NJSLA-S

New Jersey Student Learning
Assessment for Science

Instructional Guide

Constructed Response Questions

Computer-Based & Paper-Based Testing
Science

STATE OF NEW JERSEY
DEPARTMENT OF EDUCATION

PTM #XXXXX

New Jersey Student Learning Assessment–Science
(NJSLA–S)
Grades 5, 8, 11

Instructional Guide
Constructed Response Questions

Angelica Allen-McMillan, Ed.D
Acting Commissioner of Education

Jorden Schiff, Ed.D.
Assistant Commissioner, Division of Teaching and Learning Services

John Boczany, Director
Office of Assessments

Office of Assessments
New Jersey Department of Education
PO Box 500
Trenton, New Jersey 08625-0500

State Board of Education

Kathy Goldenberg ..... Moorestown, Burlington County
President

Andrew J. Mulvihill..... Andover, Sussex County

Arcelio Aponte ..... Piscataway, Middlesex County

Mary Beth Berry.....Clinton, Hunterdon County

Elaine Bobrove ..... Westmont, Camden County

Fatimah Burnam-Watkins.....Linden, Union County

Ronald K. Butcher..... Glassboro, Gloucester County

Jack Fornaro..... Oxford, Warren County

Mary Elizabeth Gazi.....Bound Brook, Somerset County

Nedd James Johnson, Ed.D. .....Pittsgrove, Salem County

Joseph Ricca, Jr., Ed.D. .....Morristown, Morris County

Sylvia Sylvia-Cioffi..... Ocean Township, Monmouth County

Angelica Allen-McMillan, Acting Commissioner
Secretary, State Board of Education

Table of Contents

Overview of the New Jersey Student Learning Assessment–Science

In the Spring of 2019, New Jersey replaced the New Jersey Assessment of Skills and Knowledge (NJ ASK) with the New Jersey Student Learning Assessment–Science (NJSLA–S), one component of a larger system of state assessments. Along with other indicators of student progress, the results of these elementary, middle, and high school assessments are intended to provide meaningful information that complements the various measures of student performance used by districts. The main goal of the assessment is to determine the proficiency level of students in both the required knowledge of their grade band and their ability to utilize the science and engineering practices to explain appropriate phenomena.

Federal requirement through the Every Student Succeeds Act (ESSA) and New Jersey Administrative Code 6A:8–4.1 requires assessment in science at least once in elementary school (grades 3–5), middle school (grades 6–9), and high school (grades 10–12).

All New Jersey fifth-, eighth,- and eleventh-grade students took the NJSLA–S for the first time in April 2018. Since the NJSLA–S was a field test in 2018, the first operational assessment occurred in the spring of 2019.

NJSLA–Science and Constructed Response Questions

The main goal of the assessment is to determine the proficiency level of students in both the required knowledge of their grade band and their ability to utilize the science and engineering practices to explain appropriate phenomena. The NJSLA–S is not intended to be a formative indicator for the individual student—the focus is on overall proficiency.

The NJSLA–S consists of four units with two sections: machine scorable and performance based. Multiple-choice and technology-enhanced items (TEIs) are computer scored based on the answer key approved by the content committee.

The performance-based section contains a constructed-response item scored on a 0–4-point rubric. Students will type a response in a text box to answer the question or questions. Given the great variability in expected responses, these items are human scored. Each item includes an item-specific scoring rubric. All performance-based sections consist of between 2 and 4 TEIs and one constructed-response item. Each item is aligned to one (1) Disciplinary Core Idea (DCI), one (1) Science and Engineering Practice (SEP), and one (1) Crosscutting Concept (CCC).

The NJSLA–S consists of questions-related standards that are spread out over the grade band. It measures a student's ability to solve problems by applying science concepts. The Disciplinary Core Ideas of Earth and Space, Life, and Physical Science will be reported, as well as the Science and Engineering Practices of Investigating, Sensemaking, and Critiquing. Not all standards of a grade band will appear every year of the assessment, but all will be eligible to select from when developing the assessment. The NJSLA–S is not specifically designed to follow a single course but rather an entire grade band. Participation in the NJSLA–S is not determined by course enrollment, but instead by grade-level enrollment as shown previously.

Description of this Manual

This manual contains six constructed-response items, two from each tested grade (5, 8, 11). Three of the items were in the 2021 edition of this document, and three are appearing for the first time in this edition (identified with the word "New"). Included for each item are the question itself, an item-specific scoring guide, and three exemplar responses from each score point.

Samples are included for each score point (all of these items use a 4-point scale). The sample responses, which are grouped by score point, represent a range of approaches that a fifth-, eighth-, or eleventh-grade science student could take with this constructed-response item. Each response is annotated according to the criteria in the scoring guide for that item to indicate why the response received the score it did.

The responses selected to appear in this handbook were written by fifth-, eighth-, and eleventh-grade students. The responses appear as the students wrote them; no corrections have been made other than the deletion of specific names that may have appeared to identify the student or the student's school and district.

NJSLA–S Grade 5
Rubric/Sample Responses
Deer Antlers (New)

Scientists observe that some male deer in a habitat have large antlers while others have small antlers.

Figure 1 shows an adult male deer with horns, called antlers. Male deer grow and shed all of their antlers each year.

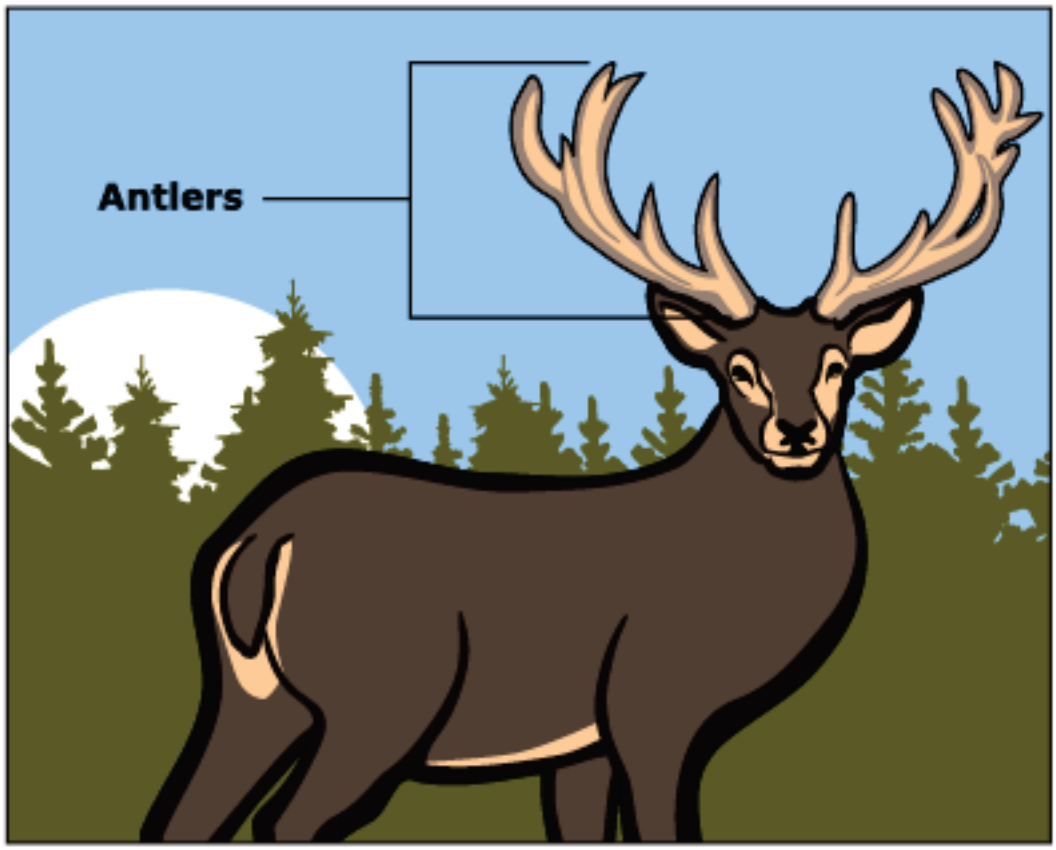


Figure 1. Male Deer with Antlers

Scientists studied populations of young male deer and their fathers in two forest sites. Table 1 gives information about each site, with data about its population of male deer from ages 2 to 4.

Table 1. Deer Data for Two Sites

Forest Site	Age of Deer (years)	Average Mass of Antlers (grams)	Average Mass of Deer (kilograms)
Forest A: Plenty of food and a wide variety of plants to eat	2	425	64
	3	700	79
	4	700	77
Forest B: Less food and limited variety of plants to eat	2	250	54
	3	600	68
	4	200	54

Table 2 shows data on selected groups of young males in Forest A with fathers that had either small or large antlers.

Table 2. Deer Groups in Forest A

Father	Age of Offspring Deer (years)	Average Mass of Offspring's Antlers (grams)
Small Antlers	2	400
	3	600
	4	650
Large Antlers	2	625
	3	1,150
	4	1,300

This item has two parts. First, answer Part A. Then answer Part B.

Part A

Based on Table 1, make a claim about whether diet affects the size of a deer's antlers.

Enter your answer in the box. Support your answer with evidence from the data.

Enter your response in your answer document. Support your answer with evidence from the data.

(Student response goes here)

Part B

Based on Table 2, make a claim about whether the age of the offspring deer affects the size of its antlers.

Enter your answer in the box. Support your answer with evidence from the data.

Enter your response in your answer document. Support your answer with evidence from the data.

(Student response goes here)

Content Alignment

Domain:
Life Science

SEP Reporting Category:
Critiquing

Phenomenon:
Scientists observe that some male deer in a habitat have large antlers while others have small antlers.

NJSLA Standard:

3-LS3 Heredity: Inheritance and Variation of Traits

3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment. [Clarification Statement: Examples of the environment affecting a trait could include that normally tall plants grown with insufficient water are stunted; and a pet dog that is given too much food and little exercise may become overweight.]

SEP (Science and Engineering Practices):

EAE Engaging in argument from evidence

DCI (Disciplinary Core Ideas):

LS3.A Inheritance of Traits

CCC (Crosscutting Concepts):

PAT Patterns

This item has 4 quality points:

- 1 point for making a valid claim about whether diet affects the size of a deer's antlers.
- 1 point for supporting the claim using data from Table 1.
- 1 point for making a valid claim about whether the age of the offspring deer affects the size of its antlers.
- 1 point for supporting the claim using data from Table 2.

Quality Points	Score
4	4
3	3
2	2
1	1
0	0

Student response #1:

Based on table 1, I can make a claim about how diet affects the size of a deer's antlers. Diet does affect the size of a deer's antlers. In table 1, Forest A, where plenty of food is provided, the deer's antlers weighed more. In Forest B, where less food was provided, the deer's antlers weighed less. This shows how the diet of a deer can affect the size and weight of their antlers.

By examining table 2, I can make a claim that the age of an offspring deer does affect the size of its antlers. I know that the age of the offspring can affect the size of its antlers because in table 2, when the deer was two, their antlers size was less than when they were three. When they were three, their antlers size was less than when they were four. This explains to me that the age of an offspring deer does affect the size of their antlers.

Score Points: 4

Scoring note:

The student provides a valid claim about whether diet affects the size of a deer's antlers and supports the claim using data from Table 1 [*Diet does affect the size of a deer's antlers. In table 1, Forest A, where plenty of food is provided, the deer's antlers weighed more. In Forest B, where less food was provided, the deer's antlers weighed less.*]. The student also provides a second claim about whether the age of the offspring affects the size of its antlers and supports the claim using data from Table 2 [. . . *the age of the offspring can affect the size of its antlers because in table 2, when the deer was two, their antlers size was less than when they were three. When they were three, their antlers size was less than when they were four.*].

Student response #2:

Yes, I think that the diet affects the antlers because in Table one in forest A the deer have bigger mass antlers then in forest B. And forest B does not have as much food as forest A.

Yes, I think that the age effects the size of the antlers because just like humans we grow as we age and same with the deer antlers. In table two it shows that the older the deer gets the more mass the antlers get.

Score Points: 4

Scoring note:

The student provides a valid claim about whether diet affects the size of a deer's antlers and supports the claim using data from Table 1 [*. . . the diet affects the antlers because in Table one in forest A the deer have bigger mass antlers then in forest B. And forest B does not have as much food as Forest A .*]. The student also provides a second claim about whether the age of the offspring affects the size of its antlers and supports the claim using data from Table 2 [*. . . the age effects the size of the antlers. In table two it shows that the older the deer gets the more mass the antlers get.].*

Student response #3:

I think that a diet of a deer affects how big there antlers are. For example in Forest A they have a wide variety of food to eat and their antlers are bigger than the deers antlers in Forest B. At every age the antlers are bigger in Forest A and they have a different diet then that in Forest B.

I think that the age of the offspring affects how big it's antlers are. For example all of antler sizes increase after they become a year older. So I do think that age affects the size of each antler.

Score Points: 4

Scoring note:

The student provides a valid claim about whether diet affects the size of a deer's antlers and supports the claim using data from Table 1 [*. . . diet of a deer affects how big there antlers are. For example in Forest A they have a wide variety of food to eat and their antlers are bigger than the deers antlers in Forest B. At every age the antlers are bigger in Forest A and they have a different diet then that in Forest B.*]. The student also provides a second claim about whether the age of the offspring affects the size of its antlers and supports the claim using data from Table 2 [*. . . the age of the offspring affects how big it's antlers are. For example all of antler sizes increase after they become a year older.*].

Student response #4:

it effects them because if they eat more there antlers would get heaver but if they eat less then there antlers would get lighter. so the deer's diet does effect how much the antlers weight.

the age does effect the size of the deer's antlers because if they are younger than they would not have time to grow there antlers yet so they would be small and if they were older then the deer's antlers would be bigger because the deer's had time to grow.

Score Points: 3

Scoring note:

The student provides a valid claim about whether diet affects the size of a deer's antlers but does not compare the food availability in the two locations [*so the deer's diet does effect how much the antlers weight.*]. The student also provides a second claim about whether the age of the offspring affects the size of its antlers and supports the claim using data from Table 2 [*the age does effect the size of the deer's antlers because if they are younger than they would not have time to grow there antlers yet so they would be small and if they were older then the deer's antlers would be bigger because the deer's had time to grow.].*

Student response #5:

The diet of a deer affects the size of its antlers because if a deer lived in a place with a lot of food it's antlers would be big but if a deer lives in a place where there is a little bit of food it's antlers would be small and decrease as it ages.

The age of the offspring affects the size of its antlers because if the father of the offspring has small antlers so will the offspring, but if the father has big antlers the son will have some too.

Score Points: 3

Scoring note:

The student provides a valid claim about whether diet affects the size of a deer's antlers and supports the claim using data from Table 1 [*The diet of a deer affects the size of its antlers because if a deer lived in a place with a lot of food it's antlers would be big but if a deer lives in a place where there is a little bit of food it's antlers would be small and decrease as it ages.*]. The student also provides a second claim about whether the age of the offspring affects the size of its antlers but does not provide correct support and instead describes how the size of the father's antlers would compare to its son's antlers and, therefore, the response receives no additional credit. [*the offspring affects the size of its antlers*].

