*). In Part B, the response correctly explains how the order of amino acids affects the structure of a protein (*beause if there was a mutation in the sequence then the structure wouldnt be the same unless the mutation would be a silent mutation*). In Part C, the response (*it helps to build the cells up and crete the shapes of cells to build up the space provided by the groups of amino acids*) incorrectly explains why having many types of proteins is important for a cell and does not receive any credit.

Item 14 – 1 point

Part A – Student Response
The DNA sequece determinds the order of amino acids.

Part B – Student Response
The amino acid sequence affects the structure of a protein because how ever the amino acid sequence is determines the structure of a protein.

Part C – Student Response
Many types of proteins is good for the cell because different parts of the cell needs different proteins.

Annotations
The response demonstrates a minimal understanding of constructing an explanation based on evidence for how the structure of DNA determines the structure of proteins that carry out the essential functions of life through systems of specialized cells. In Part A, the response correctly describes the substance in the cell that determines the order of amino acids in a protein (*DNA*). In Part B, the response (*because how ever the amino acid sequence is determines the structure of a protein*) incorrectly explains how the order of amino acids affects the structure of a protein and does not receive any credit. In Part C, the response (*because different parts of the cell needs different proteins*) incorrectly explains why having many types of proteins is important for a cell and does not receive any credit.

Item 14 – 0 points

Part A – Student Response

the substance that determines the order of amino acid proteins is the carboxylic it see exactly how much needs to be in the cell order

Part B – Student Response

the structure of the amino acids affect the structure of a protein because if it doesnt have the right amount of genes it could come out as a totally different organism

Part C – Student Response

having many tupes of proteins is important because it determines what kind of cell the proteins make. if one thing is off then the cell will be a totally different cell than what is supposed to be made.

Annotations

The response demonstrates insufficient evidence of any understanding of constructing an explanation based on evidence for how the structure of DNA determines the structure of proteins that carry out the essential functions of life through systems of specialized cells. In Part A, the response (*carboxylic*) incorrectly describes the substance in the cell that determines the order of amino acids in a protein and does not receive any credit. In Part B, the response (*because if it doesnt have the right amount of genes it could come out as a totally different organism*) incorrectly explains how the order of amino acids affects the structure of a protein and does not receive any credit. In Part C, the response (*because it determines what kind of cell the proteins make*) incorrectly explains why having many types of proteins is important for a cell and does not receive any credit.

#15 Constructed Response Item-Specific Scoring Guideline

#15 Item Information

Category	Item-Specific Information
Alignment	3.1.9-12.C
Depth of Knowledge	2
Points Possible	3

Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a *thorough* understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis by • describing why the student's eyes changed **AND** • explaining why the teacher had the classroom dimly lit for a few minutes before starting the investigation **AND** • describing a feedback mechanism for the pupil of a person's eye if the person were to move from an area with bright light to an area with dim light. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis by fulfilling **two** of the bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis by fulfilling **one** of the bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
0	The response provides *insufficient* evidence to demonstrate any understanding of the concept being tested.

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

Responses that will receive credit:

Part A (1 point):

- The student's eyes changed because the amount of light in the environment changed.

Part B (1 point):

- The teacher adjusted the light for a few minutes to give the students' eyes a chance to adjust (dilate) to the current (dim) environment.
- Keeping the light level low for a few minutes enabled the teacher to establish a baseline or setpoint for the investigation for comparison when the light is changed to bright.

Part C (1 point):

- The change from bright light to low light will stimulate the eye (pupil/iris) to change (dilate, open) to allow more light to enter the eye.
- Too much light causes structures in the eye to change shape to reduce the amount of light that enters the eye.
- Too little light causes the structures in the eye to change shape to increase the light that enters the eye.

Sample Student Responses

Item 15 – 3 points

Part A – Student Response
The studnent's pupils are reacting to the amont of light that is available.

Part B – Student Response
The student's eyes had to have time to fully adjust to the dim light in order for them to react to a sudden change in the amount of light.

Part C – Student Response
When the person's eyes are given less light, the pupils will dilate/become larger in response in order to gain as much light as it can so that the person is able to see better.

Annotations
The response demonstrates a thorough understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis. In Part A, the response correctly describes why the student's eyes changed (*The studnent's pupils are reacting to the amont of light that is available*). In Part B, the response correctly explains why the teacher had the classroom dimly lit for a few minutes before starting the investigation (*The student's eyes had to have time to fully adjust to the dim light in order for them to react to a sudden change in the amount of light*). In Part C, the response correctly describes a feedback mechanism for the pupil of a person's eye if the person were to move from an area with bright light to an area with dim light (*When the person's eyes are given less light, the pupils will dilate/become larger in response in order to gain as much light as it can so that the person is able to see better*). The response is clear, complete, and correct.

