Office of Assessments, Analytics, and Accountability

LEAP Assessment Guide for Biology

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Purpose

This document is designed to assist Louisiana educators in understanding the LEAP Biology assessment.

Introduction

All students in grades 3-8 and Biology will take the LEAP science assessments, which provide

- questions that have been reviewed by Louisiana educators to ensure their alignment to the Louisiana Student Standards for Science and appropriateness for all Louisiana students;
- measurement of the full range of student performance; and
- information for educators and parents about student readiness in science and whether students are “on track” for college and careers.

Vision for Science Standards and Assessment

The Louisiana Student Standards for Science (LSS for Science) provide appropriate content for all grades or courses, maintain high expectations, create a logical connection of content across and within grades, represent the knowledge and skills students need to successfully transition to postsecondary education and the workplace, and call for students to apply content knowledge; investigate, evaluate, and reason scientifically; and connect ideas across disciplines.

Assessment Design

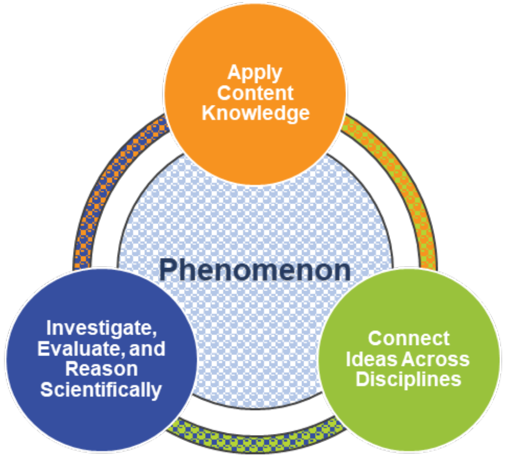
Supporting Science Instruction

The LEAP tests will assess students' understanding of the LSS for Science, reflecting the multiple dimensions of the standards.

Apply content knowledge and skills (Disciplinary Core Idea, DCI)

In the classroom, students develop skills and content knowledge reflected in the Performance Expectations (PE) and detailed in the Disciplinary Core Ideas (DCI), the key skills and knowledge students are expected to master by the end of the course.

On the LEAP test, students answer questions which require content knowledge and skills aligned to PE bundles (groupings of PEs) and the corresponding DCIs.



Investigate, evaluate, and reason scientifically (Science and Engineering Practice, SEP)

In the classroom, students do more than learn about science; they “do” science. Simply having content knowledge and scientific skills are not enough; students must investigate and apply content knowledge to scientific phenomena. Phenomena are real world observations that can be explained through scientific knowledge and reasoning (e.g., water droplets form on the outside of a water glass, plants tend to grow toward their light source, different layers of rock can be seen on the side of the road). Science instruction must integrate the practices, or behaviors, of scientists and engineers as students investigate real-world phenomena and design solutions to problems.

On the LEAP test, students do more than answer recall questions about science; they apply the practices, or behaviors, of scientists and engineers to investigate each real-world phenomenon and design solutions to problems.

Connect ideas across disciplines (Crosscutting Concept, CCC)

In the classroom, students develop a coherent and scientifically-based view of the world, they must make connections across the domains of science (life science, physical science, earth and space science, environmental science, and engineering, technology, and applications of science). These connections are identified as crosscutting concepts (CCC).

On the LEAP test, sets of questions assess student application of knowledge across the domains of science for a comprehensive picture of student readiness for their next grade or course in science.

Set Based Design

The tests include item sets, task sets, and standalone items. A scientific phenomenon provides the anchor for each set or standalone item. Stimulus materials, related to the scientific phenomenon, provide context and focus for sets. A variety of stimulus materials provide context for each described phenomenon. Art is used to help convey information in a simplified form; examples include maps, charts, data tables, bar or line graphs, diagrams, pictures, photographs, or artist’s renderings. In addition to the information presented in the stimulus materials, the questions require students to bring in content knowledge from the course to demonstrate their understanding of science. Some item sets culminate with a short constructed-response and the task culminates with an extended-response item. Each test includes standalone items which are not part of an item set or task set.

Item Types

- Selected Response (SR): includes traditional multiple-choice (MC) questions with four answer options and only one correct answer, as well as multiple-select (MS) questions with five or six answer options and more than one correct answer. For MS items, the question identifies the number of correct answers. All SR items are worth one point each.
- Technology Enhanced (TE): uses technology to capture student comprehension in authentic ways, previously difficult to score by machine for large-scale assessments. TE items are worth up to two points and may include item types such as, but not limited to, drag and drop, dropdown menus, and hot spots. The Online Tools Training allows students to experience TE items and practice answering them to prepare for the computer-based test.
- Two-part item: requires students to answer two related questions, worth two points. Two-part items may combine SR and TE item types.
  - Two-part Dependent (TPD): the first part must be correct in order to earn credit for the second part.
  - Two-part Independent (TPI): each part is scored independently.
- Constructed Response (CR): requires a brief response provided by the student and will be scored using a 2-point rubric. These items may require a brief paragraph, a few sentences, and/or completion of a chart.
- Extended Response (ER): asks students to write a response that expresses the students’ ability to apply all three dimensions of the LSS for Science and will be scored using a 9-point rubric.

Test Design

The LEAP Biology assessment contains 5 item sets, 1 task, and 16 stand-alone items. The test will contain embedded field-test questions (one item set or task set and four standalone items). The field-test questions do not count toward a student’s final score on the test and may be placed in any session; they provide information that will be used to develop future test forms. All LEAP tests are timed.

Test Session	Component	Points	Time Allowed
Session 1	3 Item Sets	18	75 minutes
	3 Standalone Items	5	
Session 2	Task Set	15	90 minutes
	3 Standalone Items	5	
Session 3	2 Item Sets	12	75 minutes
	10 Standalone Items	12	
Total Operational	5 Item Sets, 1 Task Set, 16 Standalones	67	4 hours

Reporting Categories

All Louisiana Student Standards for Science are eligible for assessment. The LEAP science assessments examine students' performance of scientific and engineering practices (SEPs) in the context of disciplinary core ideas (DCIs) and crosscutting concepts (CCCs). Although these SEPs are described separately, they generally function in concert. This overlap of SEPs means that assessment items must be designed around a bundle of related performance expectations (PEs) and not tested in isolation from one another. The task set, which contains the extended-response question, may assess any of the LSS for science from year to year. The extended-response question is reported in the overall score, but not as part of any reporting category.

The table below shows the reporting category titles and descriptions as well as the PEs associated with each reporting category.

Reporting Category	Description	Content
Investigate	Ask Questions, Define Problems, and Plan Investigations	HS-LS1-3, HS-LS3-1
Evaluate	Analyze and Interpret Data, Use Mathematics and Computational Thinking, and Engage in Argument from Evidence	HS-LS2-1, HS-LS2-4, HS-LS2-6, HS-LS3-2, HS-LS3-3, HS-LS4-1, HS-LS4-3, HS-LS4-5
Reason Scientifically	Develop and Use Models, Construct Explanations, and Design Solutions	HS-LS1-1, HS-LS1-2, HS-LS1-4, HS-LS1-5, HS-LS1-6, HS-LS1-7, HS-LS2-7, HS-LS4-2, HS-LS4-4

HS-LS1-8 may be assessed and would be reported as part of the overall score. This particular PE does not fit neatly into any one of the three categories; rather, it partly touches all three categories.