Student response #6:

I think diets do affect the size of a deer's antlers because in Table 1 it shows in forest A that there is plenty offoof and a wide variety of plants to eat, and tthe deers are 2,3,4 years old and already have a huge mass of antlers! Those deers are eating thanksgiving! But in forest B there is less food and limited variety of plants to eat and when the deer are atleast 2 years old there eating decently, 3 years old it increases which is good, but when they turn 4 years old they are practicly starving! I mean their antlers only increase the size at the age of 3! When they are 2 and 4 years old it drops!

I think the age of the deer do affect the size of its antlers because in forest B the only age when the deer eat alot iis the age of 3 thats when their antlers start increasing but at the ages 2 and 4 their antlers sizes aren't as big as when they were 3 years old! In forest A since there is plenty of food when there 2 years old they have about the size of the antlers when they were 3 in forest B.

Score Points: 3

Scoring note:

The student provides a valid claim about whether diet affects the size of a deer's antlers and supports the claim using data from Table 1 [*I think diets do affect the size of a deer's antlers because in Table 1 it shows in forest A that there is plenty offoof and a wide variety of plants to eat, and tthe deers . . . have a huge mass of antlers! . . . But in forest B there is less food and limited variety of plants to eat. . . . I mean their antlers only increase the size at the age of 3!*]. The student also provides a second claim about whether the age of the offspring affects the size of its antlers but does not provide correct support and instead continues to describe the differences in Forest A and Forest B and, therefore, receives no credit [*I think the age of the deer do affect the size of its antlers*].

Student response #7:

1. diet does effect the size of the deer antlers.

the higher the age the biger the antlers.

Score Points: 2

Scoring note:

The student provides a valid claim about whether diet affects the size of a deer's antlers but does not provide any support [*diet does effect the size of the deer antlers.*]. The student also provides a second claim about whether the age of the offspring affects the size of its antlers but does not provide any support [*the higher the age the biger the antlers.*] and, therefore, receives no additional credit.

Student response #8:

The diet does effect the size of the deer's antlers. I know this because in figure 1, forest A it says "Plenty of food and a wide variety of plants to eat," and from 2 to 4 those deer's antlers weigh more than forest B, which says " Less food limited variety of pant's to eat." For example the antlers of deer at age four in forest A is 700 grams. Rather in forest B the antlers of deer weigh 200 grams. This is do to the diet of the deer.

I don't think the age of the offspring deer have to do with the effect of the antler size. I don't think this becasue the diet of the deer have to with the weight and the size not the age. In the Large antlers section the it goes up 150 and in the small antlers section it goes up only 50. This is why I think the age of the offspring deer has nothing to do with the size of it's antlers.

Score Points: 2

Scoring note:

The student provides a valid claim about whether diet affects the size of a deer's antlers and supports the claim using data from Table 1 [*The diet does effect the size of the deer's antlers. I know this because in figure 1, forest A it says "Plenty of food and a wide variety of plants to eat," and . . . those deer's antlers weigh more than forest B, which says "Less food limited variety of pant's to eat."*]. Even though the student also compares the mass of the antlers at age 4 in Forest A [*700 grams*] to Forest B [*200 grams*], the response does not receive any additional credit. The student also provides a second claim about whether the age of the offspring affects the size of its antlers; however, it was incorrect [*I don't think the age of the offspring deer have to do with the effect of the antler size.*]. The explanation is also incorrect and, therefore, the response does not receive any additional credit.

Student response #9:

I don't think a diet would affect the mass of a deer's antlers. I think this because when you're on a diet you lose weight. Antlers don't have meat in them and they can't decrease they're mass because of a diet. If the mass of the deer is 64 and the mass of the antlers are 700 and you grow up some weight, the deer's antlers will probably have the same mass. So, I think a diet won't help.

The age of the offspring deer does affect the size of it's antler's. When a deer grows age it grow bigger and so does the antlers. As age can increase so can the mass of a deer's antlers. When deer's grow up they obviously put up more weight. This weight can also transform into giving some growth for the deer's antlers too. So yes, I do think the offspring deer's antler's do grow by age.

Score Points: 2

Scoring note:

The student does not provide a valid claim about whether diet affects the size of a deer's antlers [*I don't think a diet would affect the mass of a deer's antlers.*]. The student provides an accurate claim about whether the age of the offspring affects the size of its antlers and supports the claim using data from Table 2 [*The age of the offspring deer does affect the size of it's antler's. When a deer grows age it grow bigger and so does the antlers.*].

Student response #10:

The dear that are heavier have greater sized antlers.

When you're older your antlers are bigger.

Score Points: 1

Scoring note:

The student does not provide a valid claim about whether diet affects the size of a deer's antlers [*The dear that are heavier have greater sized antlers.*]. The student provides an accurate claim about whether the age of the offspring affects the size of its antlers but does not provide any support for the claim [*When you're older your antlers are bigger.*].

Student response #11:

Yes it will efect the size of a deers antlers because if you are a person and you have a diet, you need to keep yourself healthy, that is why you have a diet. So why would a deer die t affect then in any sort of way.

I do not think that it would affect the offspring deers antlers because if you look at the large antlers they are really big, so I just think if you are a offspring deer you just need to have large antlers to have heavy antlers.

Score Points: 1

Scoring note:

The student provides a valid claim about whether diet affects the size of a deer's antlers; however, even though support for the claim is provided, it shows a misunderstanding of the word "diet" and, therefore, does not receive any additional credit [Yes *it will efect the size of a deers antlers*]. The student also provides a second claim about whether the age of the offspring affects the size of its antlers; however, it and the support provided are both incorrect [*I do not think that it would affect the offspring deers antlers*].

Student response #12:

The diet does not effect it because the difference of 10 pounds in the deer is equal to 175 pound difference at age two for both forests. But in age 4 the 500 pound difference in the antlers only transfers to 23 pounds. Also in age 2 and 4 of forest B the antlers are different but the deers are the same.

The older the deer gets the larger the antlers become. Although I think it would eventually stop.

Score Points: 1

Scoring note:

The student does not provide a valid claim about whether diet affects the size of a deer's antlers and does not provide any correct information from Table 1 [*The diet does not effect it*]. The student provides an accurate claim about whether the age of the offspring affects the size of its antlers but does not provide any support for the claim [*The older the deer gets the larger the antlers become.*].

Student response #13:

Male dear have different systems in which they eat more to get there antlers heavier.

In table 2 it has the same information but the information wriiten in table 2 is cut out in a different way.

Score Points: 0

Scoring note:

The student attempts to provide a claim for whether diet affects the size of a deer's antlers, but it is incorrect [*Male deer have different systems in which they eat more to get there antlers heavier.*]. The claim provided for Table 2 is an inappropriate table reference and thus no credit is given.

Student response #14:

Diet does not effect the deer antlers because there diet helps them have healthy antlers when they grow up the weather does not effect them at all it helps them grow.

It does not because when they are little dear they grow up and as they are growing up there antlers get bigger and bigger so it does not affect the baby deer.

Score Points: 0

Scoring note:

The student provides two inaccurate claims for both tables [*Diet does not effect the deer antlers. . . . so it does not affect the baby deer.*]. Therefore, no credit is given.

Student response #15:

At ages 2,3,4 the biger the antler gets and it decreases by kilograms and once it grows all up it will start to shed its antlers.

By adults in grams there antlers start to shed and it would be easeir to catch prey with bigger and obnoxius antlers.

Score Points: 0

Scoring note:

Although the student attempts to provide two claims, neither is correct nor is any accurate support given. Instead, the response describes deer shedding their antlers.

NJSLA–S Grade 5
Rubric/Sample Responses
Chameleons

Some animals have a very long, sticky tongue.

Scientists conduct an investigation of the chameleon and the beetles shown in the video.

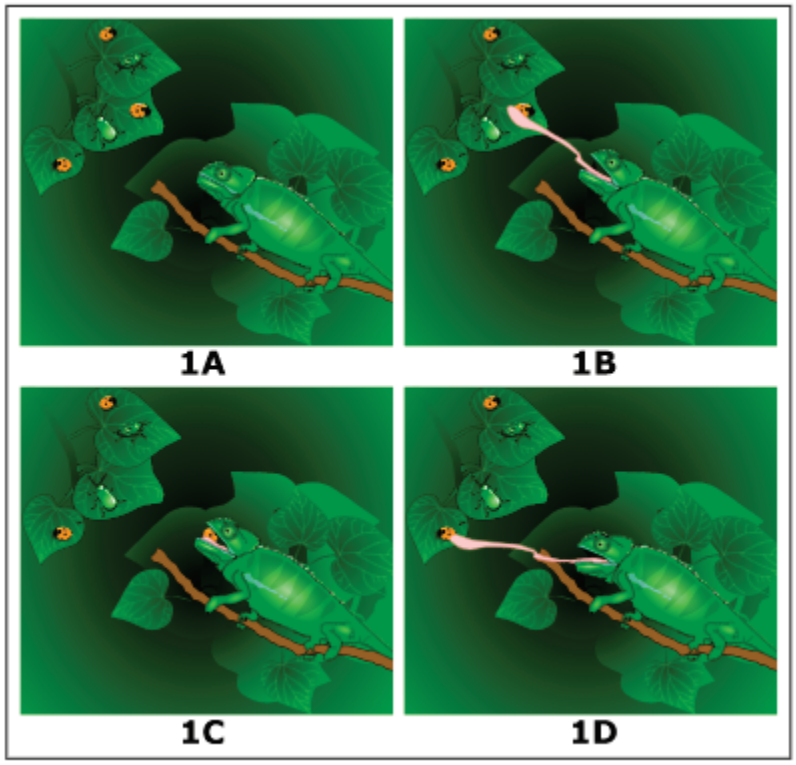


Figure 1. Chameleon Eating Beetles

Based on the video, describe **four** ways that external or internal parts of the chameleon help it survive.

Enter your answer in the box. Support your answer with information from the video.

(Student response goes here)

Note: Students who answered this item online were able to watch a video. Figure 1 was used by students who took the pencil-paper test.

Content alignment

Domain:
Life Science

SEP Reporting Category:
Sensemaking

Phenomenon:
Some animals have a very long, sticky tongue.

NJSLA Standard:

4-LS1 From Molecules to Organisms: Structures and Processes

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]

SEP (Science and Engineering Practices):

CEDS Constructing explanations (for science) and designing solutions (for engineering)

DCI (Disciplinary Core Ideas):

LS1.A Structure and Function

CCC (Crosscutting Concepts):

SF Structure and Function

This item has 4 quality points:

- 1 point for each of four ways that the external or internal parts of the chameleon help it to survive.

Quality Points	Score
4	4
3	3
2	2
1	1
0	0

Student response #1:

Four ways that the external or internal parts of a chameleon survive are **Number 1:** a chameleons long toung helps it reach food that is longer away and the stickiness helps it hold the bugs so they won't fly away. **Number 2;** a chameleons skin helps it camouflage and blend in into it's surroundings so it won't get eaten. **Number 3:** A Chameleons eyes help it see it's prey and help it see the predators around it. **Number 4:** A chameleons arms and legs and help it grab on to a branch and help the chameleon not fall off of the branch. One more fact about a chameleon is that it's tail helps it grab on to things and it also helps the chameleon balance on a small tree branch, a large tree branch. Or it helps it balance climbing up a very tall large tree, or a very tall small tree. Those are four ways that the external parts or the internal parts help a chameleon survive in the wild.

Score Points: 4

Scoring note:

The student correctly describes more than four ways that the parts of the chameleon help it survive [*long tongue helps it reach food, sticky tongue helps it hold bugs, skin helps it camouflage so it won't get eaten, eyes help it see its predators and prey, arms and legs help it grab onto a branch so it doesn't fall off, tail helps it balance*]. Note that any four of these answers would have been sufficient for full credit.

Student response #2:

The four ways that the external or internal part of the chameleon help it survive. In the video the chameleon was green it blended in with its surroundings and the bug didn't notice it. And the chameleon had both of it's eyes moving so it could see if anything was behind him like a predator. Next it has a very sticky tongue to grapple on to prey and fling them to it. Finally in the video I saw it's claws were round and i believe that is so that it can hold on to branches easier.

Score Points: 4

Scoring note:

The student correctly describes four ways that the parts of the chameleon help it survive [*the chameleon can blend into its surroundings, its eyes can see predators, and its sticky tongue grabs prey and its claws hold on to branches*] Note that "blending in" or "camouflage" refers to the chameleon's skin.

Student response #3:

The tounge is fast enough to catch food. It is long enough to to reach its food. It is sticky so he can grab it. He can change colors to blend in

Score Points: 4

Scoring note:

The student correctly describes four ways that the parts of the chameleon help it survive [*Its fast, long, sticky tongue helps it to catch food and it can change colors to blend in*]. Note that each attribute of the chameleon's tongue (fast, long, sticky) was counted as a separate way that the tongue helps the chameleon to catch food and survive.

Student response #4:

External:
What makes a chameleon survive externally is that it has a very long tongue that helps it catch prey that is far away or fast. Another external thing that chameleons have is a sticky tongue that helps when catching prey. Their tongue tongue reaches out and since it is so sticky it grabs on and holds tight to the bug it wants to eat.

Internal:
Chameleons have internal ways that help them survive. For instance, they have a very quick tongue that can reach out faster than a bug can get away so that their long and sticky tongue can grab it and eat it.

Score Points: 3

Scoring note:

The student has correctly described three ways that the parts of the chameleon help it survive [*its long, sticky, quick tongue helps to catch prey*]. Note that each attribute of the chameleon's tongue (long, sticky, quick) was counted as a separate way that the tongue helps the chameleon to catch food and survive. The student repeats the same ideas in both their external and internal sections and thus receives no additional credit.

Student response #5:

Its tongue helps it survive so it could like catch insects that are farther away. It uses its camafloge to hide from preditors or sneak up on its prey. It uses its feet to climb on trees and small branches. It also uses its tongue as a defence mechanisom to scar the enemy.

Score Points: 3

Scoring note:

The student has correctly described three ways that the parts of the chameleon help it survive [*the tongue helps it catch prey and the camouflage helps it hide from both predators and prey*]. Note that hiding from predators and hiding from prey were counted as separate ways the chameleon's skin helps it survive. Climbing was not considered necessary for survival. The tongue was not considered to be a defense mechanism.

Student response #6:

Four ways external and internal parts help the chameleon survive are the tongue, eyes, skin, habitat. It's tongue helps it get bugs farther away and its big eyes make it easier to see. The skin can make it so other animals can't see it. Depending on the area the chameleon lives in getting food can be easy or hard. These are four things externally and internally that help the chameleons survive in this certain environment.

Score Points: 3

Scoring note:

The student correctly describes three ways that the parts of the chameleon help it survive [*the tongue helps it to catch bugs, its eyes help it see and the skin helps it blend in so it cannot be seen*]. The habitat is not a part of the chameleon.

Student response #7:

The first way that chameleon use they ex and interial parts is they neck. Before they cach anytheing they use they neck to point what they catching. the also use they eye to see were they will be pointing or were what they willbe eating

Score Points: 2

Scoring note:

The student correctly describes two ways that the parts of the chameleon help it survive [*the neck points the head towards prey and the eyes see their food*].

Student response #8:

The parts of a chameleon that help it survive are its tongue,and his body wich is camoflouge. There tongue helps them so they can catch prey And food for there family. And there camoflouge body to hide from predetors. Other ways are the way chameleons look predetors might be scared. Also, there tongue is really fast.There body is also very long.