Item 15 – 2 points

Part A – Student Response

The students eyes changed because the pupil of the eye no longer had to adjust, had to enlarge in order to see more clearly.so it returned to its normal state.

Part B – Student Response

The teacher has the classroom dimly lit for a few minutes before starting the investigation because she wanted to show the difference in the eyes shape to see how the different light settings can affect the size of the pupil.

Part C – Student Response

A feedback mechanism for the pupil of a persons eye if a person were to move from an area with brihgt ligth to an area with dim light is how the pupils size will enlarge greatly to allow the person to see more celarly once again, asjusting to the new light source.

Annotations

The response demonstrates a partial understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis. In Part A, the response (*because the pupil of the eye no longer had to adjust, had to enlarge in order to see more clearly. so it returned to its normal state*) incorrectly describes why the student's eyes changed and does not receive any credit. In Part B, the response correctly explains why the teacher had the classroom dimly lit for a few minutes before starting the investigation (*because she wanted to show the difference in the eyes shape to see how the different light settings can affect the size of the pupil*). In Part C, the response correctly describes a feedback mechanism for the pupil of a person's eye if the person were to move from an area with bright light to an area with dim light (*how the pupils size will enlarge greatly to allow the person to see more celarly once again, asjusting to the new light source*).

Item 15 – 1 point

Part A – Student Response
The switch of the lights are instant. so it might take time to get used to it.

Part B – Student Response
The teacher had it dim so there can be change. and differences. If she had it in bright light the whole time, you wouldn't notice a change.

Part C – Student Response
The eye would have to adjust between the dimness of the lights.

Annotations
The response demonstrates a minimal understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis. In Part A, the response (*The switch of the lights are instant. so it might take time to get used to it*) incorrectly describes why the student's eyes changed and does not receive any credit. In Part B, the response correctly explains why the teacher had the classroom dimly lit for a few minutes before starting the investigation (*so there can be change. and differences. If she had it in bright light the whole time, you wouldn't notice a change*). In Part C, the response (*The eye would have to adjust between the dimness of the lights*) incorrectly describes a feedback mechanism for the pupil of a person's eye if the person were to move from an area with bright light to an area with dim light and does not receive any credit.

Item 15 – 0 points

Part A – Student Response
The students eyes changed because of the quick time that the lights changed and there eyes didn't adjust yet.

Part B – Student Response
To show how the eyes are sensortive.

Part C – Student Response
They would do the same thing.

Annotations
The response demonstrates insufficient evidence of any understanding of planning and conducting an investigation to provide evidence that feedback mechanisms maintain homeostasis. In Part A, the response (*because of the quick time that the lights changed and there eyes didn't adjust yet*) incorrectly describes why the student's eyes changed and does not receive any credit. In Part B, the response (*To show how the eyes are sensortive*) incorrectly explains why the teacher had the classroom dimly lit for a few minutes before starting the investigation and does not receive any credit. In Part C, the response (*They would do the same thing*) incorrectly describes a feedback mechanism for the pupil of a person's eye if the person were to move from an area with bright light to an area with dim light and does not receive any credit.

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BIOLOGY MODULE 2

Biology Module 2—Summary Data

Multiple-Choice

Sample Number	Alignment	Answer Key	Depth of Knowledge	Points
1	3.1.9-12.D	A	2	1
2	3.1.9-12.P	D	2	1
3	3.1.9-12.Q	A	2	1
4	3.1.9-12.R	B	2	1
5	3.1.9-12.N	C	2	1
6	3.1.9-12.V	C	2	1
7	3.1.9-12.S	C	2	1
8	3.1.9-12.U	B	2	1
9	3.1.9-12.W	C	2	1
10	3.1.9-12.X	D	2	1
11	3.1.9-12.Q	C	2	1
12	3.1.9-12.R	C	2	1
13	3.1.9-12.S	A	2	1

Constructed Response

Sample Number	Alignment	Depth of Knowledge	Points
14	3.1.9-12.P	2	3
15	3.1.9-12.N	3	3

Biology Test Directions

Read these directions carefully before beginning the assessment. To look at these directions again, select the **? [Help]** button and choose the **Test Directions** tab.