Achievement-Level Definitions

Achievement-level definitions briefly describe the expectations for student performance at each of Louisiana's five achievement levels:

- **Advanced:** Students performing at this level have **exceeded** college and career readiness expectations and are well prepared for the next level of study in this content area.
- **Mastery:** Students performing at this level have **met** college and career readiness expectations and are prepared for the next level of study in this content area.
- **Basic:** Students performing at this level have **nearly met** college and career readiness expectations and may need additional support to be fully prepared for the next level of study in this content area.
- **Approaching Basic:** Students performing at this level have **partially met** college and career readiness expectations and will need much support to be prepared for the next level of study in this content area.
- **Unsatisfactory:** Students performing at this level have **not yet met** the college and career readiness expectations and will need extensive support to be prepared for the next level of study in this content area.

Achievement Level Descriptors

Achievement Level Descriptors (ALDs) indicate what a typical student at each level should be able to demonstrate based on his or her command of grade-level standards. ALDs are written for the three assessment reporting categories. Access the ALDs in the Assessment library for a breakdown of the knowledge, skills, and practices associated with each achievement level.

Test Administration

Administration Information

The school or district test coordinator will communicate each school's testing schedule. For updates to the testing schedule, refer to the 2024-2025 Louisiana Assessment Calendar. All LEAP assessments are timed. No additional time is permitted, except for students who have a documented extended time accommodation (e.g., an IEP).

Administration	Testing Window	Student-Level Results
Fall	December 2 - December 20, 2024	In window
Spring	April 2 - May 14, 2025	Near the end of the test window
Summer	June 23 - June 27, 2025	In window

Scheduling Requirements for Computer-Based Testing

Computer-based testing allows school systems some flexibility in scheduling. However, to reduce incidences of testing irregularities, school systems **must** adhere to the following scheduling and administration practices:

- Testing students in the same grade level across the school at or very close to the same time
- Completing makeup testing for students immediately upon their return
- Limiting student interaction during breaks between test sessions
- Isolating students who have not completed testing for the day (e.g., students with extended time accommodation)
- Preventing interaction between groups of students taking the same tests at different times within a testing day
- Requiring the completion of a session once it is opened (i.e., limiting the reopening of test sessions)
- Taking the sessions within a content area in the correct order (e.g., Math Session 1 taken before Math Session 2)

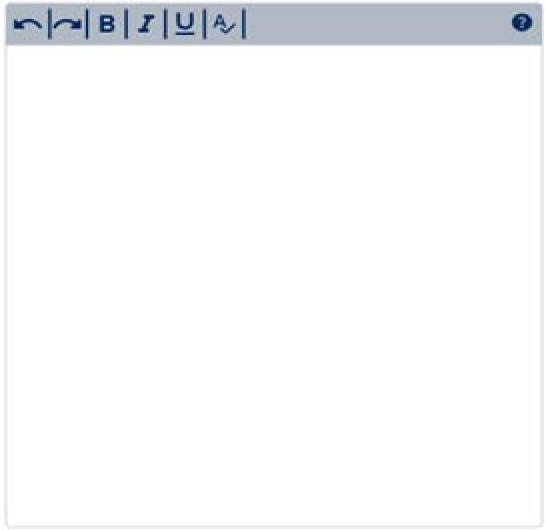
The Department also recommends limiting sessions to no more than three in one day for a student and administering no more than one session that includes an extended-response task or writing prompt (e.g., ELA Sessions 1 and 2, English I/II Sessions 1 and 2, and U.S. History Session 2) in a day to an individual student. For more information about scheduling and administration policies, refer to the Online Assessment Scheduling Guidance, found in the LDOE Assessment library.

Testing Materials

All students should receive scratch paper and two pencils from their test administrator.

Testing Platform

Students will enter their answers into the online testing system. When composing their written responses, students will type their responses into an answer box, like the one shown. The toolbar at the top of the response box allows students to undo or redo an action; and add boldface, italics, or underlining to their response. There is a limit to the amount of characters that can be typed into the response box; however, it is set well beyond what a student might produce given the LEAP expectations for written responses and timing. The character count is not included on the response box so students focus on the quality of their responses rather than the amount of writing.



The computer-based tests include the following online tools, which allow a student to select answer choices, “mark” items, eliminate answer options, highlight text, take notes, enlarge the item, apply a mask to cover a part of the screen, and guide the reading of a text or an item line by line. A help tool is also featured to assist students as they use the online system.

- Pointer
- Cross-off
- Highlighter
- Sticky note
- Magnifier
- Line guide
- Masking
- Help

All students taking the computer-based test should work through the Online Tools Training, using the online tools so students are well prepared to navigate the online testing system.

Sample Test Items

Standalone Items

This section includes sample test items. With each item, item set, and task set, is a table containing alignment information and the answer key, where possible. Additionally, analyses of the multi-dimensional alignment for the item set and the task set are included. Rubrics for CRs and ERs are included with the items. An asterisk (*) denotes correct answer(s).

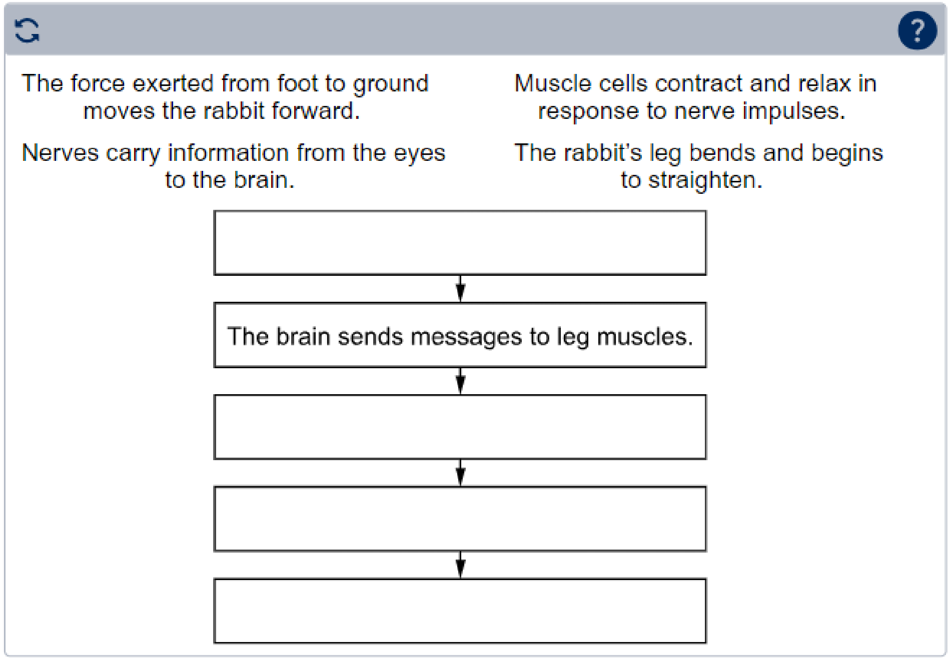
Item Type	PE	DCI	SEP	CCC	Points
TEI	HS-LS1-2	**HS.LS1A.b**	**2. MOD**		2
TEI	HS-LS3-3	**HS.LS3B.a**	**4. DATA**		2
MC	HS-LS4-4	**HS.LS4B.a**	**6. E/S**		1
TEI	HS-LS1-7	**HS.LS1C.c**	**2. MOD**		2

SEP = blue; DCI = orange; CCC = green

Technology-Enhanced Item

A rabbit sees a predator, which activates the interactions of several body systems to make the rabbit move.