Score Points: 2

Scoring note:

The student correctly describes two ways that the parts of the chameleon help it survive [*the fast tongue helps it catch prey and its camouflage helps it hide from predators*]. The chameleon's body being long does not explain how that helps it survive.

Student response #9:

about the chameleon

the camouflage

your big tongue

were he live

you eyes that see around

Score Points: 2

Scoring note:

The student correctly describes two ways that the parts of the chameleon help it survive [*its camouflage and its eyes help it see*]. Note that "camouflage" can be considered both the part of the chameleon (the skin) and the way it helps it survive (blend in).

Student response #10:

A chameleon has many parts of its body that shall help survive and longer lifetime. One is its sticky tongue. They use their tongue the catch their prey. This is a main priotiry.

Score Points: 1

Scoring note:

The student correctly describes one way that the parts of the chameleon help it survive [*the sticky tongue helps it catch prey*].

Student response #11:

The first way is to have the chameleon somewhere where there is a lot bugs that the chameleon likes to eat. The second way is to keep the chameleon somewhere there are no predators that will eat the chemeleon or the chameleon can just go somewhere that there is green so the chameleon can match with it. The third way is to stay up high so no predators come and eat the chameleon. The fourth way is to

Score Points: 1

Scoring note:

The student correctly describes one way that the parts of the chameleon help it survive [matching with green]. Matching was considered camouflage. There were no other ways that parts of the chameleon help it to survive.

Student response #12:

internal

strong

- sticky
- long
- small

external

- chamafluge
- long toung
- green
- small

Score Points: 1

Scoring note:

The student correctly describes one way that the parts of the chameleon help it survive [*camouflage*]. Recall that camouflage counts both as a part of the chameleon and the way it helps it survive.

Student response #13:

The 4 ways of the extaral parts. the first way is theat the it is green secound is big third long toung and can climp trees those are the four parts of a chameleon

Score Points: 0

Scoring note:

The student fails to describe any ways that the parts of the chameleon help it survive. While the student mentions the chameleon's long tongue, there is no explanation of how it helps the chameleon survive.

Student response #14:

BY eating and living out in the wild.

Score Points: 0

Scoring note:

The student fails to describe any ways that the parts of the chameleon help it survive. There are no parts of the chameleon listed.

Student response #15:

The chameleon will survive by eating bugs. It will also survive by sleeping. Also by using the big tongue because it can chase people and catch up to people or animals easily. They will be resting by searching around and going to places.

Score Points: 0

Scoring note:

The student fails to describe any ways that the parts of the chameleon help it survive. While the student mentions the chameleon's "big tongue," there is no explanation of how it helps the chameleon survive.

NJSLA–S Grade 8
Rubric/Sample Responses
Air Rockets (New)

Students investigate the forces that affect the maximum height of a toy rocket. An air rocket uses compressed air that is stored in the tank. The force in the air pressure from the compressed air causes the rocket to be propelled upward. Figure 1 shows a typical air rocket.

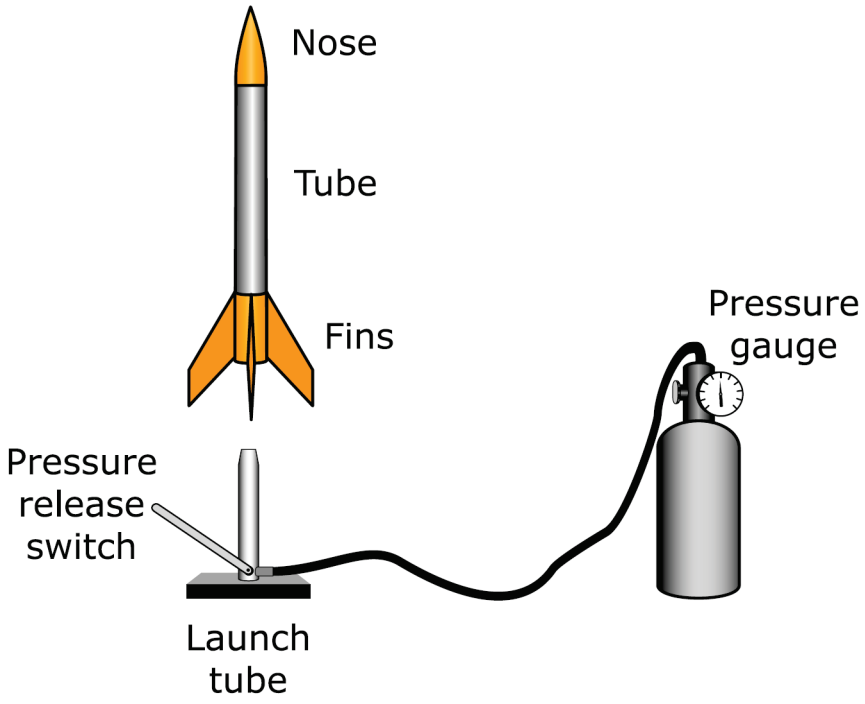


Figure 1. Air Rocket

The gauge is used to measure the pressure of the air, in pounds per square inch (psi) that will provide the force used to propel the rocket. The rocket is launched by pressing the pressure release switch. Figure 2 shows the path of the rocket after launching.

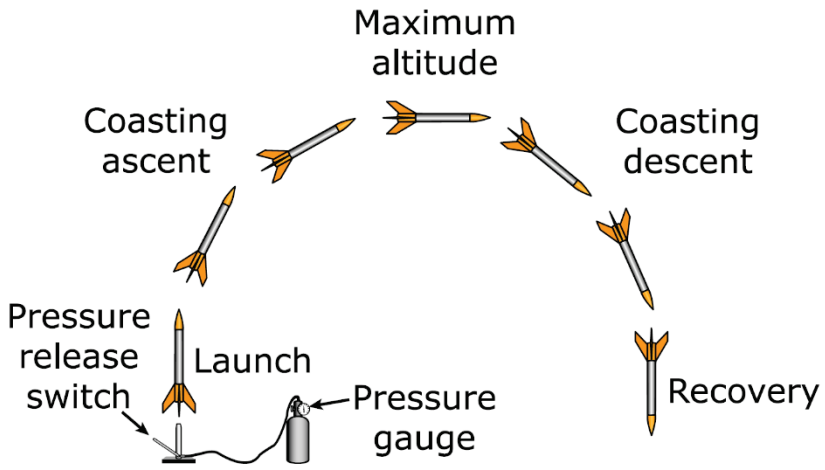


Figure 2. Launched Air Rocket Path

An air rocket was launched with a force provided by a different air pressure for each trial to launch a 57-gram rocket. The environmental conditions on the day of the investigation were: sunny, no precipitation, with a slight wind. Table 1 shows the data.

Table 1. Air Rocket Data

Trial	Air Pressure (psi)	Maximum Altitude (m)	Average Speed (m/s)	Flight Time (s)
1	50	74.6	23.5	4.3
2	70	114.8	29.1	5.4
3	90	150.9	33.4	6.1
4	110	182.5	36.7	6.8
5	130	210.3	39.4	7.3

A second investigation was performed with a water rocket instead of an air rocket. The environmental conditions were the same as the air rocket investigation.

Water rockets are set up the same way as air rockets, except that a soda bottle is attached to the bottom half of the rocket and filled with a different amount of water for each trial. The rocket has a mass of 57 grams before the water is added. Figure 3 shows a typical water rocket setup.

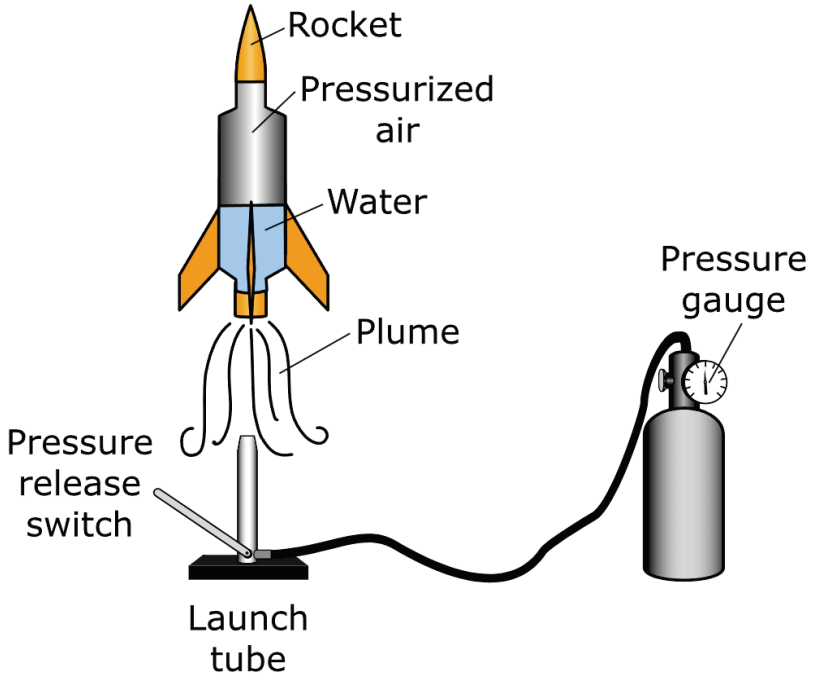


Figure 3. Water Rocket

A pressure of 140 psi was used to launch the water rocket and its path was observed. The plume shown in Figure 3 is water expelled from the rocket. Table 2 contains the data from the investigation.

Table 2. Water Rocket Investigation Data

Trial	Volume of Water (liters)	Maximum Altitude (m)	Average Speed (m/s)	Flight Time (s)
1	0.3	244.0	43.0	7.8
2	0.6	266.0	44.0	8.1
3	0.9	287.0	46.0	8.5
4	1.2	197.0	38.0	7.0
5	1.5	111.0	29.0	5.0
6	1.8	46.0	18.0	3.4

Examine the air rocket in Figure 2 and the data in Table 1.

- Describe the forces acting on the air rocket that cause it to reach its maximum altitude.
- Explain why the maximum altitudes and flight-time values increased from Trial 1 to Trial 5.

Enter your answer in the box. Support your answer with details from the data.

(Student response goes here)

Examine the air rocket in Figure 2 and the data in Table 1.

- Describe the relationship between the time it takes the rocket to reach its maximum altitude and the rocket's flight time.

Enter your answer in the box. Support your answer with details from the data.

(Student response goes here)

Examine the air rocket in Figure 2 and the data in Table 1.

A 77-gram air rocket was launched on the same day as the 57-gram air rocket using the same air pressures. The two air rockets had the same overall shape and design.

- Describe how the maximum altitude, average speed, and flight times would change for the 77-gram rocket.
- Explain why these changes would occur.

Enter your answer in the box. Support your answer with details from the data.

(Student response goes here)

Content Alignment

Domain:
Physical Science

SEP Reporting Category:
Sensemaking

Phenomenon:
Students investigate the forces that affect the maximum height of a toy rocket.

NJSLA Standard:

MS-PS2 Motion and Stability: Forces and Interactions

MS-PS2-2 Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.]

SEP (Science and Engineering Practices):

CEDS Constructing explanations (for science) and designing solutions (for engineering)

DCI (Disciplinary Core Ideas):

PS2.A Forces and Motion

CCC (Crosscutting Concepts):

C and E Cause and Effect: Mechanism and explanation

This item has 4 quality points:

- 1 point for describing the forces acting on the air rocket that cause it to reach its maximum altitude.
- 1 point for explaining why the maximum altitudes and flight times increased from Trial 1 to Trial 5.
- 1 point for describing the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data.
- 1 point for describing why the maximum altitude, average speed, and flight times would change for the 77-gram rocket.

Quality Points	Score
4	4
3	3
2	2
1	1
0	0

Student response #1:

The forces acting on the air rocket that cause it to reach its maximum altitude are air pressure (from compressed air that is released), gravity, and air resistance. The maximum altitudes and flight-time values increased from Trial 1 to Trial 5 because the amount of air pressure inside the rocket increased from Trial 1 to Trial 5, meaning that the rocket in Trial 5 had more force propelling it upwards that the rocket in Trial 1. Since there was more and more force applied, the maximum altitudes and flight-time values increased from Trial 1 to Trial 5.

The time it takes for a certain rocket to reach its maximum altitude is half of that same rocket's flight time. I have come to this conclusion because Figure 2 shows the same amount of rockets on the ascent and descent. As well, Table 1 shows that, as the maximum altitude of a rocket increases, its flight time also increases. From this information, I have deduced that the time it takes to reach the maximum altitude must be half of the total flight time (the flight time increases as the maximum altitude of a rocket increases).

The maximum altitude, average speed, and flight times would all be less for the 77-gram rocket than the 57-gram rocket. This is so because since there is more weight on the 77-gram rocket than the 57-gram one, the force of gravity increases on the 77-gram rocket. As shown in Table 2, since there is more water (and more weight) in the rocket from Trial 6, its maximum altitude, average speed, and flight times are all less from Trial 1, where there was less water and weight. This difference in the force of gravity causes the values for maximum altitude, average speed, and flight time to decrease (there is a stronger force of gravity pulling the 77-gram rocket to Earth than the force of gravity pulling the 57-gram one down to Earth).

Score Points: 4

Student response #1 (continued):

Scoring note:

The student correctly describes the forces acting on the air rocket that cause it to reach its maximum altitude [*air pressure (from compressed air that is released), gravity*]. The student explains why the maximum altitudes and flight times increased from Trial 1 to Trial 5 [*the amount of air pressure inside the rocket increased from Trial 1 to Trial 5*]. The student describes the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data [*The time it takes for a certain rocket to reach its maximum altitude is half of that same rocket's flight time . . . as the maximum altitude of a rocket increases, its flight time also increases*]. Note that the student can state that as the maximum altitude of the rocket increases, its flight time also increases or that the time it takes for a rocket to reach its maximum altitude is half that of the rocket's total flight time to receive credit. No additional points are given for providing both. The student describes why the maximum altitude, average speed, and flight times would change for the 77-gram rocket [*The maximum altitude, average speed, and flight times would all be less for the 77 -gram rocket than the 57-gram rocket. This is so because since there is more weight on the 77-gram rocket than the 57-gram one.*].

Student response #2:

The force needed to cause the rocket to reach its maximum flight altitude is psi, or pressure. The pressure is the only force that is propelling the rocket upward as gravity pushes it downward. As the pressure was increased, the maximum altitude was increased as it did from trials one to five. This happens because there is more force propelling the rocket up.

The maximum altitude isnt the full flight time because as shown in figure 2, the rocket has an arc. that arc adds more flight time so the time it takes the rocket to reach its maximum altitude is only part of the time.

Well the 77-gram rocket would have less speed, maximum altitude, and flight time because of its weight. this is true because in order for it to fly, it woould require more energy to push it up compared to the 57-gram rocket. The maximum altitude, flight time and average speed would be less because of the weight of the rocket. It would need more force and it would fall quicker.

Score Points: 4

Scoring note:

The student correctly describes the forces acting on the air rocket that cause it to reach its maximum altitude [*The pressure is the only force that is propelling the rocket upward as gravity pushes it downward.*]. The student explains why the maximum altitudes and flight times increased from Trial 1 to Trial 5 [*As the pressure was increased, the maximum altitude was increased*]. The student describes the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data [*the time it takes the rocket to reach its maximum altitude is only part of the time.*] The student describes why the maximum altitude, average speed, and flight times would change for the 77-gram rocket [*the 77-gram rocket would have less speed, maximum altitude and flight time because of its weight*].