This test has multiple-choice questions and constructed-response questions. Each multiple-choice question has four answer choices. Each constructed-response question has one or more areas in which to enter your response(s). The constructed-response questions may have multiple pages. These page numbers will be shown below the question number, for example, "Page 1 of 3."

Answering Questions

Read each question carefully and choose your answer or enter your response.

1. For the multiple-choice questions, first, find the answer to the question. Then, choose the correct answer by clicking on the answer bubble using the **Pointer** tool.
   - Only one of the answer choices provided is correct.
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2. For the constructed-response questions, use the keyboard, the **Equation Builder**, and other online tools to enter your response in the areas provided.
   - For questions that require using the **Equation Builder** or constructing a graph, click on the question mark icon **[?]** in the upper-right corner of those features. This will open **Help**, which offers descriptions on how to use these features.
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Navigation

1. Use the **Next** and **Back** buttons to move from question to question or page to page.
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Helpful Hints

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- To see your progress on the test, select the **Review/End Test** button. You may go to any question by selecting it from the list that appears on the screen.
- Select the **? [Help]** button to find more information.

#14 Constructed Response Item-Specific Scoring Guideline

#14 Item Information

Category	Item-Specific Information
Alignment	3.1.9-12.P
Depth of Knowledge	2
Points Possible	3

Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a *thorough* understanding of asking questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring by • describing how breeders can develop different-colored bearded dragons **AND** • describing the role of parental DNA in affecting the colors produced in the offspring **AND** • describing the process a breeder should use to develop the recessive trait in bearded dragons. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of asking questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring by fulfilling **two** of the bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of asking questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring by fulfilling **one** of the bullets listed under the 3-point response. The response may contain some work that is incomplete or unclear.
0	The response provides *insufficient* evidence to demonstrate any understanding of the concept being tested.

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

Responses that will receive credit:

Part A (1 point):

- The breeders can selectively cross (breed) bearded dragons that have different appearances.

Part B (1 point):

- Offspring get their DNA from their parents, and the DNA determines the traits that an organism has.
- Offspring receive half of their DNA from each parent and the new combined DNA determines the proteins that are produced by cells in the offspring.
- Parental DNA is passed to offspring by fertilization. The offspring's cells then produce colors based on genetic information from each parent.
- Each parent provides a haploid sex cell that carries one allele for every gene. When gene pairs form through sexual reproduction, offspring phenotypes can reflect the genotypic pairs.

Part C (1 point):

- The breeder should breed two individuals that are both recessive for the trait, which will result in the most offspring with the recessive trait.
- The breeder should breed heterozygous individuals in order to produce homozygous recessive offspring, then breed those homozygous recessive offspring with other homozygous recessive individuals.

Sample Student Responses

Item 14 – 3 points

Part A – Student Response
Breeders can develop different colors of Bearded dragons by breeding certain colored bearded dragons together.

Part B – Student Response
The parents pass down there genes and DNA to offspring. So, the parents colors will be shown in the offspring. Or they may not depending on if they get recessive or dominant traits.

Part C – Student Response
Breed two dragons with recessive traits. Then Breed two more. This way the offspring will express those recessive traits.

Annotations
The response demonstrates a thorough understanding of asking questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. In Part A, the response correctly describes how breeders can develop different-colored bearded dragons (*by breeding certain colored bearded dragons together*). In Part B, the response correctly describes the role of parental DNA in affecting the colors produced in offspring (*The parents pass down there genes and DNA to offspring. So, the parents colors will be shown in the offspring. Or they may not depending on if they get recessive or dominant traits*). In Part C, the response correctly describes a process a breeder should use to develop the recessive trait in bearded dragons (*Breed two dragons with recessive traits. Then Breed two more. This way the offspring will express those recessive traits*). The response is clear, complete, and correct.

Item 14 – 2 points

Part A – Student Response
To make a new color there would need to either be a mutation or incomplete dominance. An example of incomplete dominance could be a red dragon crossed with a yellow one to create an orange dragon.

Part B – Student Response
Parental DNA dictates the DNA of the offspring as the offspring's DNA is just ½ of each parent's DNA.

Part C – Student Response
The breeder should breed those that have the trait for a gaurenteed outcome. If there are none expressing the trait, then breed dragons that are heterozygous for the trait. This will have a 1 in 4 chance of working.