Drag the interactions into the correct order needed to make the rabbit move.



The force exerted from foot to ground moves the rabbit forward.

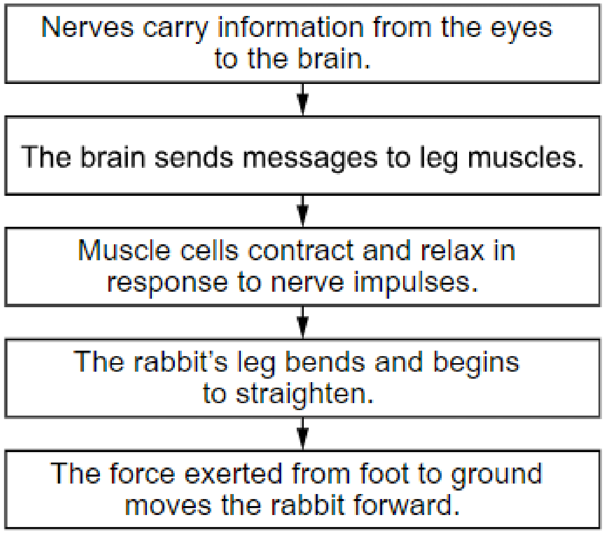
Muscle cells contract and relax in response to nerve impulses.

Nerves carry information from the eyes to the brain.

The rabbit's leg bends and begins to straighten.

The brain sends messages to leg muscles.

Scoring Information



Nerves carry information from the eyes to the brain.

The brain sends messages to leg muscles.

Muscle cells contract and relax in response to nerve impulses.

The rabbit's leg bends and begins to straighten.

The force exerted from foot to ground moves the rabbit forward.

Multi-Dimensional Alignment: While effectively applying the science practice of **developing and using models** by **illustrating the relationships between different systems**, the student demonstrates knowledge of **how multicellular organisms have a hierarchical structure where systems are made up of numerous parts**

Technology-Enhanced Item

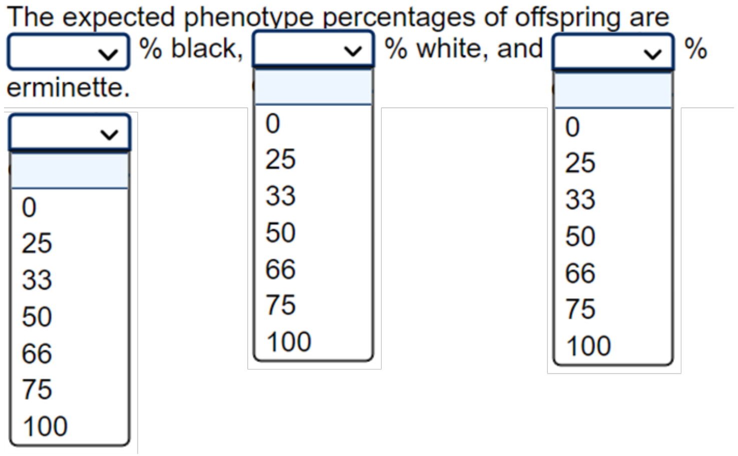
Performance Expectation: **HS-LS3-3** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

In chickens, the black (***B***) and white (***W***) alleles for feather color are codominant. If a homozygous white chicken is crossed with a homozygous black chicken, the offspring has feathers that are both black and white, a trait that is known as erminette, as shown in the diagram.

The Punnett square shows the possible genotypes resulting from the cross of an erminette chicken with a white chicken.

		White Chicken	
		W	*W*
Erminette Chicken	*B*	*BW*	*BW*
	W	*WW*	*WW*

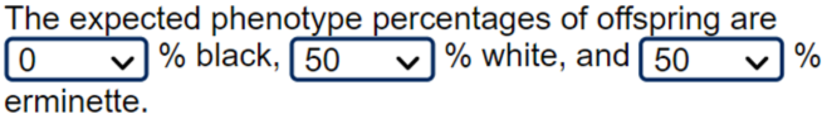
Select the correct answers from the dropdown menus to complete the sentence to indicate the expected percentage of offspring with each phenotype resulting from the cross shown in the Punnett square.


The expected phenotype percentages of offspring are ☐ % black, ☐ % white, and ☐ % erminette.

Multi-Dimensional Alignment

While effectively applying the science practice of **analyzing and interpreting data** by **applying concepts of statistics and probability**, the student demonstrates knowledge **that sexual reproduction results in genetic variation, which is passed onto offspring**.

Scoring Information

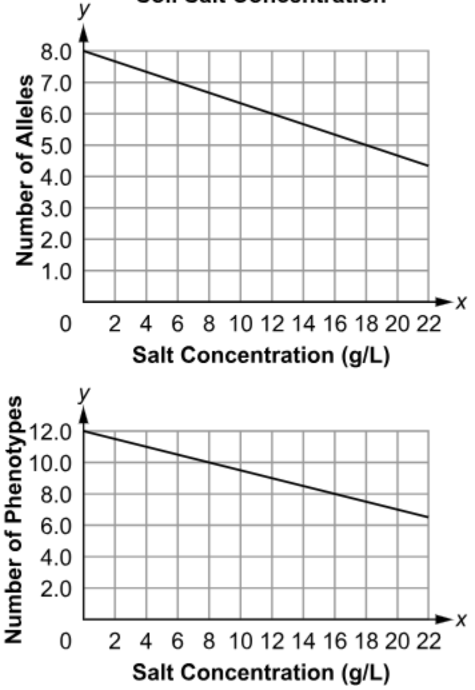

The expected phenotype percentages of offspring are 0 % black, 50 % white, and 50 % erminette.

Multiple-Choice Item

Performance Expectation: **HS-LS4-4** Construct an explanation based on evidence for how natural selection and other mechanisms lead to genetic changes in populations.