Student response #3:

The forces acting on the air rocket that caused it to reach its max altitude is air pressure and gravity. The air pressure determines how high it can go. While the gravitational pull determines how long it has to reach and maintain max altitude. The flight times and max altitudes increased over Trials 1-5 because the air pressure was increasing.

The time the rocket takes to reach max height is only half of the rocket's flight time.

The 77 gram air rocket would not go as high, fast, or stay in the air for as long as the 57 gram rocket. This is because as the rockets get heavier, the more air pressure is needed to make the rocket go. If they are using the same air pressure, obviously the lighter one overall will be better.

Score Points: 4

Scoring note:

The student correctly describes the forces acting on the air rocket that cause it to reach its maximum altitude [*air pressure and gravity*]. The student explains why the maximum altitudes and flight times increased from Trial 1 to Trial 5 [*the air pressure was increasing*]. The student describes the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data [*The time the rocket takes to reach max height is only half of the rocket's flight time.*]. The student describes why the maximum altitude, average speed, and flight times would change for the 77-gram rocket [*The 77 gram air rocket would not go as high, fast, or stay in the air for as long as the 57 gram rocket. This is because as the rocket gets heavier, the more air pressure is needed to make the rocket go.*].

Student response #4:

The Forces acting on the air rocket are gravity potential energy and kinetic energy. Kinetic energy acts when the rocket first acends, slowly turning to potential energy as the rocket reaches its maximum altitude. This potential energy is than turned back to kinetic energy on the decent down where gravity acts on it until the rocket is on the ground again. The factor that made Flight time and altitude increase over the 5 trials was the air preasure (psi) because the more preasure was stored the more potential energy there was to turn to kinetic energy.

The amount of time it takes a rocket to reach its maximum altitude is always half of the total flight time. This is because the potential energy that exists when the rocket peaks will always be that of the kinetic energy it had climbing up. As Newton said “For every action, an equal and opposite reaction”.

The 77 gram air rocket is simply heavier, thus it would take more force to push it off the ground, this could easily be met but it would still not go as far with the same air preasure because of the

Score Points: 3

Scoring note:

The student correctly describes the forces acting on the air rocket that cause it to reach its maximum altitude [*gravity . . . air pressure (psi)*]. The student explains why the maximum altitudes and flight times increased from Trial 1 to Trial 5 [*the more pressure was stored the more potential energy there was to turn to kinetic energy*]. The student describes the relationship between the time it takes a rocket to reach its maximum altitude and the rocket’s flight time with details from the data [*the amount of time it takes a rocket to reach its maximum altitude is always half of the total flight time*]. The student does not sufficiently describe why the maximum altitude, average speed, and flight times would change for the 77-gram rocket. The student simply states that it is heavier so it will not go as far but does not describe how the weight impacts the average speed or the flight time.

Student response #5:

The forces acting on the rocket that caused it o reach maximum altitude is air pressure which is what caused the rocket to go flying in the first place. They increased because the air pressure was steadily increasing the whole time.

It will take about half or more of the time since when gravity starts to pull it is a quick descend. The flight time will most likely split close to evenly since it will be hard for the rocket to fight against gravity while it is going upward.

The changes would be, it wouldn't go as high as the 57-gram rocket. Since it weighs more it will descend faster and also won't go as high. That would result in a lower average speed, and flight times would be less.

Score Points: 3

Scoring note:

The student correctly describes the forces acting on the air rocket that cause it to reach its maximum altitude [*air pressure . . . gravity starts to pull it (box 2)*]. The student explains why the maximum altitudes and flight times increased from Trial 1 to Trial 5 [*the air pressure was steadily increasing the whole time*]. The student does not sufficiently describe the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data. The student gives a range for the amount of time for the rocket to reach its maximum altitude by saying that it would take about half or more, instead of saying that it is half of the flight time. The student describes why the maximum altitude, average speed, and flight times would change for the 77-gram rocket [*it wouldn't go as high . . . since it weighs more . . . lower average speed, and flight times would be less*].

Student response #6:

The forces that caused the rocket to reach it's maximum altitude is most likely the air pressure, the average speed, and the design of the rocket. In the data, it is shown that the greater the air pressure and average speed causes the maximum altitude to go higher.

The relationship with the filght time for the rocket to reach it's maximum altitude is when the flight time is longer, it shows that it is flying higher because it takes longer to fall. The data shows that the longer it takes to fall, the higher the maximum altitude is.

The overall added mass with the 77-gram rocket would have a high chance of decreasing the height of the maximum altitude, speed, and flight times since the mass will weigh down the rocket.

Score Points: 3

Scoring note:

The student does not sufficiently describe the forces acting on the air rocket that cause it to reach its maximum altitude. The student identifies air pressure but does not identify gravity. The student explains why the maximum altitudes and flight times increased from Trial 1 to Trial 5 [*the greater the air pressure . . . causes the maximum altitude to go higher.*]. The student describes the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data [*when the flight time is longer, it shows that it is flying higher*]. The student describes why the maximum altitude, average speed, and flight times would change for the 77-gram rocket [*The overall added mass with the 77-gram rocket would have a high chance of decreasing the height of the maximum altitude, speed, and flight times since the mass will weigh down the rocket.*].

Student response #7:

The maximum altitudes and flight- time values increase from trial 1 to trial 5 because the air pressure is higher causing their to be more force acting against the rocket. For example in table 1 trail 1 the air pressure is 50 psi and the flight time is 4.3 seconds, but on the other hand trial 5 has the aire pressure of 130 psi and the flight time of 7.3 seconds. So it really is a matter of the forces acting for and against the rocket. There really is only one force acting for the rocket and that is air or gas. The air or gas moves the rocket along while gravity and wind push it back.

The time it takes the rocket to reach its maximum altitude is about 4.3 seconds when the air pressure is 50 psi. For each trial the flight time goes up about .7 seconds while the air pressure is increased by 20 psi. If the maximum altitude is 114.8 and you divide that by the flight time of 5.4 you should get the average speed.

If a 77-gram air rocket was launched on the same day as the 57-gram air rocket using the same pressure everything would be increased. The reason all of these increases would occur is the fact that the air rocket is heavier. The more mass something has the harder it is to move. The 57-gram air rocket would be easier to get from point a to point b faster than 77-gram air rocket.

Score Points: 2

Scoring note:

The student correctly describes the forces acting on the air rocket that cause it to reach its maximum altitude [*air or gas moves the rocket along while gravity*]. The student explains why the maximum altitudes and flight times increased from Trial 1 to Trial 5 [*the air pressure is higher*]. The student does not describe the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data. The student instead discusses average speed. The student does not sufficiently describe why the maximum altitude, average speed, and flight times would change for the 77-gram rocket. The student says that the change is because of the rocket's weight, but incorrectly identifies the change as increased.

Student response #8:

The forces acting on the air rocket causes it to reach it's maximum altitude because the air forces and the other forces are pushing the rocket upward. Depending on how weak or strong the force is the rocket will go higher or lower. As the psi gets higher so does the maximum altitude. This is because as the psi gets higher it makes the maximum altitude go higher because there is more pressure to push the rocket.

The relationship between the time of rockets flight time and the maximum altitude have a similar relationship. They have a similar relationship because the maximum altitude is almost like the half way point of the rockets flight time. The maximum altitude is only half of the flight time.

The maximum altitude, average speed, and flight times would be much longer for the 77-gram rocket because it is heavier. The lighter the rocket is the higher and faster it will go. If your rocket is really light then the average speed, maximum altitude, and flight times will be much faster than the heavier.

Score Points: 2

Scoring note:

The student does not sufficiently describe the forces acting on the air rocket that cause it to reach its maximum altitude. The student identifies air pressure but does not identify gravity. The student explains why the maximum altitudes and flight times increased from Trial 1 to Trial 5 [*As the psi gets higher it makes the maximum altitude go higher because there is more pressure to push the rocket*]. The student describes the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data [*The maximum altitude is almost like the halfway point of the rocket's flight time. The maximum altitude is only half of the flight time*]. The student does not sufficiently describe why the maximum altitude, average speed, and flight times would change for the 77-gram rocket. The student says that the change is because of the rocket's weight but states that the maximum altitude, average speed, and flight times would both increase and decrease for the heavier rocket.

Student response #9:

The forces acting on the air rocket are the pressure coming from the pressure gauge and is released from the release switch. The flight time evalues increased because there was more air pressure from trial 1 to trial 5.

The flight time increases as it reaches a greater maximum altitude.

The time decreases as the grams decrease because of the increase in the pressure.

Score Points: 2

Scoring note:

The student does not sufficiently describe the forces acting on the air rocket that cause it to reach its maximum altitude. The student identifies air pressure but does not identify gravity. The student explains why the maximum altitudes and flight times increased from Trial 1 to Trial 5 [*more air pressure*]. The student describes the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data [*The flight time increases as it reaches a greater maximum altitude*]. The student does not sufficiently describe why the maximum altitude, average speed, and flight times would change for the 77-gram rocket. The student indicates that the rocket's weight is a factor but only discusses the time and states the incorrect change.

Student response #10:

The forces are just gravity and a concentrated blast of air. it is in Newton's laws where it says forces must have an equal reaction.

At the rockets max height it started falling because the gravity wouldn't allow it to go any higher.

the 77 gram rocket wouldnt go as high if it had the same air pressure.

Score Points: 1

Scoring note:

The student correctly describes the forces acting on the air rocket that cause it to reach its maximum altitude [*Gravity and a concentrated blast of air*]. The student does not explain why the maximum altitudes and flight times increased from Trial 1 to Trial 5. The student only discusses forces in the first box. The student does not describe the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data. The student instead discusses the path the rocket takes. The student does not sufficiently describe why the maximum altitude, average speed, and flight times would change for the 77-gram rocket. The student says that the 77-gram rocket would not go as high but does not explain why and does not discuss average speed or flight times.

Student response #11:

the main forces that where acting up on the rocket where air pressuer and gravity they both where pulling the rocket down to the ground and the air pressuer wasnt enought to make it havea higher altitude.the maximum altitudes and air pressure went up from trials 1 and 5 because they increased the amount of air pressure used.

the difference in flight time and the time it takes to reach the maximum altituded isnt that great of a difference the air pressure is being relased in that time propelling the rocket up into the sky.Then it eventually reaches its max hight then falls to the ground.

they would change because the mass of the rocket has changed so it needs more air pressure to launch it up into the sky but once it gets this ar pressure then it will go much higher and have a greater max hight then the 55 gram rocket.

Score Points: 1

Scoring note:

The student does not sufficiently describe the forces acting on the air rocket that cause it to reach its maximum altitude. The student identifies both air pressure and gravity but says that both of these forces pull the rocket down instead of air pressure pushing the rocket up. The student explains why the maximum altitudes and flight times increased from Trial 1 to Trial 5 [*. . . they increased the amount of air pressure used*]. The student does not describe the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data. The student instead discusses the path the rocket takes. The student does not sufficiently describe why the maximum altitude, average speed, and flight times would change for the 77-gram rocket. The student says that the change is because of the rocket's weight, but incorrectly states that the maximum altitude would increase for the heavier rocket.

Student response #12:

the fores acting on the rocket that cause it to reach its maximum altitude are the shape of the rocket and the weight disrobution. On the top of the rocket there is the nose which has a cane shape, this allows it to split the air and travel furthur and faster. The tube allows the pressure to build in inside of it and when it is released all of the air pressure is released and pushes the rocket up. The fins allow the rocket to break the air like the nose does which is why it is on a curve.

the time it takes the rocket to reach its maximum altitude is very short and quick because the force of the pressured air pushes the rocket up at a high speed but when that pressured air is gone it falls to the ground a lot slower than when it went up.

becuase the 77 gram rocet is heavier it would take more force to bring the rocket up to speed that the 57 gram rocket would, but since the air presure is the same the hight, average speed, flight time would all be decreased. Also becuase the 77 gram rocket is heavier it would fall faster.

Score Points: 1

Scoring note:

The student does not sufficiently describe the forces acting on the air rocket that cause it to reach its maximum altitude. The student identifies that air pressure pushes the rocket up but does not identify gravity. The student does not explain why the maximum altitudes and flight times increased from Trial 1 to Trial 5. The student only discusses air pressure pushing the rocket up and the rocket's attributes in the first box. The student does not describe the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data. The student incorrectly describes that the rocket will take less time to reach its maximum height than it does to come back down. The student describes why the maximum altitude, average speed, and flight times would change for the 77-gram rocket [*because the 77 gram rocket is heavier . . . the height, average speed, flight time would all be decreased.*].

Student response #13:

The force in air rocket will increased in trail 1 to 5 because its keep going up and not going down so the rocket will get more speed and more air.

In figure 2 the air rocket takes about 244.0 altitude to reach its full hight and its speed will go 43.0 and the time is 7.8

the 77 gram and the 57 gram will change in time beacuse the 77 gram is higer and the 57 gram is lower and so on the rocket will get more speed than the other rocket.

Score Points: 0

Scoring note:

The student does not describe the forces acting on the air rocket that cause it to reach its maximum altitude. The student only states that forces cause the change in the trials but does not discuss what the forces are. The student does not sufficiently explain why the maximum altitudes and flight times increased from Trial 1 to Trial 5. The student states that the increase is caused by forces but does not identify the force of air pressure. The student does not describe the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data. The student instead estimates Table 1 values for a rocket launched with an air pressure higher than 130 psi. The student does not sufficiently describe why the maximum altitude, average speed, and flight times would change for the 77-gram rocket. The student says that the change is because of the rocket's weight but incorrectly states that the speed would increase for the heavier rocket.

Student response #14:

The rocket cannot reach its max altitude because as the rocket rises the pressure increases causing it to slow down before it reach it destined height.

it takes the rocket 7.3 seconds to reach its estamated max altitude, but the flight time for a regular test launch is 4.3 seconds, although it didnt reach max altitude it is still very impressive.

the 77-gram rocket would be the one to go highest because as it gets so much momentum from the launch that it allows the rockets weight to continuously propell the rocket up.

Score Points: 0

Scoring note:

The student does not describe the forces acting on the air rocket that cause it to reach its maximum altitude. The student incorrectly states that increased air pressure slows the rocket and does not discuss gravity. The student does not explain why the maximum altitudes and flight times increased from Trial 1 to Trial 5. The student only explains why the rocket does not reach its maximum height in box 1, which is not the question. The student does not describe the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data. The student instead discusses the amount of time the rocket takes to reach its maximum altitude. The student does not sufficiently describe why the maximum altitude, average speed, and flight times would change for the 77-gram rocket. The student incorrectly states that the 77-gram rocket would go higher.

Student response #15:

figure two shows that once the rocket went up it came down almost immediately.

the data table says basically everything the same as the figure two rocket, figure two shows that once the rocket went up it came down almost immediately.

the 57 gram air rocket took five trials to get an air pressure of 130, maximum altitude of 210.3, average speed of 39.4, and 7.3 seconds of flight time.

Score Points: 0

Scoring note:

The student does not describe the forces acting on the air rocket that cause it to reach its maximum altitude or explain why the maximum altitudes and flight times increased from Trial 1 to Trial 5. The student only discusses the path of the rocket in box 1. The student does not describe the relationship between the time it takes a rocket to reach its maximum altitude and the rocket's flight time with details from the data. The student instead discusses how Table 1 mimics Figure 2. The student does not describe why the maximum altitude, average speed, and flight times would change for the 77-gram rocket. The student instead discusses values from Trial 5.