Annotations
The response demonstrates a partial understanding of asking questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. In Part A, the response (*To make a new color there would need to either be a mutation or incomplete dominance*) incorrectly describes how breeders can develop different-colored bearded dragons and does not receive any credit. In Part B, the response correctly describes the role of parental DNA in affecting the colors produced in offspring (*Parental DNA dictates the DNA of the offspring OR the offspring's DNA is just ½ of each parent's DNA*). In Part C, the response correctly describes a process a breeder should use to develop the recessive trait in bearded dragons (*The breeder should breed those that have the trait for a gaurenteed outcome OR If there are none expressing the trait, then breed dragons that are heterozygous for the trait. This will have a 1 in 4 chance of working*).

Item 14 – 1 point

Part A – Student Response
They can breed the different-colored bearded dragons together to mix the types of melanin and create a new color of bearded dragon.

Part B – Student Response
Their role is for the Dominant and Non-dominat colors to mix and create different colored or the same colored offspings.

Part C – Student Response
The recessive trait should be used with dominant traits because it will create many types of different colored offspring.

Annotations
The response demonstrates a minimal understanding of asking questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. In Part A, the response correctly describes how breeders can develop different-colored bearded dragons (*They can breed the different-colored bearded dragons together to mix the types of melanin and create a new color of bearded dragon*). In Part B, the response (*Their role is for the Dominant and Non-dominat colors to mix and create different colored or the same colored offspings*) incorrectly describes the role of parental DNA in affecting the colors produced in offspring and does not receive any credit. In Part C, the response (*The recessive trait should be used with dominant traits because it will create many types of different colored offspring*) incorrectly describes a process a breeder should use to develop the recessive trait in bearded dragons and does not receive any credit.

Item 14 – 0 points

Part A – Student Response
The bearded dragons have different amounts of melanin.

Part B – Student Response
Some bearded dragons have a very strong dominant trait and other have weak recessive trait

Part C – Student Response
To breed the breeder should get a dragon that has a strong recessive trait and one that has a weak one so that the dragon has a higher rate of getting the recessive trait.

Annotations
The response demonstrates insufficient evidence to demonstrate any understanding of asking questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. In Part A, the response (*The bearded dragons have different amounts of melanin*) incorrectly describes how breeders can develop different-colored bearded dragons and does not receive any credit. In Part B, the response (*Some bearded dragons have a very strong dominant trait and other have weak recessive trait*) incorrectly describes the role of parental DNA in affecting the colors produced in offspring and does not receive any credit. In Part C, the response (*the breeder should get a dragon that has a strong recessive trait and one that has a weak one so that the dragon has a higher rate of getting the recessive trait*) incorrectly describes a process a breeder should use to develop the recessive trait in bearded dragons and does not receive any credit.

#15 Constructed Response Item-Specific Scoring Guideline

#15 Item Information

Category	Item-Specific Information
Alignment	3.1.9-12.N
Depth of Knowledge	3
Points Possible	3

Item-Specific Scoring Guideline

Score	Description
3	The response demonstrates a *thorough* understanding of designing, evaluating, and refining a solution for reducing the impacts of human activities on the environment and biodiversity by • describing a likely way that adding green stormwater infrastructure to a community would benefit the local ecosystem **AND** • describing **two** ways that researchers could measure the effectiveness of green stormwater infrastructure. The response is clear, complete, and correct.
2	The response demonstrates a *partial* understanding of designing, evaluating, and refining a solution for reducing the impacts of human activities on the environment and biodiversity by • describing **two** ways that researchers could measure the effectiveness of green stormwater infrastructure **OR** • describing a likely way that adding green stormwater infrastructure to a community would benefit the local ecosystem **AND** • describing **one** way that researchers could measure the effectiveness of green stormwater infrastructure. The response may contain some work that is incomplete or unclear.
1	The response demonstrates a *minimal* understanding of designing, evaluating, and refining a solution for reducing the impacts of human activities on the environment and biodiversity by • describing a likely way that adding green stormwater infrastructure to a community would benefit the local ecosystem **OR** • describing **one** way that researchers could measure the effectiveness of green stormwater infrastructure. The response may contain some work that is incomplete or unclear.
0	The response provides *insufficient* evidence to demonstrate any understanding of the concept being tested.

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

Responses that will receive credit:

Part A (1 point):

- The collection of rainwater could prevent flood damage and allow more water to enter the groundwater or be used by plants for photosynthesis (which also removes CO_2 and returns O_2 to atmosphere).
- It can reduce the pollution and erosion that can be a result of stormwater runoff.
- It could convert otherwise unused space (e.g., a rooftop) to additional habitat for local organisms, which could support or improve local biodiversity.