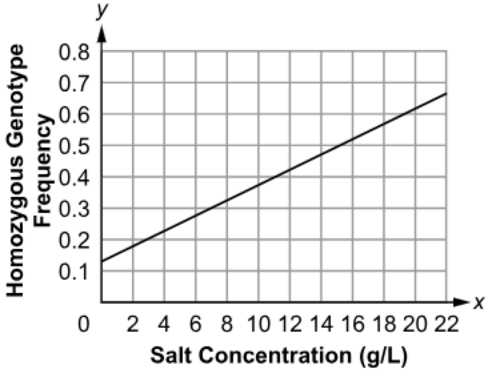
Weather conditions such as heavy rains, floods, or high rates of evaporation can affect salt concentration in soil. A high salt concentration limits most plants' ability to take in water, affecting their ability to grow and survive. Scientists conducted an experiment to find out how changes in salt concentrations affect the genetic diversity of reed grasses. Their results are shown in the Genetic Diversity vs. Soil Salt Concentration graphs.

Genetic Diversity vs.
Soil Salt Concentration



Another graph shows the relationship between increased salt concentrations and individuals that are homozygous for a particular gene.

Homozygous Genotype Frequency
vs. Soil Salt Concentration



Which explanation is **best** supported by the data in the graphs?

A. There is less genetic diversity among reed grasses that grow well at lower salt concentrations and greater genetic diversity among reed grasses that grow well at higher salt concentrations.

B. There are more reed grasses that are heterozygous for certain genes at higher salt concentrations than reed grasses that are homozygous for the same genes at higher salt concentrations.

C. There is high genetic diversity among reed grasses that grow well in lower salt concentrations, but a higher percentage of the reed grasses that grow well at higher salt concentrations are homozygous.*

D. There are more reed grass phenotypes at higher salt concentrations than there are at lower salt concentrations, but most phenotypes result from homozygous genotypes at higher salt concentrations.

Multi-Dimensional Alignment

While effectively applying the science practice of **constructing explanations and designing solutions** by **selecting the valid evidence**, the student demonstrates knowledge of **how variations among traits result in natural selection leading to populations with adaptations**.

Technology-Enhanced Item

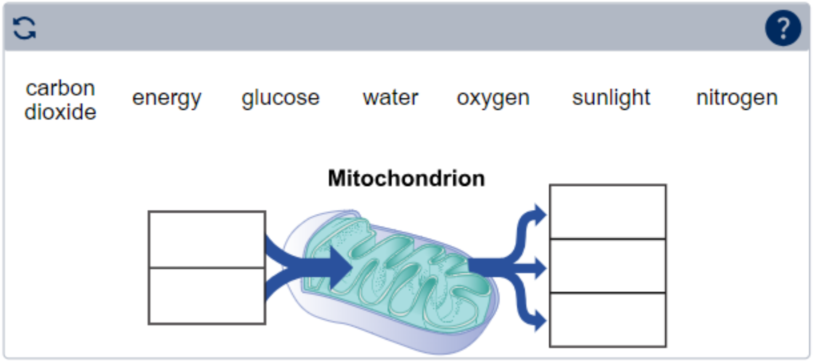
Performance Expectation: **HS-LS1-7** Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.

Plants and animals undergo the same process to obtain energy needed for cellular function, including growth, repair, and movement. This process occurs in the mitochondria of both plant and animal cells.

Complete the model to show how energy and matter are affected by the process that occurs in the mitochondria of both plant and animal cells.

Drag the labels into the correct boxes to model the flow of matter and energy during this process.

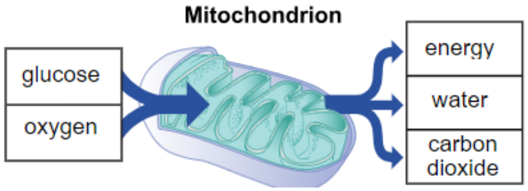
Not all labels will be used.



Multi-Dimensional Alignment

While effectively applying the science practice of **developing and using models** by **illustrating the relationship between components of a system**, the student demonstrates knowledge of **how chemical elements recombine to form different products as matter and energy flow through living systems**.

Scoring Information



Item Set: Biodiversity in Longleaf Pine Ecosystems

Performance Expectations

HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity, biodiversity and populations of ecosystems at different scales.

HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Item Type	PE	DCI	SEP	CCC	Points
TEI	HS-LS2-1	**HS.LS2A.a**	**5. MCT**		1
TPD	HS-LS2-1	**HS.LS2A.a**	**5. MCT**	**SPQ**	2
MS	HS-LS2-1	**HS.LS2A.b**	**5. MCT**		1
CR	HS-LS2-7	**HS.LS4D.a; HS.LS2C.b; HS.ETS1B.a**	**6. E/S**	**S/C**	2

SEP = blue; DCI = orange; CCC = green

An asterisk (*) denotes correct answer(s).

Stimulus

Use the information about biodiversity in longleaf pine ecosystems and your knowledge of science to answer the questions.

Biodiversity in Longleaf Pine Ecosystems

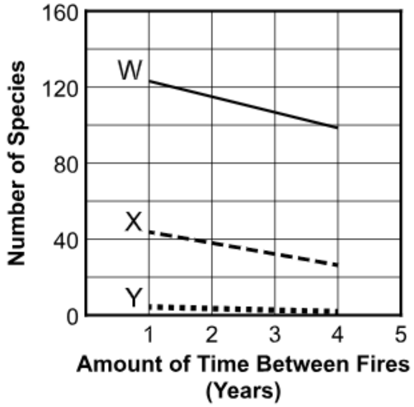
Longleaf pine forests once covered large areas of the Southeast, including Louisiana. These ecosystems once contained a variety of wildlife and very diverse communities of plants. These ecosystems consisted of longleaf pines that were spaced far apart. This left open gaps in the forest that could support large populations of herbs and grasses. Many species of plants on the forest floor relied on fire to stimulate their flowering and seed production.

Human activities, such as farming and livestock grazing, have destroyed large areas of longleaf pine ecosystems. In the few remaining longleaf pine ecosystems, fire suppression (management strategies to prevent forest fires and/or fight fires to keep them from spreading) has allowed other large trees, such as oaks, to fill in the once-open spaces. Woody shrubs have also taken over the forest floor. This has caused a large decrease in plant biodiversity.

In recent decades, people have attempted to restore longleaf pine ecosystems across the Southeast. Data from these efforts show an increase in plant biodiversity, as measured by species richness.

Scientists conducted a study to investigate the effects of fire suppression on biodiversity. The scientists selected plots (sections) of land in different areas. The plots were different scales (small to large) and were assigned to groups that would receive regular controlled burns every one to four years. Some plots were assigned to a group that would not receive any controlled burns. Each year of the study, the scientists counted the number of different plant species living in each plot. Graph 1 shows the relationship between the amount of time between controlled burns and the number of species in each plot.