NJSLA–S Grade 8
Rubric/Sample Responses
Sports Energy

A group of students is studying energy and motion in a science class. The students decide to use sports as the basis for their studies. To begin, the students find the masses of objects thrown in a variety of sports. Next, one of the students threw each type of ball. The other students measured the height at which each ball was released. Then they calculated potential energy for each ball at the moment it was released.

Table 1 lists the masses of the sports equipment and the results of the student investigation.

Table 1. Potential Energy versus Mass and Height

Object	Mass (kg)	Height (m)	Potential Energy (J)
Baseball	0.15	1.61	2.37
Softball	0.22	1.67	3.60
Football	0.40	1.63	6.39
Javelin	0.80	?	?
Discus	2.0	?	?
Shot put	7.2	?	?

Next, the students locate data about the relationship between mass, speed, and kinetic energy. Table 2 shows these data.

Table 2. Kinetic Energy versus Mass and Speed

Mass (kg)	Speed (m/s)	Kinetic Energy (J)
10	2	20
10	4	80
10	6	180
20	2	40
20	4	160
20	6	360
30	2	60
30	4	240

To show the relationship between kinetic energy and potential energy, students create a model of a baseball being thrown (Figure 1).

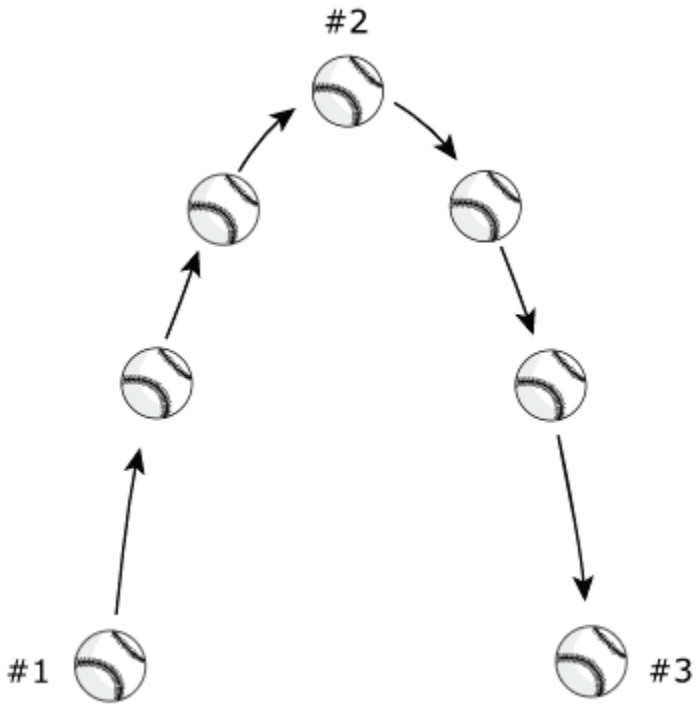


Figure 1. Baseball in Motion

A group of students creates a model that illustrates the potential energy in a system. Examine Figures 3 and 4, which show a shot put and a javelin being thrown.

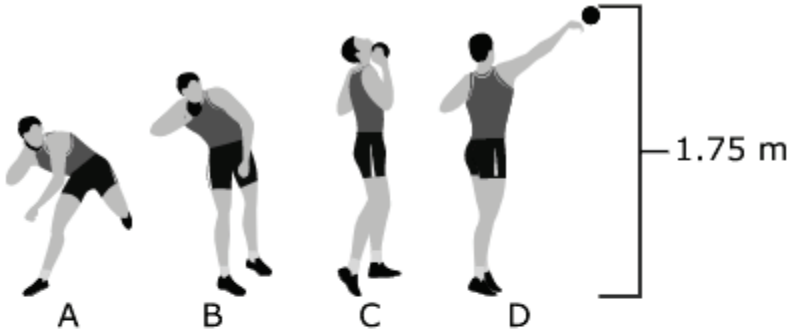


Figure 3. Shot Put

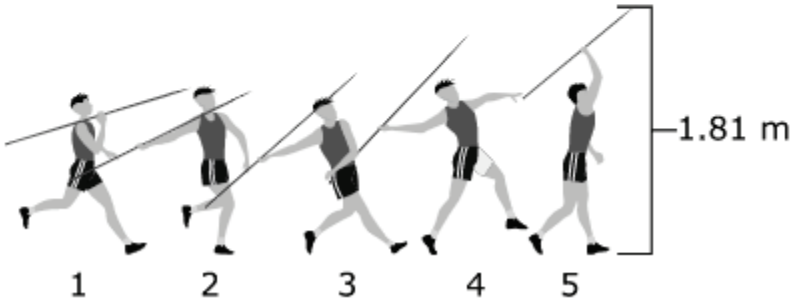


Figure 4. Javelin

Using the data from Table 1, determine what proportional relationship exists between mass and potential energy, as well as the proportional relationship between height and potential energy. Apply these relationships to predict which object — the shot put or the javelin — would have more potential energy. Then explain your prediction.

Enter your answer in the box. Support your answer with information from the data.

(Student response goes here)

Content Alignment

Domain:
Physical Science

SEP Reporting Category:
Investigating

Phenomenon:
Potential energy is a result of an object's mass as well as its height above Earth.

NJSLA Standard:

MS-PS3 Energy

MS-PS3-2 Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]

SEP (Science and Engineering Practices):

UMCT Using mathematics and computational thinking

DCI (Disciplinary Core Ideas):

PS3.A Definitions of Energy

CCC (Crosscutting Concepts):

S, P, and **Q** Scale, proportion, and quantity

This item has 4 quality points:

- 1 point for explaining that potential energy is directly proportional to mass
- 1 point for explaining that potential energy is directly proportional to height
- 1 point for recognizing that the shot put has the greatest potential energy.
- 1 point for explaining that the significant difference in mass is the determining factor in the comparison.

Quality Points	Score
4	4
3	3
2	2
1	1
0	0

Student response #1:

The larger the mass, the higher the potential energy. The higher the height, the higher the potential energy. Based on these relationships, the shot put would have more potential energy than the javelin, despite the javelin having a higher height. The javelin's mass is 0.8kg, while the shot put's is 7.2kg. The shot put weighs 6.4 kg more than the javelin, and the javelin is only thrown 0.06m heigher than the shot put. Therefore, the shot put has more potential energy.

Score Points: 4

Scoring note:

The student correctly explains that potential energy is directly proportional to mass [*The larger the mass, the higher the potential energy*] as well as to height [*The higher the height, the higher the potential energy*]. The student recognizes that the shot put has the greater potential energy [*the shot put would have more potential energy*] and explains that the significant difference in mass is the determining factor [*The shot put weighs 6.4 kg more*].

Student response #2:

If the mass of an object is greater, it will have a greater amount of potential energy as see in Table l. As the mass increases the potential energy it will have increases too. the height of the object differs, the baseball has a smallest height so the potential energy it has is the smallest too. Although the softball has a greater height, it's potential energy is not the greatest because of it's mass being average. The height of the football is not the greatest but since it has the greatest mass, it has the greatest amount of potential energy. The shot put would have a greater amount of potential energy than the javelin beacause a shot put has more mass than the javelin does which would cause it to have more potential energy.

Score Points: 4

Scoring note:

The student correctly explains that potential energy is directly proportional to mass [*As the mass increases the potential energy it will have increases*] as well as to height [*smallest height so the potential energy it has is the smallest*]. The student recognizes that the shot put has the greater potential energy [*the shot put would have a greater amount of potential energy*] and explains that the significant difference in mass is the determining factor [*a shot put has more mass than a javelin does*].

Student response #3:

The proportional relation between the mass and PE was that the heavier the object is the more PE the object stored before releasing. With height and PE, the realtionship is that when the object reached its maxium height it stored the most PE or that is the highset amount of potential energy. Javiln has little mass so little PE shot is the opposite.

Score Points: 4

Scoring note:

The student correctly explains that potential energy is directly proportional to mass [*the heavier the object is the more PE the object stored*] as well as to height [*its maximum height stored the most PE*]. The student recognizes that the shot put has the greater potential energy [*Javelin has little PE*] and explains that the significant difference in mass is the determining factor [*Javelin has little mass*]. Note that the student can state that the shot put has more PE/mass or that the javelin has less PE/mass to receive credit.

Student response #4:

Different relationships between potential energy change the amount of potential energy. In Table l, it shows that the more mass an object has, the more potential energy it will supply. In Figures 3 and 4, it shows that the height of object will affect how long the object remains in the air. Based on this information, it can be said that the shot put will have more potential energy. This can be said because the mass of the object is 7 times the weight of a javelin stick and since the mass is greater, the shot put will last longer in the air. Although, the height is a tad bit shorter than the javelin stick the object used for shot put will have the most potential energy.

Score Points: 3

Scoring note:

The student correctly explains that potential energy is directly proportional to mass [*the more mass an object has, the more potential energy*] but not to height. The student recognizes that the shot put has the greater potential energy [*the shot put will have more potential energy*] and explains that the significant difference in mass is the determining factor [*the mass of the object is 7 times the weight of a javelin*].

Student response #5:

The proportional relationship between mass and potential energy is that potential energy increases as mass increases. The proportional relationship between height and potential energy is that potential energy increases as height increases.

The shot put would have more potential energy because the shot put has a greater mass and reaches a greater height. As mentioned in the proportional relationships for mass and height compared to Potential Energy, the higher the mass/height, the greater the potential energy.

Score Points: 3

Scoring note:

The student correctly explains that potential energy is directly proportional to mass [*potential energy increases as mass increases*] as well as to height [*potential energy increases as height increases*]. The student recognizes that the shot put has the greater potential energy [*The shot put would have more potential energy*] but does not sufficiently explain that the significant difference in mass is the determining factor. The student attributes the shot put's higher potential energy to its greater mass and height. While the shot put does have a greater mass than the javelin, it does not reach a greater height.

Student response #6:

The more mass an object has, the greater it's potential energy due to gravity. Sijnce the Shot put has a similiar height to the Javelin, but a greater mass, the potential energy is going to be greater with the Shot put.

Score Points: 3

Scoring note:

The student correctly explains that potential energy is directly proportional to mass [*The more mass an object has, the greater its potential energy*] but not to height. The student recognizes that the shot put has the greater potential energy [*the potential energy is going to be greater with the Shot put*] and explains that the significant difference in mass is the determining factor [*the Shot put has a similar height to the Javelin, but a greater mass*].

Student response #7:

The javelin would have less potential energy because the mass is less than the shot put. 1.2 kg less than the shot. In the table the baeball had less mass than the football and the football had more potential energy. The height of the throw does not matter as much to find the potential energy but the javelin has more height than the shotput.

Score Points: 2

Scoring note:

The student does not explain that potential energy is directly proportional to mass or height. The student recognizes that the shot put has the greater potential energy [*The javelin would have less potential energy*] and explains that the significant difference in mass is the determining factor [*the mass is less than the shot put*]. Note that the student can state that the shot put has more PE/mass or that the javelin has less PE/mass to receive credit.

Student response #8:

Mass has a huge impact on potential energy. If it is a larger mass, it is more likely to have less potential energy. The higher the height, the more the potential energy. I believe that the shotput would have more potential energy, since it can reach a higher height which would have a lot of potential energy. Also, shotput has less of a mass than javelin so it would be more likely to have more potential energy.

Score Points: 2

Scoring note:

The student correctly explains that potential energy is directly proportional to height [*The higher the height, the more the potential energy*] but not to mass. The student incorrectly states that a larger mass would have less potential energy. The student recognizes that the shot put has the greater potential energy [*the shotput would have more potential energy*] but does not explain that the significant difference in mass is the determining factor. The student incorrectly states that the shot put has less mass than the javelin.

Student response #9:

The more mass an object has, it seems as if it will end up having more potential energy. The more height an object has, the more potential energy it will have because the higher it gets the more potent

Score Points: 2

Scoring note:

The student correctly explains that potential energy is directly proportional to mass [*The more mass an object has … more potential energy*] as well as to height [*The more height an object has, the more potential energy*]. The student does not recognize that the shot put has the greater potential energy or explain that the significant difference in mass is the determining factor.

Student response #10:

The proportional relationship between mass and potential energy is that the more mass an object has, the harder it will be to make the object go high enough and gain GPE. If the object is heavier, it will be more dificult for someone to put enough force to make it go up. Also, the height affects the potential energy because the higher it is, the more potential energy it has. I belive the Javelin would have the most potential energy because on the chart it says that it has less mass than the Shot Put and went higher.

Score Points: 1

Scoring note:

The student correctly explains that potential energy is directly proportional to height [*the higher it is, the more potential energy it has*] but not to mass. The student incorrectly states that the javelin has the most potential energy because it has less mass.

Student response #11:

The proportional relationship that already exists is between mass and potential energy is that the more mass it has the more potential energy it has. It does not go up the same amount each time though. The relationship between height and potential energy is that it goes up six and down four each time. The object that could have more potential energy is the football because it had the biggest number when calculated.

Score Points: 1

Scoring note:

The student correctly explains that potential energy is directly proportional to mass [*the more mass it has the more potential energy it has*] but not to height. The student incorrectly states that the football has more potential energy and thus does not address the question.

Student response #12:

In the shot put A would have more potential energy because he brung it back so far. For the Javelin 3 Would give the pole the most potential energy because the farther you bring it back the more potential energy it will have.

Score Points: 1

Scoring note:

The student does not explain that potential energy is directly proportional to mass or height. The student recognizes that the shot put has the greater potential energy [*the shot put A would have more potential energy*] but does not explain that the significant difference in mass is the determining factor.

Student response #13:

This relationship is not proportional. I believe that the Javelin has more potential energy. According to the pictures the javelin is being thrown farther by.6 m.

Score Points: 0

Scoring note:

The student neither explains that potential energy is directly proportional to mass nor height. The student incorrectly states that the javelin has more potential energy because it is thrown further.

Student response #14:

The javelin will go father because its light and long and easier to throw.and since its smaller it has higher potential energy.The shot put dose have potential energy comming down as the javelin has little potential energy.

Score Points: 0

Scoring note:

The student neither explains that potential energy is directly proportional to mass nor height. The student incorrectly states that the javelin has higher potential energy but also states that the javelin has little potential energy.