Part B (2 points):

- Record incidents of flooding and compare them with historical data to determine whether there is less flooding with green stormwater infrastructure.
- Measure water quality before and after a rainstorm and compare it with historical data to determine whether there is less pollution with green stormwater infrastructure.
- Measure water availability in the ground water/water table before and after a storm.
- Measure the amount of photosynthesis in green roof/rain garden areas (by measuring carbon dioxide and/or oxygen concentrations).
- Count the number and kinds of plants (or animals) supported by garden/bioswale areas.
- Measure the amount of runoff and pollutants in areas receiving runoff.

Sample Student Responses

Item 15 – 3 points

Part A – Student Response
The green roof on the infrastructure provides more oxygen in the community, as plants on the roof will take in sunlight and water and go through photosynthesis and cell respiration, creating oxygen in the air.

Part B – Student Response
The first way for researchers to measure the effectiveness of the infrastructure is to analyze stormwater volume in streets, parking lots, and roofs before and after the implementation of the green stormwater infrastructure. The second was is to analyze flower numbers in the community, as an increase in the flower number in the community signals that the rain garden is working.

Annotations
The response demonstrates a thorough understanding of designing, evaluating, and refining a solution for reducing the impacts of human activities on the environment and biodiversity. In Part A, the response correctly describes a likely way that adding green stormwater infrastructure to a community would benefit the local ecosystem (*provides more oxygen in the community, as plants on the roof will take in sunlight and water and go through photosynthesis and cell respiration, creating oxygen in the air*). In Part B, the response correctly describes two ways that researchers could measure the effectiveness of green stormwater infrastructure (*first way . . . to analyze stormwater volume in streets, parking lots, and roofs before and after the implementation of the green stormwater infrastructure AND second was is to analyze flower numbers in the community, as an increase in the flower number in the community signals that the rain garden is working*). The response is clear, complete, and correct.

Item 15 – 2 points

Part A – Student Response
The local ecosystem would no longer get flooded because the water would be taken care of in a better way this would also decrease the erosion rate.

Part B – Student Response
One way is to measure how much water is still being left on the ground. Another way is by measuring how much water is absorbed by the green stormwater ifrastructure solutions.

Annotations
The response demonstrates a partial understanding of designing, evaluating, and refining a solution for reducing the impacts of human activities on the environment and biodiversity. In Part A, the response correctly describes a likely way that adding green stormwater infrastructure to a community would benefit the local ecosystem (*The local ecosystem would no longer get flooded . . . also decrease the erosion rate*). In Part B, the response correctly describes one way that researchers could measure the effectiveness of green stormwater infrastructure (*One way is to measure how much water is still being left on the ground*). The second description (*Another way is by measuring how much water is absorbed*) repeats the idea of the first description and does not receive any credit.

Item 15 – 1 point

Part A – Student Response
it would help more plants grow so animals would have more food and oxagen

Part B – Student Response
do an experament some where isolated. do a large experament on a whole town

Annotations
The response demonstrates a minimal understanding of designing, evaluating, and refining a solution for reducing the impacts of human activities on the environment and biodiversity. In Part A, the response correctly describes a likely way that adding green stormwater infrastructure to a community would benefit the local ecosystem (*help more plants grow so animals would have more food and oxagen*). In Part B, the response (*do an experament some where isolated. do a large experament on a whole town*) is too vague. The response incorrectly describes two ways that researchers could measure the effectiveness of green stormwater infrastructure and does not receive any credit.

Item 15 – 0 points

Part A – Student Response
A likely way that adding green stormwater infrastructure in a community would benefit the local ecosystem would have to be is, the plants could die, or they could also affect the growth of the plants which is not good

Part B – Student Response
Two ways researchers could measure the effectiveness of green stormwater infrastructure is, they could start by maybe changing from using greenwater, or find something that is a little more ecosystem friendly.

Annotations
The response demonstrates insufficient evidence of any understanding of designing, evaluating, and refining a solution for reducing the impacts of human activities on the environment and biodiversity. In Part A, the response (*the plants could die, or they could also affect the growth of the plants which is not good*) incorrectly describes a likely way that adding green stormwater infrastructure to a community would benefit the local ecosystem and does not receive any credit. In Part B, the response (*they could start by maybe changing from using greenwater, or find something that is a little more ecosystem friendly*) incorrectly describes two ways that researchers could measure the effectiveness of green stormwater infrastructure and does not receive any credit.

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Keystone Exams Biology
Item Sampler Scoring Guide