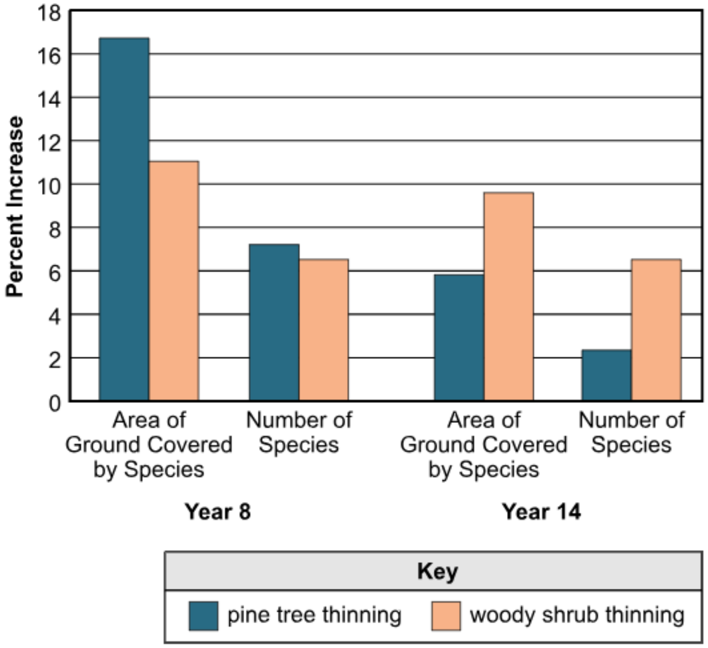
Graph 1. Results of Plot Study



Key	
Line	Plot Size (m²)
— W	1000.00
-- X	10.00
·· Y	0.01

A second study showed further increases in biodiversity, with thinning (selective removal) of pine trees and woody shrubs in addition to controlled burns. Data from that study are shown in Graph 2.

Graph 2. Pine Tree Thinning vs. Woody Shrub Thinning



Images 1 and 2 show effects of different management practices in different areas.

Image 1. Periodic Burning Only

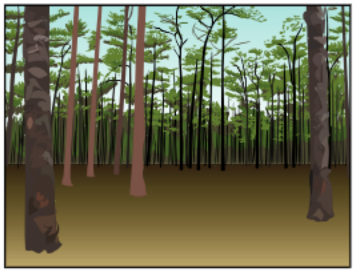
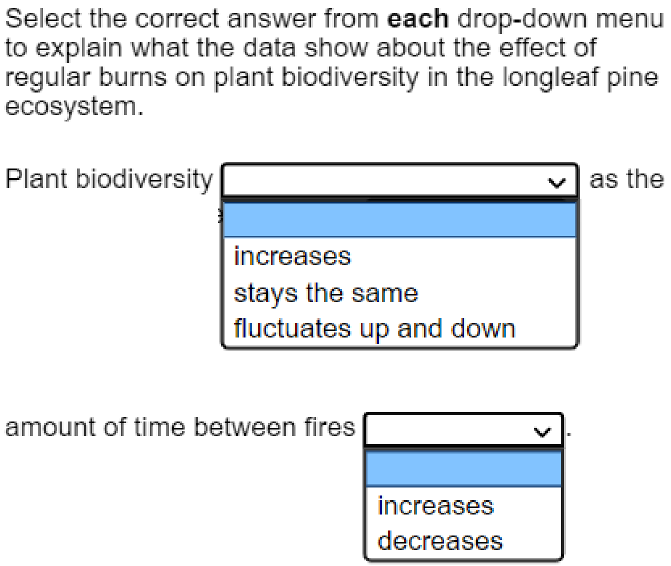


Image 2. Periodic Burning and Thinning of Pine Trees and Woody Shrubs

Technology-Enhanced Item

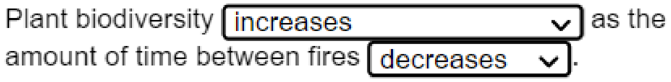


Select the correct answer from **each** drop-down menu to explain what the data show about the effect of regular burns on plant biodiversity in the longleaf pine ecosystem.

Plant biodiversity ☐ as the amount of time between fires ☐.

Multi-Dimensional Alignment: While effectively applying the science practice of **using mathematics and computational thinking** by **using the information from a mathematical representation to explain the relationship between parts of an ecosystem**, the student demonstrates knowledge of **the factors that affect carrying capacity, which include the availability of nonliving resources that can affect the biodiversity of an ecosystem**.

Scoring Information



Plant biodiversity increases as the amount of time between fires decreases.

Two-Part Dependent Item

Part A

Which statement **best** explains how the effect of fewer years between burns relates to the scale of the ecosystem area that is burned?

A. Burning smaller areas causes a greater increase in biodiversity than burning larger areas.
B. Burning smaller areas causes a decrease in biodiversity compared to burning larger areas.
C. Burning larger areas causes a greater increase in biodiversity than burning smaller areas.*
D. Burning larger areas causes a decrease in biodiversity compared to burning smaller areas.

Part B

Which statements about Graph 1 are evidence that supports the answer to Part A?

Select **all** that apply.

A. The slopes of the data lines become more steep as the scale of the plot size increases.*
B. The slopes of the data lines become less steep as the scale of the plot size increases.
C. The slopes of the data lines become more steep as the scale of the plot size decreases.
D. The slopes of the data lines become less steep as the scale of the plot size decreases.*
E. The slopes of the data lines reverse from the largest scale to the smallest scale of plot size.
F. The slopes of the data lines are all negative at all three scales of plot size.*

Multi-Dimensional Alignment: The item requires the student to apply the science practice of **mathematics and computational thinking** by **using a mathematical representation to explain the relationship between parts of an ecosystem** and knowledge of **the factors that affect carrying capacity, which include the availability of nonliving resources that can affect the biodiversity of an ecosystem** to demonstrate an understanding of the **scale, proportion, and quantity of changes to an ecosystem**.

Multiple-Select Item

Which statements **best** explain what the data in Graph 2 and the images of the different management practices show about easing the biodiversity of herbs and grasses?

Select the **three** correct answers.

A. The effects of thinning pine trees and woody shrubs are greater in unburned areas than in burned areas.*
B. The effects of thinning pine trees and woody shrubs are much greater than the effects of burning alone.*
C. The continued thinning of pine trees in burned areas has a much greater effect on the biodiversity of herbs and grasses than the thinning of woody shrubs does.
D. The effects of thinning pine trees on the biodiversity of herbs and grasses in burned areas, compared to the effects of thinning of woody shrubs, is about the same over time.
E. The thinning of pine trees in burned areas had a slightly greater effect on the biodiversity of herbs and grasses than the thinning of woody shrubs in Year 8, but that effect decreased by Year 14.*

Multi-Dimensional Alignment: While effectively applying the science practice of **using mathematics** by **using a mathematical representation to explain the relationship between parts of an ecosystem**, the student demonstrates knowledge of **how humans can directly and indirectly affect biodiversity and ecosystem health**.

Constructed-Response Item

Based on the data from the two studies and your knowledge of stability and change in ecosystems, develop a management plan for restoring plant biodiversity in a 1-km^2 longleaf pine ecosystem. In your plan, describe **two** steps that should be taken, and explain how **each** step will affect plant biodiversity. Use evidence from the information provided on longleaf pine ecosystems to support your answer.