Student response #15:

The javelin would have more energy because it has more mass than the shot put

Score Points: 0

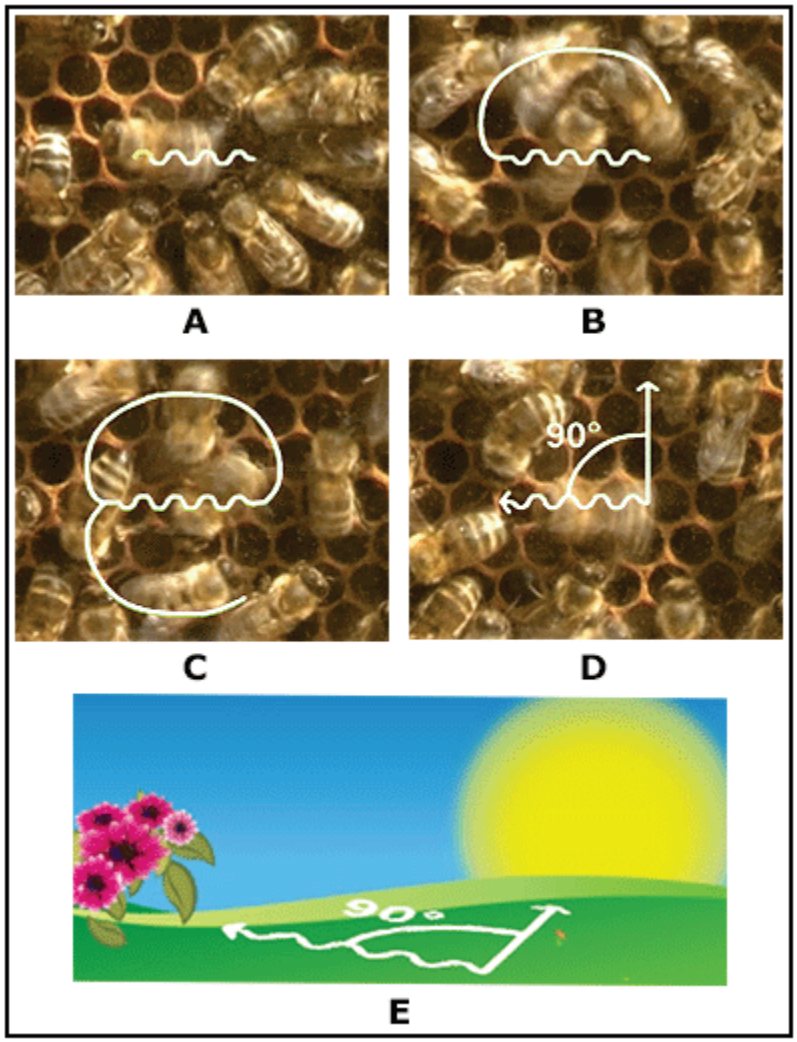
Scoring note:

The student neither explains that potential energy is directly proportional to mass nor height. The student incorrectly states that the javelin has more energy because it has more mass.

NJSLA–S Grade 11
Rubric/Sample Responses
Bee Waggle Dance (New)

Sometimes when honey bees return from gathering food, they do a waggle dance.

The image below shows a bee performing a waggle dance for other bees.



Bee Waggle Dance

Note: Students who tested online were able to access a video about bee waggle dancing.

Two colonies from each of the two sites were studied to determine why bee waggle dancing evolved.

Scientists observed the behavior in the beehives during several events when waggle dancing was displayed in the colony, both without human interference and with human interference. This was done to determine if waggle dancing evolved to help bees gather food.

A claim and two predictions to explain waggle dancing behavior are shown in Table 1.

Table 1. Waggle Dance Claim and Predictions

Claim	Bee waggle dancing evolved because it helps bee colonies gather food sources more efficiently.
Prediction 1	Bee colonies will find and use the same food sources more often when there is no interference in waggle dancing compared to when there is interference.
Prediction 2	Bee colonies will produce more honey when there is no interference with waggle dancing compared to when there is interference.

A description of each study site is shown in Table 2.

Table 2. Description of Waggle Dance Study Sites

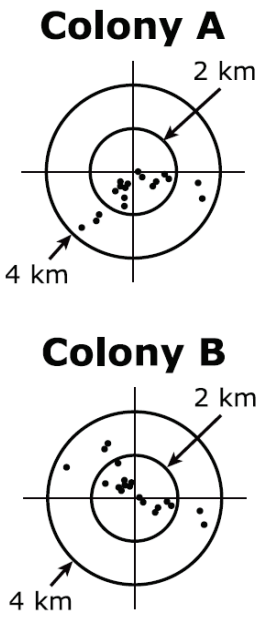
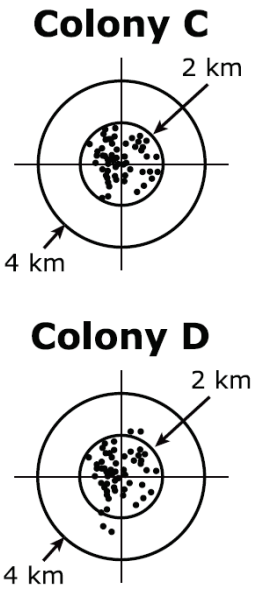
Site Information	Site 1	Site 2
Habitat	Forest	Meadow
Average proportion of energy in food sources	0.54	.012
Average days food sources are available	2	14
Location of food sources around observed beehives		

Figure 1 shows how often bees in each colony found and reused the same food sources based on whether waggle dancing was interfered with or not.

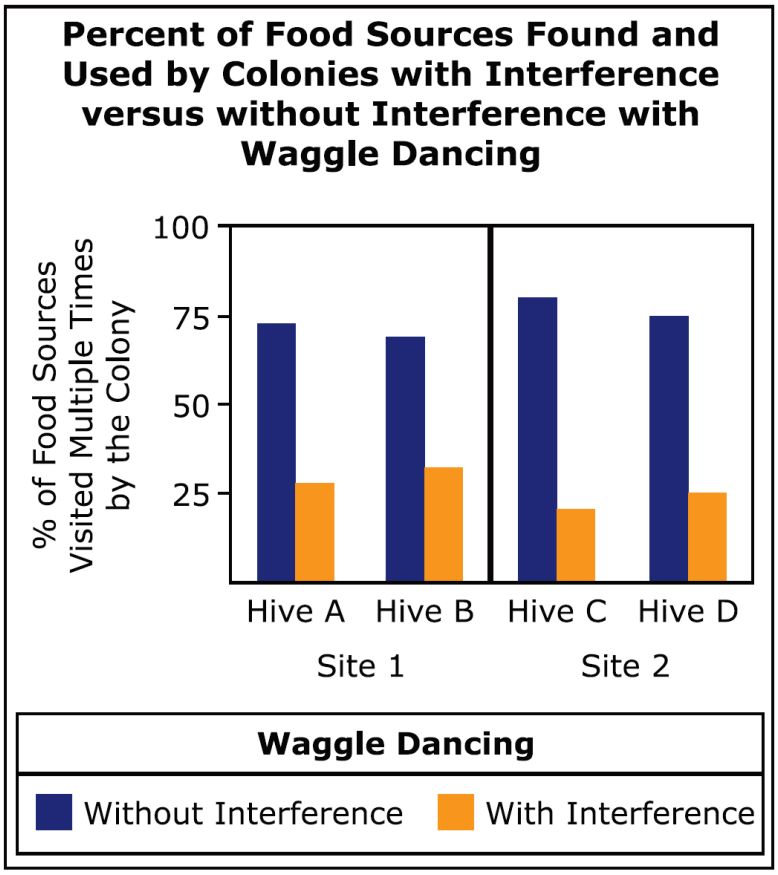


Figure 1.

Figure 2 shows percentages of days that the total amount of honey in the beehives increased or decreased, based on whether waggle dancing was interfered with or not.

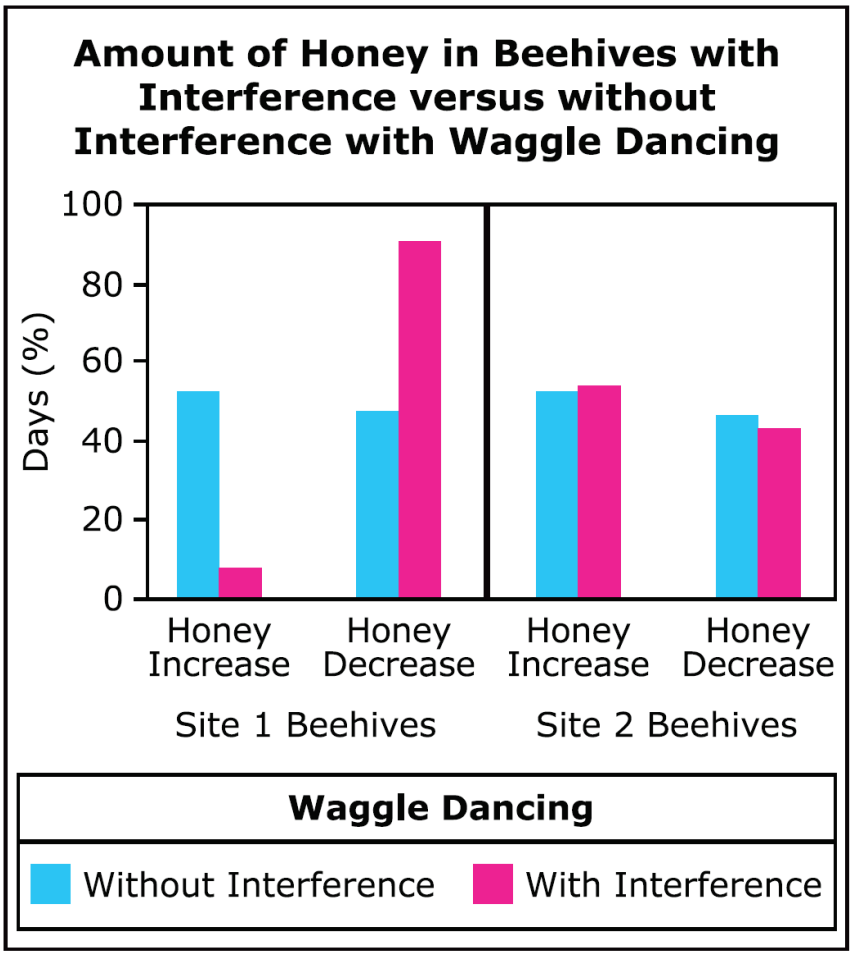


Figure 2.

The environment may or may not impact the effectiveness of bee waggle dancing.

Based on Figure 1 and Figure 2, describe whether the claim in Table 1 is fully, partially, or not supported.

Enter your answer in the box. Support your answer with evidence from Figure 1 and Figure 2.

(Student response goes here)

Based on Table 2, Figure 1, and Figure 2, describe whether or not the environment impacts the effectiveness of waggle dancing.

Enter your answer in the box. Support your answer with evidence from Table 2, Figure 1, and Figure 2.

(Student response goes here)

Content Alignment

Domain:
Life Science

SEP Reporting Category:
Sensemaking

Phenomenon:
Sometimes when honey bees return from gathering food, they do a waggle dance.

NJSLA Standard:
HS-LS2/IRE Interdependent Relationships in Ecosystems

HS-LS2-8 Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. [Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.]

SEP (Science and Engineering Practices):

CEDS Constructing explanations (for science) and designing solutions (for engineering)

DCI (Disciplinary Core Ideas):

LS2.D Social Interactions and Group Behavior

CCC (Crosscutting Concepts):

S & SM Systems and System Models

This item has 4 quality points:

- 1 point for describing whether the claim in Table 1 is fully, partially, or not supported.
- 1 point for supporting the answer with evidence from Figure 1 and Figure 2.
- 1 point for describing whether or not the environment impacts the effectiveness of waggle dancing.
- 1 point for supporting the answer with evidence from Table 2 and Figure 2.

Quality Points	Score
4	4
3	3
2	2
1	1
0	0

Student response #1:

The claim presented in Table 1 is partially supported by the information in Figures 1 and 2. Figure 1 shows how having no anthropogenic interference in the waggle dancing can increase the percentage of frequent food source visits as opposed to interference. This directly supported the claim because it showed that carrying out the dance had a noticable impact on the food source dependance. However, the entire Figure 2 does not completely support this narrative. In site 1, there was a much higher number of days the honey amount decreased when the dance was not interfered with, and a much higher number of days the honey amount *decreased* when the waggle dance was interrupted. In site 2, there was actually a higher increase of days when the honey increased when the dance was interfered with, and a higher decrease of days when the dance was not interfered with. This means that the claim was supportive of most of the data, but there is enough evidence to say that the claim cannot be generalized.

For the most part, it is evident that the environment does have an impact on waggle dancing. Even though site 2 has more food sources that site 1 (Table 2), there is a higher visitation of the same ones when there was no interference in the dancing. Additionally, the same situation was consistent for site 1. In Figure 2, there is a noticable disparity in the difference between the increases when there was no interruptions versus when there was. However, one fallback of this is that site 2 presented less honey increase without interruptions. It is unclear as to what this was caused by.

Score Points: 4

Student response #1 (continued):

Scoring note:

The student correctly indicates that the claim in Table 1 is *partially supported* and supported that answer with evidence from Figure 1 and Figure 2 [*Figure 1 shows how no interference in waggle dancing can increase the percentage of frequent food source visits as opposed to no interference. Figure 2 does not completely support this narrative. In site 1 there was a much higher number of days the honey amount decreased when the dance was not interfered with, and a much higher number of days the honey amount decreased when waggle dancing was interrupted. In site 2 there was actually a higher increase of days when the honey increased when the dance was interfered with, and a higher decrease of days when the dance was not interfered with.*] The student also correctly describes whether the environment impacts the effectiveness of waggle dancing and supports that answer with evidence from Table 2, Figure 1, and Figure 2 [*The environment does have an impact on waggle dancing. Even though site 2 has more food sources than site 1 (Table 2), there is higher visitation of the same ones when there was no interference with dancing. In Figure 2 there is a noticeable disparity in the difference between the increases when there were no interruptions versus when there were interruptions.*]

Student response #2:

The claim in table one is that when waggle dancing is done, the bees are able to collect food more efficiently. This is true because in figure 1, the bees who suffered no interference in their dance repeatedly visited the same food sources, which means they know where to get their food from. Also, in site 1 in figure 2, the bees without interference say a greater increase in honey while the ones with interference saw a decrease in honey.

Environment does affect waggle dancing because in site 2, where the location of food sources is more closer together, the waggle dancing does not hinder their ability to get food, which is seen in figure 2. In figure 2, it is seen that site 2, which has more food sources closer to them gets equal amounts of honey, when interfered with or not. However in site 1 that is not the case because their food sources are further. Clearly, the environment controls their ability to get food, and the effectiveness of wiggle dancing.

Score Points: 4

Scoring note:

The student correctly indicates that the claim in Table 1 is *true* and supports that answer with evidence from Figure 1 and Figure 2 [*Figure 1 shows that when there was no interference, the bees repeatedly visited the same food sources. At site 1 in Figure 2, the bees without interference saw a greater increase in honey whereas the ones with interference saw a decrease.*] The student also correctly describes whether the environment impacts the effectiveness of waggle dancing and supports that answer with evidence from Table 2, Figure 1, and Figure 2 [*Environment does affect waggle dancing. At site 2 in Figure 2, the food sources are closer together and dancing did not hinder their ability to get food. This is not the case at site 1 where their food sources are farther apart.*]

Student response #3:

The claim in Table 1 is partially supported because the bees are able to find more food sources without interuption in both sites (figure 1) but in site 2 there was more honey produced with interference than without (figure 2). That means that the first prediction is true but the second one is only true for one site.

Environment has a heavy impact on the effectiveness of the waggle dancing because if the environment has fewer days and less locations to find food (table 2) it will still be able to find food (figure 1) but would require no interaction at all (figure 2). But if there were more days and a higher saturation of locations (table 2) it wouldnt matter if they were interupted to produce honey (figure 2).