Multi-Dimensional Alignment: The item requires the student to apply the science and engineering practices of **constructing explanations and designing solutions** by **designing and evaluating a solution to a complex real-world problem based on scientific knowledge**, and knowledge of: **ecosystems with greater biodiversity are more resilient to change, and that changes (induced by human activity) can disrupt an ecosystem**; **humans' activity has adverse impacts on biodiversity, and biodiversity is essential to supporting life**; and **constraints to consider when evaluating solutions** to demonstrate an understanding of **stability and change**.

Scoring Guide

Score	Description
2	Student's response clearly describes **two** steps that should be taken, correctly predicts how **each** step will change plant biodiversity, and supports the predictions with evidence.
1	Student's response clearly describes **one** step that should be taken, correctly predicts how **one** step will change plant biodiversity, and supports **one** prediction with evidence.
0	Student's response does **not** clearly describe **one** step that should be taken, correctly predict how **one** step will change plant biodiversity, or support **one** prediction with evidence.

Sample Response:

- Regular burning: In both studies, regular burning increased plant biodiversity. The first study showed that biodiversity improved as the frequency of burning increased up to one burn per year.
- Thinning pine trees: Study number two showed that thinning of pine trees in burned areas increased biodiversity initially, but if the area were allowed to overgrow again, those increases could lessen, which suggests that thinning needs to be conducted regularly.

Accept any other plausible answer that is supported by evidence from the stimulus. Example: (Thinning woody plants) Study number two showed that the removal of woody plants from burned areas has a sustainable effect, which increases biodiversity through Year 14 of the study.

Task Set: Bee Communication

Performance Expectations:

HS-LS1-1 Construct 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.

HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Item Type	PE	DCI	SEP	CCC	Points
TEI	HS-LS1-2	**HS.LS1A.b**	**2. MOD**		2
MS	HS-LS1-1	**HS.LS1A.c**	**6. E/S**		1
MC	HS-LS1-1	**HS.LS1A.a**		**S/F**	1
TEI	HS-LS1-2	**HS.LS1A.b**	**2. MOD**		2
ER	HS-LS1-1; HS-LS1-2	**HS.LS1A.c; HS.LS1A.b; HS.LS1A.a**	**6. E/S; 2. MOD**	**S/F; SYS**	9

SEP = blue; DCI = orange; CCC = green

An asterisk (*) denotes correct answer(s).

Stimulus Materials

Use the information about bee communication and your knowledge of science to answer the questions.

Bee Communication

Insects communicate with one another in different ways. Some insects communicate through the use of chemical signals called pheromones. There are many different types of pheromones used by insects. Bees have one of the most advanced pheromone-based communication systems. An individual bee can have up to fifteen different glands, and each gland can produce a collection of different pheromones. Bees also have sensory glands, such as antennae and mouth parts, that detect different pheromones in the environment.

Queen bees use pheromones to control the behavior of the bees in a colony. Pheromones help coordinate activities among bees. Individual bees release different pheromones in response to different stimuli. Colonies without queen bees become stressed and collapse.

Picture 1 shows an example of a bee colony swarming in response to queen bee pheromones. When the queen bee becomes trapped in a car, she emits pheromones, and bees from her colony swarm the car in an attempt to rescue her.

Picture 1. Bee Colony Swarm

Source: Dai Roberts.

Bees make specific proteins that bind to different pheromones. When proteins bind to a pheromone, a response is triggered in the bee. Examples of bee responses include:

- location detection
- sexual attraction
- direction of a flying swarm
- the calming of a landed swarm
- queen replacement
- defense alarms
- attack-site location
- signals that trigger attack

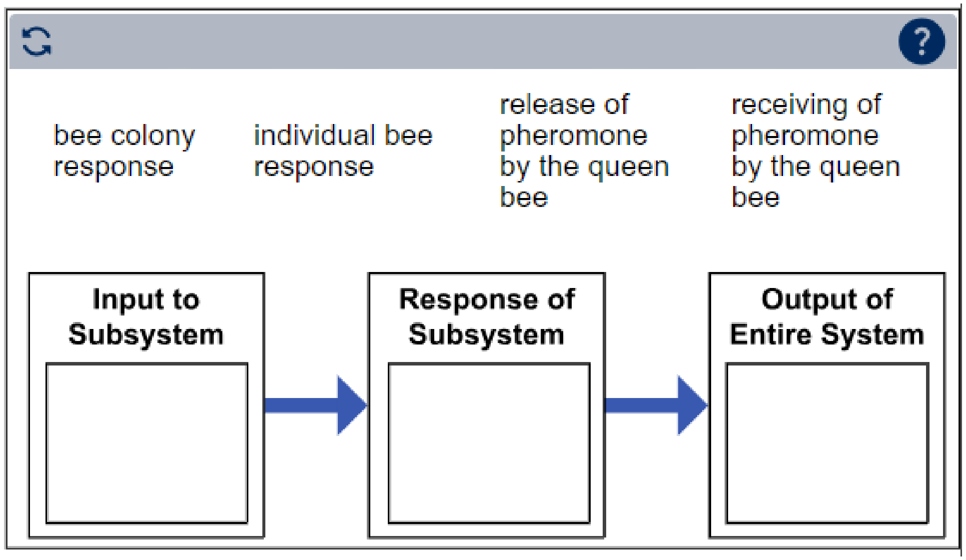
Individual bees that lack specific proteins or that have malformed proteins are unable to detect and respond to certain pheromones.

Technology-Enhanced Item

Bee colonies are an example of biological systems. The input of a subsystem affects the output of the entire system.

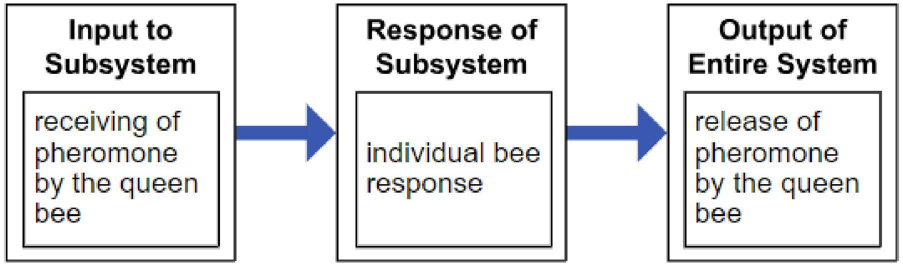
Drag the correct phrase into **each** box to represent a subsystem–system relationship that causes a bee colony to swarm.

Not all phrases will be used.



Multi-Dimensional Alignment: While effectively applying the science practice of **developing and using models** by **illustrating the relationship between components of a system**, the student demonstrates knowledge of **how multicellular organisms have a hierarchical structure where systems are made up of numerous parts**.

Scoring Information



Input to Subsystem
receiving of pheromone by the queen bee

Response of Subsystem
individual bee response

Output of Entire System
release of pheromone by the queen bee

Multiple-Select Item

A student claims that DNA determines the structures of pheromone-detecting proteins in bees. Which evidence **best** supports the student's claim?

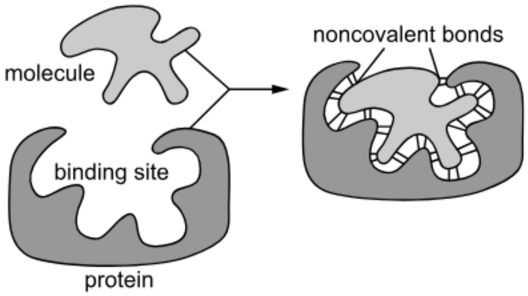
Select the **two** correct answers.

A. Bee cells contain both DNA and pheromone-detecting proteins.
B. A single bee can produce multiple pheromone-detecting proteins.
C. Bee DNA contains unique genes for each pheromone-detecting protein.*
D. The queen bee contains more DNA than other bees that receive pheromone signals.
E. A mutation in a bee gene causes a change in the function of a pheromone-detecting protein.*

Multi-Dimensional Alignment: While effectively applying the science practice of **constructing explanations** by **using valid and reliable evidence to form an explanation of scientific phenomena**, the student demonstrates knowledge of **how all cells contain genetic information in the form of DNA** and **that genes found in DNA code for specific proteins, which carry out the essential functions of life**.

Multiple-Choice Item

A student makes a model to show how the structure of a protein allows it to bind to a molecule. The student's model is shown.



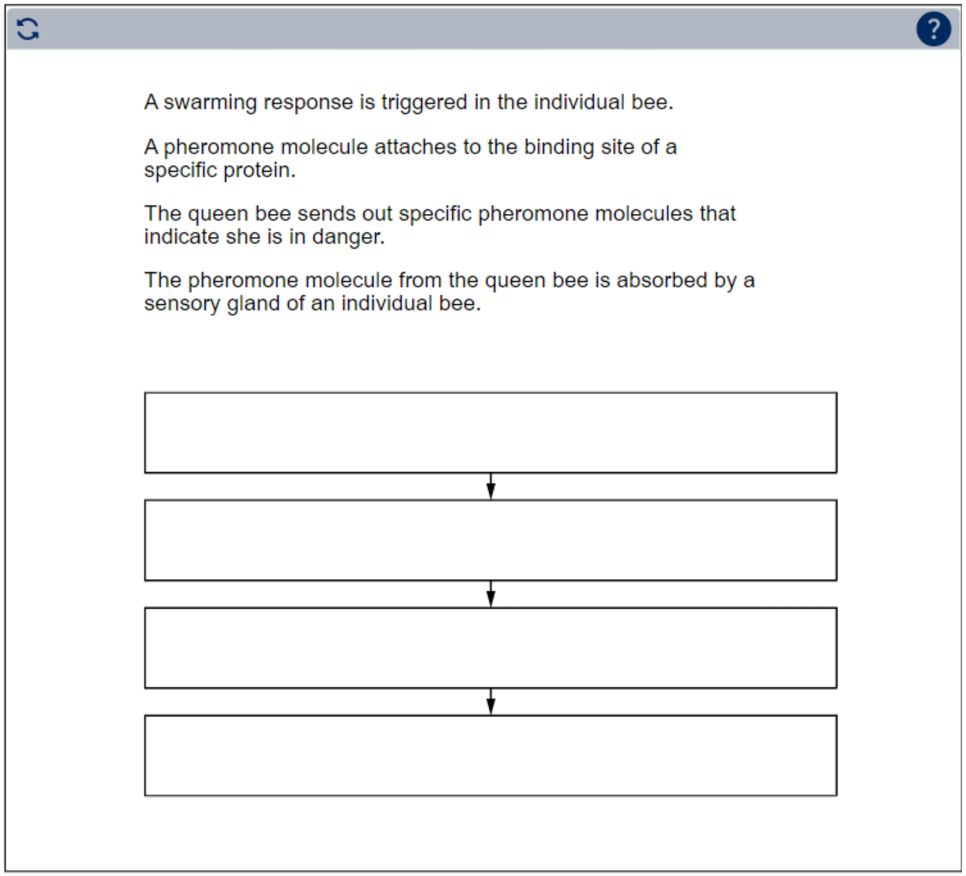
Which pair of statements correctly explains how the student's model shows how bees produce different responses to different pheromones?

A. The large and irregular binding site allows a variety of different pheromones with different shapes to bind with a specific protein. Different responses to different pheromones can be produced by a single protein.
B. The unique shape and size of the binding site allows only one pheromone with a specific shape to bind with a specific protein. Different responses to different pheromones are produced by different proteins.*
C. A protein changes the shape of a pheromone by forming covalent bonds at the binding site. This allows the protein to produce different responses.
D. A pheromone changes the shape of the binding site of a protein by forming covalent bonds. This allows the pheromone to produce different responses.

Multi-Dimensional Alignment: The item requires the student to apply knowledge of **the systems of specialized cells within organisms** to demonstrate an understanding of **structure and function**.

Technology-Enhanced Item

Drag the statements into the correct boxes to model how a pheromone triggers a swarming response in a bee colony.



A swarming response is triggered in the individual bee.

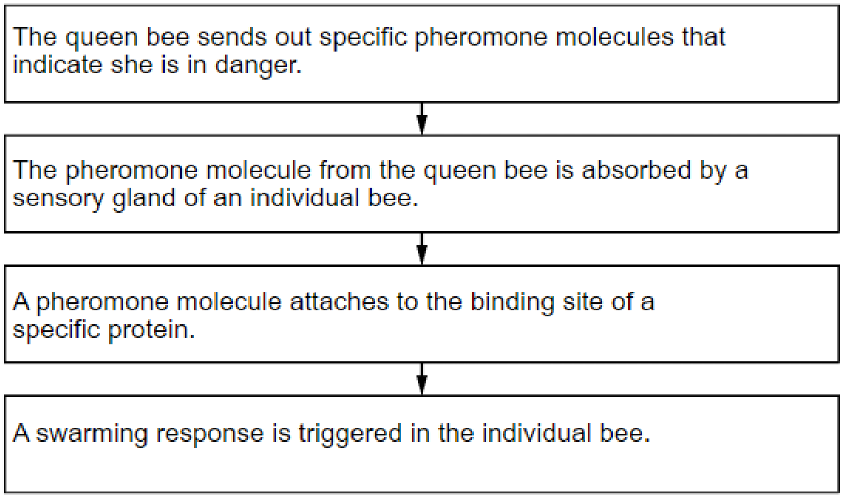
A pheromone molecule attaches to the binding site of a specific protein.

The queen bee sends out specific pheromone molecules that indicate she is in danger.

The pheromone molecule from the queen bee is absorbed by a sensory gland of an individual bee.

Multi-Dimensional Alignment: While effectively applying the science practice of **developing and using models** by **illustrating the relationship between components of a system**, the student demonstrates knowledge of **how multicellular organisms have a hierarchical structure where systems are made up of numerous parts**.

Scoring Information



The queen bee sends out specific pheromone molecules that indicate she is in danger.

The pheromone molecule from the queen bee is absorbed by a sensory gland of an individual bee.