Score Points: 4

Scoring note:

The student correctly indicates that the claim in Table 1 is *partially supported* and supports that answer with evidence from Figure 1 and Figure 2 [*Figure 1 show that the bees were able to find more food sources without interruption at both sites*, but there was more honey produced at site 2 with interference than without interference.] The student also correctly describes whether the environment impacts the effectiveness of waggle dancing and supports that answer with evidence from Table 2, Figure 1, and Figure 2 [*Environment has a heavy impact on the effectiveness of waggle dancing. Figure 2 shows that bees at site 1 were able to find food even though availability was limited, and at site 2 the availability of food was greater therefore it doesn't matter if waggle dancing is interfered with or not (Table 2).*]

Student response #4:

The claim in table one is only partially supported. For figure 1, all 4 hive sites show a higher percent of food sources being revisited multiple times when there was no interference of waggle dancing. This evidence supports the claim that waggle dancing evolved because it helps bee colonies gather food sources more efficiently. In figure 2, while honey increased without interference at a higher percentage in site 1, it increased at a higher percentage with interference in site 2. Therefore, the claim can only be partially supported.

The environment definitely impacts the effectiveness of waggle dancing. In table 2, the habitat of the bee had an effect on the amount of energy in food sources, the average time the food sources were available for, and the density if food sources based on location. These differences in habitat can effect the amount of food sources available, and how much honey could be found in beehives, according to figures 1 and 2.

Score Points: 3

Scoring note:

The student correctly indicates that the claim in Table 1 is *only partially supported* and supports that answer with evidence from Figure 1 and Figure 2 [*For Figure 1, all 4 sites show a higher percent of food sources being revisited multiple times when there was no interference. In Figure 2, while honey increased without interference at a higher percentage in site 1, it increased at a higher percentage with interference in site 2.*] The student also correctly describes whether the environment impacts the effectiveness of waggle dancing [*The environment definitely impacts the effectiveness of waggle dancing.*] but misinterprets the data to address the habitat's impact on the amount of energy in food sources and the amount of food sources available, as opposed to how the data support the impact of the environment on the effectiveness of waggle dancing.

Student response #5:

The claim in table 1 is partially supported as Site 1 Beehives in Figure 2 represent how there was a longer percentage of days that there was a honey decrease after the waggle dancing was interfered with. However, table 1 was completely unsupported by Site 2 Beehives as all of their numbers remained relatively the same.

The environment greatly impacts the effectiveness of waggle dancing because hives with several food sources nearby are still more likely to find an adequate amount of food with or without the waggle dancing. Most of site 2's food sources were densely packed within a 2 kilometer radius which was represented by their lack of versatility in Figure 2. Conversely, site 1 has scarcely populated food sources within a 4 mile radius, making it diffiult for them to find food and rely more on thier waggle dancing. For that reason, the interruption of their waggle dancing led to a significant decrease in honey for the Site 1 Bees.

Score Points: 3

Scoring note:

The student correctly indicates that the claim in Table 1 is *partially supported* but fails to provide sufficient evidence, addressing data from Figure 2 and not Figure 1. The student also correctly describes whether the environment impacts the effectiveness of waggle dancing [*The environment greatly impacts the effectiveness of waggle dancing*] and supports that answer with evidence from Table 2, Figure 1, and Figure 2 [*hives with several food sources nearby are still more likely to find an adequate amount of food with or without the waggle dancing.* (Table 2 and Figure 2) *Site 1 has scarcely populated food sources within a 4 mile radius, making it difficult for them to find food and rely more on their waggle dancing* (Table 2 and Figure 2).]

Student response #6:

The claim that interference helps the colonies is partially supported. This is because in figure one, every time there was interference, the percent of food sources decreased significantly. However, in figure two, only about half the times did the amount of honey increase.

The environment does impact effectiveness of waggle dancing, because it changed so much between the sites. In figure one, interfering did not work and decreased food significantly. However, in figure 2, it was not as significant.

Score Points: 3

Scoring note:

The student correctly indicates that the claim in Table 1 is *partially supported* and supports that answer with evidence from Figure 1 and Figure 2 [*in figure one, every time there was interference, the percent of food sources decreased significantly. However, in figure two, only about half the times did the amount of honey increase*]. The student also correctly describes whether the environment impacts the effectiveness of waggle dancing [*The environment does impact effectiveness of waggle dancing*] but fails to correctly use the data to address the impact of the environment on the effectiveness of waggle dancing.

Student response #7:

In Figure 1, the claim “bee waggle dancing evolved because it helps bee colonies gather food sources more efficiently” is supported. When bee colonies were able to do their waggle dance instead of not being able to, they visited a lot more food sourcs thereby gathering more food. In Figure 2, the claim “bee waggle dancing evolved because it helps bee colonies gather food sources more efficiently” is partially supported because in Site 1 when the amount of honey increased for colonies, mainly the colonies without their waggle dance being interfered with had an increase in honey supply, very few colonies that had been inerfered with while dancing had an increase in their supply. On the other hand, in Site 2, just a bit more bee colonies that were interfered with than colonoies that weren’t interfered with while waggle dancing had more honey.

I’m not sure how to answer, I’m guessing more waggle dancing means less food available. When food has more energy, bees eat more. When food has less energy, bees eat less. Some more waggle dancing from more energy means more of a need for food.

Score Points: 2

Scoring note:

The student correctly indicates that the claim in Table 1 is *supported* by Figure 1 and *partially supported* by Figure 2 [*In Figure 1, the claim . . . is supported. In Figure 2, the claim . . . is partially supported*] and supports the answer with evidence from Figure 1 and Figure 2 [*When bee colonies were able to do their waggle dance instead of not being able to, they visited a lot more food sources thereby gathering more food.* (Figure 1)]. The student explains that, in site 1, the colonies that did not have their waggle dance interfered with [*had an increase in honey supply*] while [*very few colonies that had been interfered with while dancing had an increase in their supply.*]. The student further explains that [*In site 2, just a bit more bee colonies that were interfered than colonies that weren’t interfered with while waggle dancing had more honey (Figure 2).*] The student fails to describe whether or not the environment impacts the effectiveness of waggle dancing and, therefore, cannot provide sufficient support.

Student response #8:

The claim from Table 1 is fully supported by the data scientists have collected. Without human interference, bees have successfully been able to collect pollen and make honey by using the waggle dance. The dance lets other bees know that there are flowers around them.

The environment does impact the effectiveness of the bee waggle dance. In order for the bees to do the waggle dance, they have to know if there is flowers and sunlight around them. Then, a bee does the dance to show a 90 degree angle with the flowers and the sun.

Score Points: 2

Scoring note:

The student correctly indicates that the claim in Table 1 *is fully supported* [*The claim from Table 1 is fully supported*] but fails to use the data correctly to support that answer. The student also correctly describes whether the environment impacts the effectiveness of waggle dancing [*The environment does impact the effectiveness of the bee waggle dance*] but misinterprets the data and fails to correctly support that answer.

Student response #9:

The claim for table one is partically supported because both move up and down throughout the chart.

The enviroment has a huge impact on the effectiveness of waggle dancing because at first it had a increase then later it had a huge decrease.

Score Points: 2

Scoring note:

The student correctly indicates that the claim in Table 1 is *partially supported* [*The claim for table one is partially supported*] but fails to use the data to support that answer. The student also correctly describes whether the environment impacts the effectiveness of waggle dancing [*The environment has a huge impact on the effectiveness of waggle dancing*] but fails to use the data to support that answer.

Student response #10:

The claim is table 1 is partically supported because it shows that without interference the percentage of food sources are higher but the numbers go down when the food sources are with interference.

The enviroment does not impact the effectiveness of the waggle dancing because the bees can do it whenever and don’t need the enivorment to have it to affect them.

Score Points: 1

Scoring note:

The student correctly indicates that the claim in Table 1 is *partially supported* [*The claim is table 1 is partially supported*] but incorrectly uses the data to support that answer. The student incorrectly describes whether or not the environment impacts the effectiveness of waggle dancing and, therefore, cannot use the data correctly to support that answer.

Student response #11:

The claim made in table one that says bee waggle dancing evolved because it helps bee colonies gather food sources more efficiently. This claim is not supported because in figure two there was a 90 percent of honey decrease with interfere, even without interfere the numbers of honey increase without interference remains very low in site one. As for site two the percentages are similar, but honey decrase remains partially lower than the honey increase. For site one this claim is not supported, in site two this claim is very midly to not supported.

The environment does have an impact on waggle dancing. For example in table two meadows have more food sources than a forest which means lesser time spent of finding foos, so more dances. Bees in a forest only have 2 food sources a day available while in the meadows there are 14 food sources. In tsite two the percentage of the times the bees visited the food sources and eve in site one were pretty high. Although in site two higher due to the variety of food sources.

Score Points: 1

Scoring note:

The student incorrectly indicates that the claim in Table 1 is *not supported* and, therefore, cannot use the data correctly to support that answer. The student correctly describes whether the environment impacts the effectiveness of waggle dancing [*The environment does have an impact on waggle dancing*] but incorrectly uses the data in an attempt to support that answer.

Student response #12:

I personally think it is partially supported because it still is a little lower but not by a significant amount.

YEs

Score Points: 1

Scoring note:

The student correctly indicates that the claim in Table 1 is *partially supported* [*I personally think it partially supported*] but does not clearly support that answer with data. The student correctly identifies that the environment impacts the effectiveness of waggle dancing but fails to explanation or evidence.

Student response #13:

The claim in Table 1 is barely supported because from evaluating Figure 1 and 2 I concluded there was no correlation between the efficiency of bee colonies' food sources and Bee waggle dancing. Figure 2 is unreliable to make such a bold claim because within the different Beehive sites the percentage of days were widely varied. This brings me to conclude that if there was a wider range of data the claim might be supported.

The environment slightly impacts the effectiveness of waggle dancing because as seen in Table 1, Site 1, the Forest had a higher average proportion of energy in food sources compared to Site 2 which had a larger span of available food sources. This relationship did not quite add up to the effectiveness of waggle dancing, especially because the data from Figure 1 and 2 have different outcomes. I believe with further simulations and experiments, scientists will be able to have a better understanding of the environment's impact of waggle dancing.

Score Points: 0

Scoring note:

The student indicates that the claim in Table 1 is *barely supported,* which is too vague for credit on its own, and incorrectly interprets the data in an attempt to support that answer, which indicates a lack of understanding. The student indicates that the environment *slightly impacts* the effectiveness of waggle dancing, which is also too vague for credit on its own, and then incorrectly interprets the data in an attempt to support that answer, also indicating an overall lack of understanding.

Student response #14:

Based on Figure 1 and Figure 2, it does not support the claim in Table 1 because for site 1 and site 2, there are different results from both figures. It contracted each other, which makes the claim harder to be supported.

There are environment impacts the effectiveness of waggle dancing because the differences in the result of site 1 and site 2 reveals that there has to be something that makes those two site different in both figures. It might be the season, weather, and how bees impacts on other bees.

Score Points: 0

Scoring note:

The student incorrectly indicates that the claim in Table 1 is *not supported* and, therefore, cannot use the data correctly to support that answer. The student describes that there are environmental impacts on the effectiveness of waggle dancing but qualifies this based on nonsensical support, indicating a complete lack of understanding.

Student response #15:

Table 1 is not supported because when bees are without interference the food percentage is a higher amount than of those with interference. Not only that but honey percentages each day go sigificantly down due to the interference.

The studies show that waggle dancing has proven to harm to work and food supply of the bee's because when interfered with they have less production that before.

Score Points: 0

Scoring note:

The student incorrectly indicates that the claim in Table 1 is *not supported* and, therefore, cannot use the data correctly to support that answer. The student fails to describe whether the environment impacts the effectiveness of waggle dancing and states that waggle dancing is harmful to the bee's food supply.

NJSLA–S Grade 11
Rubric/Sample Responses
Glycogen

Two marathon runners of similar athletic capabilities are running a marathon. Runner 1 ate a large meal of pasta the night before the race. Runner 2 ate tuna fish and salad. After 100 minutes of the race, one runner is farther ahead than the other runner.

Proteins, carbohydrates, and fats are dietary components that are the three basic nutritional building blocks of food. All of these can be converted to glucose, which is the body's primary energy source.

Glucose can also be converted to glycogen, which is used as a source of energy while running when it is available, and stored in liver and muscle tissue.

Figure 1 shows the glycogen levels of the two runners and the distances they traveled during the first 100 minutes of the race.

Figure 1: Depletion Rate of Muscle Glycogen in the Runners over Time

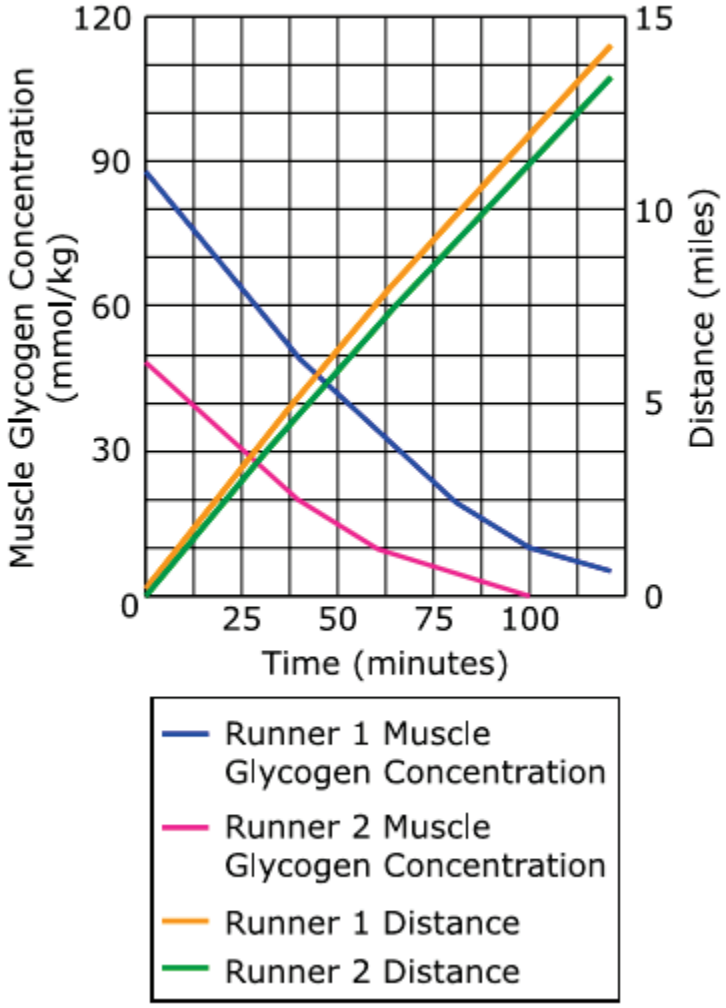


Table 1: Glycemic Indices of Runners' Meals

Runner 1	
Food	**Glycemic Index**
Macaroni	23
Sauce	1
Cheese	2
Apple	3
Runner 2	
Food	**Glycemic Index**
Tuna fish	0
Lettuce	0
Tomato	3
Salad dressing	2

The glycemic index of a food indicates how much blood glucose is produced by eating that food. Pure glucose has a glycemic index of 100.

Use the information provided in Figure 1 and the table to complete the following tasks.

Explain how the change in glycogen levels was different for each runner after 75 minutes of running.

Enter your answer in the box. Support your answer with evidence from the data.

(Student response goes here)

Identify the runner who ran the shorter distance over 100 minutes and how the food the runners ate resulted in the difference of distances traveled.

Enter your answer in the box. Support your answer with evidence from the data.