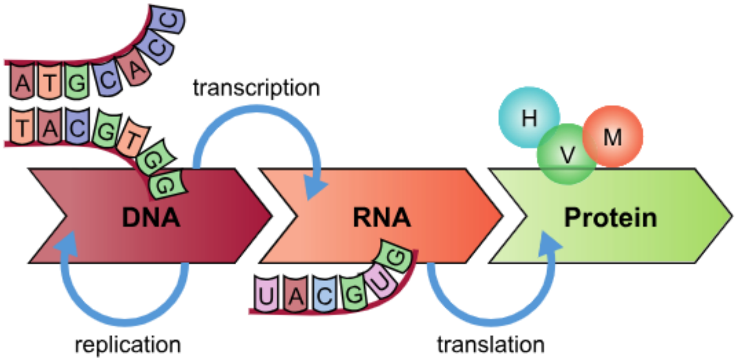
A pheromone molecule attaches to the binding site of a specific protein.

A swarming response is triggered in the individual bee.

Extended Response Task

Many natural systems are involved in the biological organization of an individual bee. These systems interact to allow the individual bee to survive in its environment and contribute to the well-being of the entire bee colony.

The model can be used to explain how a bee's cell structures use information in DNA to produce specific proteins that can bind to specific pheromones.



As you respond to Part A and Part B, follow the directions below.

- Address all of the instructions in each prompt.
- Use evidence from the information provided and your own knowledge of science to support your responses.

Part A

Explain how the structure and function of nucleotides (DNA and RNA) allow the cell to assemble specific proteins with different structures and functions. In your answer, discuss the roles of:

- the DNA double helix structure
- nucleotide base pair bonding
- tRNA molecules

Use evidence from the model to support your answer.

Part B

Explain how the path from DNA to the swarming response in an individual bee involves a combination of biological systems at multiple scales. In your answer, describe the bee's biological systems that are involved in the swarming response, and explain how the systems work together to perform the response. Use evidence to support your answer.

Multi-Dimensional Alignment: The item requires the student to apply the science practices of **constructing explanations** by **using valid and reliable evidence to form an explanation of scientific phenomena** and **developing and using models** by **illustrating the relationship between components of a system**, and knowledge of: **multicellular organisms have a hierarchical structure where systems are made up of numerous parts; all cells contain genetic information (DNA) and genes found in DNA code for specific proteins, which carry out the essential functions of life**; and **systems of specialized cells within an organism help them perform the essential functions of life** to demonstrate an understanding of **systems and system models** and **structure and function**.

Score Points

An ER item may contain a single part or multiple parts. For multiple-part items: The student's score is the sum total of all the points earned across all parts (up to an item-maximum of 9 points) of the item. No response (blank) or a response that does not address the prompt earns 0 points.

Part A (6 points maximum)

- 3 points: 1 point for explaining the role of each of the following:
    - the role of DNA double helix structure
    - the role of nucleotide base pair bonding
    - the role of tRNA molecules
- 3 points: 1 point for using evidence to support each explanation

Sample Response:

Part A:
DNA contains information to produce a protein. The information that codes for a protein is encoded in the order of nucleotides in a gene. The model shows that, during protein synthesis, the double helix structure unwinds and "unzips" to expose single strands of nucleotides on a gene that is then used as a template to assemble the protein. The structures of nucleotides allow the information to be copied because they form hydrogen bonds with only their complementary base pairs. The model shows that a strand of mRNA is transcribed from the DNA template strand and that it carries the complementary code from the gene. At the ribosome, tRNA assembles the protein by adding amino acids in the specific order coded for in the mRNA strand. The tRNA molecule carries a 3-base anticodon on one side and an amino acid that is specific to the anticodon on the other side. The model can be used to show how this structure allows the correct amino acid to be placed in the correct order by binding to the complementary bases (the codon) on the mRNA molecule.

Part B (3 points maximum)

- 1 point for description of bee's biological systems
- 1 point for description of how multiple scales in biological systems are affected
- 1 point for explanation of how different biological systems work together

Sample Response:

Part B:
The path from DNA to the swarming response in an individual bee is actually a combination of biological systems because many systems are involved. First, DNA is copied to allow for protein synthesis at the level of the cellular system, which includes the nucleus and ribosomes, to allow for pheromone detection. Detection of pheromones triggers a swarming response that involves the flight and navigation systems of the bee. Flight requires coordination in the wings, and involves cells and tissues working together in muscles to pull on the wing structure for motion. Navigation requires the bee's brain obtaining directional information from the environment and signaling the flight system to move in a specific direction based on the information.

Accept any other plausible explanation of how the path from DNA to the swarming response involves a combination of biological systems at multiple scales.

Resources

Assessment Guidance Library

- Assessment Development Educator Review Committees: describes the item development process and the associated committees, includes information on applying for participation

Practice Test Library

- LEAP Biology Practice Test Answer Key: helps prepare students for the Biology assessment, includes answer keys, scoring rubrics, and alignment information
- LEAP Science Practice Test Guidance: provides guidance on how teachers might better use the practice tests to support their instructional goals
- Practice Test Quick Start Guide: provides information regarding the administration and scoring process needed for the online practice tests

Assessment Library

- 2024-2025 Louisiana Assessment Calendar: includes information on testing windows for test administrations
- Biology Achievement Level Descriptors: contains descriptions of the knowledge, skills, and processes that students demonstrate with relative consistency and accuracy at each level of achievement
- LEAP Accessibility and Accommodations Manual: provides information about accessibility and accommodations
- LEAP Technology Enhanced Item Types: provides a summary of technology enhanced items students may encounter

EAGLE: instructional resources in grade-level documents that teachers can download and incorporate into their daily instruction; contact school test coordinator for instructions on accessing the files

DRC INSIGHT Portal:

- includes access to tutorials, manuals, and user guides
- LEAP Biology Practice Test: helps prepare students for the spring assessment
- Online Tools Training: allows students to become familiar with the online testing platform and its available tools; also available through this link using the Chrome browser

K-12 Science Planning Resources Library

- K-12 Louisiana Student Standards for Science (2017): provides the performance expectations and three-dimensional learning for all grades
- Planning Guide for Science Instruction: assists educators in planning with high quality curriculum
- Louisiana Guide to Piloting inquiryHUB Biology: assists teachers with the implementation of high quality curriculum
- Louisiana Guide to Piloting OpenSciEd Biology: assists teachers with the implementation of high-quality curriculum

Contact the LDOE

- assessment@la.gov for assessment questions
- classroomsupporttoolbox@la.gov for curriculum and instruction questions
- AskLDOE for general questions
- ldoecommunications@la.gov to subscribe to newsletters; include the newsletter(s) you want to subscribe to in your email

Newsroom: archived copies of newsletters including LDOE Weekly School System Newsletters and Teacher Leader Newsletters

Updates Log

The table below lists any updates made to this document after the original posting date.

Available	Description of Updates
September 2024	Document original posting for 2024-2025

Email assessment@la.gov with any questions or comments about this assessment guide.