(Student response goes here)

Predict if the rate of running for Runner 2 will increase or decrease after 100 minutes, and explain why.

Enter your answer in the box. Support your answer with evidence from the data.

(Student response goes here)

Content Alignment

Domain:
Life Science

SEP Reporting Category:
Critiquing

Phenomenon:
Two marathon runners of similar athletic capabilities are running a marathon. Runner 1 ate a large meal of pasta the night before training. Runner 2 ate tuna fish and salad. After 100 minutes of the race, one runner is farther ahead than the other runner.

NJSLA Standard:

HS-LS1/MEOE Matter and Energy in Organisms and Ecosystems

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. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] [Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.]

SEP (Science and Engineering Practices):

OECI Obtaining, evaluating, and communicating information

DCI (Disciplinary Core Ideas):

LS1.C Organization for Matter and Energy Flow in Organisms

CCC (Crosscutting Concepts):

E&M Energy and Matter: Flows, cycles, and conservation

This item has 4 quality points:

- 2 points (1 point for each runner) for explaining how the runners' glycogen levels were different after 75 minutes of running.
- 1 point for identifying Runner 2 as having traveled the shorter distance and describing how the food eaten by the runners correlates with the difference in distances traveled.
- 1 point for predicting if the rate of running for Runner 2 will increase or decrease, and for explaining why.

Quality Points	Score
4	4
3	3
2	2
1	1
0	0

Student response #1:

Runner 1 started out with a higher glycogen concentration than Runner 2. After the first 75 minutes of running, both runners experienced a significent drop in the glycogen levels. Runner 1 experienced a change of 64 mmol/kg in 75 minutes. This is 0.89333 mmol/kglminute. Runner 2 experienced a change of 41 mmol/lg in 75 minutes. This is 0.546667 mmol/kg/minute. This shows how the change in glyvogen levels for Runner 1 happened more quickly than Runner 2. However, Runner 1 can allow this because he started out with higher levels in the first place.

Runner 2 ran the shorter distance over 100 minutes. Runner 2 ate tuna fish and a salad prior to running. This caused him to obtain lower glycogen levels than if he had eaten a meal containing more carbohydrates, like a large meal of pasta. This glycogen provided a source of energy while Runner 2 was running. Since Runner 1 ate a large pasts meal the night before, he was able to obtain higher glycogen levels, allowing him to run further in the first 100 minutes. Therefore, Runner 2's lower glycogen meal caused him to run a shorter difference in the first 100 minutes.

The rate for Runner 2 will decrease after the first 100 minutes. This is because once he reached the 100 minute mark, his body has already ran out of glycogen. This was his main energy source that was allowing him to run the speed that he was going. Since he no longer has any glycogen to provide enery, he wiII show a significant decrease in speed after the first 100 minutes of running**.**

Score Points: 4

Scoring note:

This student explains how the change in glycogen levels was different after 75 minutes for Runner 1 [*Runner 1 experienced a change of 64 mmol/kg in 75 minutes*] and Runner 2 [*Runner 2 experienced a change of 41 mmol/kg in 75 minutes*]. The student also identifies Runner 2 as the runner who ran the shorter distance over 100 minutes and explains how the food the runners ate resulted in the difference between the distances traveled [*Since Runner 1 ate a large pasta meal the night before he was able to obtain higher glycogen levels*]. The student predicts that the rate of running for Runner 2 will decrease after 100 minutes and explains why [*once he has reached the 100 minute mark, his body has already ran out of glycogen*].

Student response #2:

The change of glycogen levels was higher in Runner 1 after 75 minutes but he or she had a higher starting posiston of Muscle Glycogen Concentration so they still had more than Runner 2, who in this case, didn't lose their glycogen levels as quickly but had less to start with and in turn, less than Runner 1 after 75 minutes.

Runner 2 ran the shorter distance than Runner 1 because runner 1 had the high levels of Muscle Glycogen Concentrations due to eating foods with high glucose levels.

The rate will most likely decrease because eventually the Glycogen concentrations will be depleted and the runner will feel fatigued.

Score Points: 4

Scoring note:

This student explains how the change in glycogen levels was different after 75 minutes for Runner 1 [*The change of glycogen levels was higher in Runner 1 after 75 minutes*] and Runner 2 [*Runner 2 didn't lose their glycogen levels as quickly*]. The student also identifies Runner 2 as the runner who ran the shorter distance over 100 minutes and explains how the food the runners ate resulted in the difference between the distances traveled [*Runner 1 had the high levels of muscle glycogen concentrations due to eating foods with high glucose levels*]. The student predicts that the rate of running for Runner 2 will decrease after 100 minutes and explains why [*eventually the glycogen concentrations will be depleted*].

Student response #3:

As each runner ran there glycolic concentrations went down. Specifically as Runner 1 ran their glycolic concentration went from 90 and then decreased to about 30 at the 75 minute mark. Runner 2 had started with a glycolic conecntration of about 55 and decreased to less than 5 after 75 minutes of running.

Runner 2 ran a shorter distance. This makes sense since the food their ate was less glycolically concentrationed than runner 1.

It will decrease since they have less muslce glycogen concentration. As is their distance is going down and will continue to d so in the future.

Score Points: 4

Scoring note:

This student explains how the change in glycogen levels was different after 75 minutes for Runner 1 [*As Runner 1 ran their glycolic concentration went from 90 and then decreased to about 30*] and Runner 2 [*Runner 2 had started with a glycolic concentration of about 55 and decreased to less than 5*]. The student also identifies Runner 2 as the runner who ran the shorter distance over 100 minutes and explains how the food the runners ate resulted in the difference between the distances traveled [*the food they ate was less glycolically concentrated than Runner 1*]. The student predicts that the rate of running for Runner 2 will decrease after 100 minutes and explains why [*they have less muscle glycogen concentration*].

Student response #4:

Runner 1 had a lot greater concentration of glycogen at the beginning of the race, so his glycogen level decreased a greater amount after 75 minutes because he had more to start with than runner 2 had.

Runner 2 ran a shorter distance in the 100 minutes because the food he ate had a lower level of glycogen which helped runner one run a greater distance in the 100 minutes that they ran. So the more glycogen in the meal they ate resulted in runner 1 getting farther because he had a greater concentration of glycogen.

It will decrease because his levels of glycogen are very low and will only get lower.

Score Points: 3

Scoring note:

This student explains how the change in glycogen levels was different after 75 minutes for Runner 1 [*his glycogen level decreased a greater amount*] but not for Runner 2. The student also identifies Runner 2 as the runner who ran the shorter distance over 100 minutes and explains how the food the runners ate resulted in the difference between the distances traveled [*the food he ate had a lower level of glycogen*]. The student predicts that the rate of running for Runner 2 will decrease after 100 minutes and explains why [*his levels of glycogen are very low and will only get lower*].

Student response #5:

The glycogen levels were different for each runner after 75 minutes of running because since each runner had a different meal which resulted in different amounts of protein, fats, and carbohydrates even though the calories were off by 2 their can have a major difference in the levels. After 75 minutes, Runner 1 levels even though are higher than Runner 2 they are dropping more than Runner 2.

Runner 2 ran the shortest distance compared to Runner 1. This is probably due to the lack of glycemic index the food the runner ate. Runner one probably had more energy due to the food it ate which resulted in a longer distance ran.

I predict that Runner 2 rate of running will decrease since the food the runner ate probably didnt give enough energy and lacked glycemic index. As you see in the graph, Runner 2 line is slightly below Runner 1 but the slope is decreasing which is showing that the runner is slowing down.

Score Points: 3

Scoring note:

This student explains how the change in glycogen levels was different after 75 minutes for Runner 1 [*After 75 minutes, Runner 1 levels even though they are higher than Runner 2 they are dropping more than Runner 2*] but not Runner 2. The student also identifies Runner 2 as the runner who ran the shorter distance over 100 minutes and explains how the food the runners ate resulted in the difference between the distances traveled [*the lack of glycemic index of the food the runner ate*]. The student predicts that the rate of running for Runner 2 will decrease after 100 minutes and explains why [*Runner 2 line is slightly below Runner 1 but the slope is decreasing which is showing that the runner is slowing down*].

Student response #6:

After 75 minutes, runner 1 's glycogen concentration was at about 25, it started off arounf 90. Runner 2's glycogen concentration started off around 50 and dropped to around 5.

Runner 2 ran the shorter distance because they had a lower glycogen concentration level.

It will decrease because of their lower glycogen levels.

Score Points: 3

Scoring note:

This student explains how the change in glycogen levels was different after 75 minutes for Runner 1 [*After 75 minutes, Runner 1's glycogen concentration was at about 25, it started off around 90*] and Runner 2 [*Runner 2's glycogen concentration started off around 50 and dropped to around 5*]. The student also identifies Runner 2 as the runner who ran the shorter distance over 100 minutes but does not explain how the food the runners ate resulted in the difference between the distances traveled. The student predicts that the rate of running for Runner 2 will decrease after 100 minutes and explains why [*because of their low glycogen levels*].

Student response #7:

runner 1's glycogen levels changed faster than runner 2's.

runner 2 ran less, because the food eaten by runner 2 had a lower glyccemic index than runner 1. therefore, less energy was available to runner 2.

decrease, no more glycogen in muscles, therefore, no energy left.

Score Points: 2

Scoring note:

This student does not clearly explain how the change in glycogen levels was different after 75 minutes for Runner 1 or Runner 2. The student identifies Runner 2 as the runner who ran the shorter distance over 100 minutes and explains how the food the runners ate resulted in the difference between the distances traveled [*the food eaten by Runner 2 had a lower glycemic index than Runner 1*]. The student also predicts that the rate of running for Runner 2 will decrease after 100 minutes and explains why [*no more glycogen in muscles, therefore, no energy left*].

Student response #8:

The change is glycogen leves was different for each runner after 75 minutes because they each ate different foods and had different muscle glycogen concentration when they began the race

Runner 2 ran the shorter distance over 100 minutes. The food the runners ate resulted in the difference of distances traveled because Runner 1 had more carbohydrates to sustain energy long enough to run a long distance over a long period of time, whereas Runner 2 had more protein.

The rate of running for Runner 2 will decrease because he will slowly become much more tired since he didnot consume the correct amount of carbohydrates before his run.

Score Points: 2

Scoring note:

This student does not explain how the change in glycogen levels was different after 75 minutes for Runner 1 or Runner 2. The student identifies Runner 2 as the runner who ran the shorter distance over 100 minutes and explains how the food the runners ate resulted in the difference between the distances traveled [*Runner 1 had more carbohydrates to sustain energy long enough to run a long distance*]. The student also predicts that the rate of running for Runner 2 will decrease after 100 minutes and explains why [*he will slowly become much more tired because he did not consume the correct amount of carbohydrates*].

Student response #9:

After 75 minutes of running runner 1 had a Muscle glycogen concentration of about 22 while runner 2 had less than 10.

Runner 2 ran a shorter distance because he had less glycogen in his food

The rate of running will decrease becase he will have little to no glycogen left in his body

Score Points: 2

Scoring note:

This student does not explain how the change in glycogen levels was different after 75 minutes for Runner 1 or Runner 2. The student identifies Runner 2 as the runner who ran the shorter distance over 100 minutes and explains how the food the runners ate resulted in the difference between the distances traveled [*he had less glycogen in his food*]. The student also predicts that the rate of running for Runner 2 will decrease after 100 minutes and explains why [*he will have little to no glycogen left in his body*].

Student response #10:

Runner 1 had twice as much concentration after 75 minutes.

Runner 2 ran a shorter distance because he was going at a slower rate than Runner 1.

The rate will decrease because the concentration will run out.

Score Points: 1

Scoring note:

This student does not explain how the change in glycogen levels was different after 75 minutes for Runner 1 or Runner 2. The student identifies Runner 2 as the runner who ran the shorter distance over 100 minutes but does not explain how the food the runners ate resulted in the difference between the distances traveled. The student predicts that the rate of running for Runner 2 will decrease after 100 minutes and explains why [*the concentration will run out*].

Student response #11:

The food that Runner 1 ate before the marathon gave him a higher glycogen amount.

Runner 2 ran a shorter distance because his food gave him no glycogen stores.

It will not, because Runner 2 is losing energy; not gaining it.

Score Points: 1

Scoring note:

This student does not explain how the change in glycogen levels was different after 75 minutes for Runner 1 or Runner 2. The student identifies Runner 2 as the runner who ran the shorter distance over 100 minutes and explains how the food the runners ate resulted in the difference between the distances traveled [*his food gave him no glycogen stores*]. The student does not clearly predict that the rate of running for Runner 2 will decrease after 100 minutes or explain why.

Student response #12:

runner 2s muscle glycogen concentration levels decreased as runner number 1s have increased signefigancly then runner number 2.

runner number 1 ran a longer distance then runner number 2. Runner number 2 didnt have the same amount of muscle glycogen as runner number 1 had.

Runner number 2 will decrease after 100 minutes because of his muscle glycogen concentration because it is lower then runner number 1s.

Score Points: 1

Scoring note:

This student does not explain how the change in glycogen levels was different after 75 minutes for Runner 1 or Runner 2. The student identifies Runner 1 as the runner who ran a longer distance over 100 minutes but does not explain how the food the runners ate resulted in the difference between the distances traveled. Note that it is acceptable for the student to indicate that Runner 2 ran a shorter distance or that Runner 1 ran a longer distance. The student also predicts that the rate of running for Runner 2 will decrease after 100 minutes and explains why [*his muscle glycogen concentration is lower than Runner 1*].

Student response #13:

Because they both had dfferent diets and each diet had different glycemic index and different amount which affects their body and abilities differently. Thats why it affected their 75 minutes running time.

Runner 2 ran shorter distance over 100 minutes because as you can see in the graph runner 1 had lower glycogen concentration over 100 minutes.

It will decrease.

Score Points: 0

Scoring note:

This student does not explain how the change in glycogen levels was different after 75 minutes for Runner 1 or Runner 2. The student identifies Runner 2 as the runner who ran the shorter distance over 100 minutes but does not explain how the food the runners ate resulted in the difference between the distances traveled. The student also predicts that the rate of running for Runner 2 will decrease after 100 minutes but does not explain why.

Student response #14:

runner 1's glycogen level was higher then runner 2's as a result runner 1 ran a greater distance

runner 2 ran the shorter distance bewteen the two

i don't really know why

Score Points: 0

Scoring note:

This student does not explain how the change in glycogen levels was different after 75 minutes for Runner 1 or Runner 2. The student identifies Runner 2 as the runner who ran the shorter distance over 100 minutes but does not explain how the food the runners ate resulted in the difference between the distances traveled. The student does not predict that the rate of running for Runner 2 will decrease after 100 minutes or explain why.

Student response #15:

Runner 1 had a higher glycogen level then runner 2, runner 1 had a 22 mmol of glycogen and runner 2 had 7mmol. they have a 15 difference betweem their glyogen level.

Runer 1 ran a higher distance over 100 min because of his glycemic index. His glycemic index of food was lower than runner 2.

it will decrease

Score Points: 0

Scoring note:

This student does not explain how the change in glycogen levels was different after 75 minutes for Runner 1 or Runner 2. The student identifies Runner 1 as the runner who ran a longer distance over 100 minutes but incorrectly states that the glycemic index of his food was lower. The student predicts that the rate of running for Runner 2 will decrease after 100 minutes but does not explain why.