

# Pennsylvania PSSA 2019 Grade 4 Science

Exam & Answer Key Materials  
Pages 2 - 37



**pennsylvania**  
DEPARTMENT OF EDUCATION

# **The Pennsylvania System of School Assessment**

## **Science Item and Scoring Sampler**



**2019–2020  
Grade 4**

**SCIENCE TEST DIRECTIONS**

On the following pages are the Science questions. There are two types of questions.

**Multiple-Choice Questions:**

Some questions will ask you to select an answer from among four choices. These questions will be found in your test booklet.

For the multiple-choice questions:

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

**Open-Ended Questions:**

Other questions will require you to write your response. These questions will be found in your answer booklet.

For the open-ended questions:

- Be sure to read the directions carefully.
- If the question asks you to do two tasks, be sure to complete both tasks.
- If the question asks you to compare, be sure to compare. Also, if the question asks you to explain, describe, or identify, be sure to explain, describe, or identify.

## GENERAL DESCRIPTION OF SCORING GUIDELINES FOR SCIENCE OPEN-ENDED ITEMS

**2 Points**

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

**1 Point**

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

**0 Points**

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

Special Categories within zero reported separately:

**Blank**.....Blank, entirely erased, entirely crossed out, or consists entirely of whitespace

**Refusal** .....Refusal to respond to the task

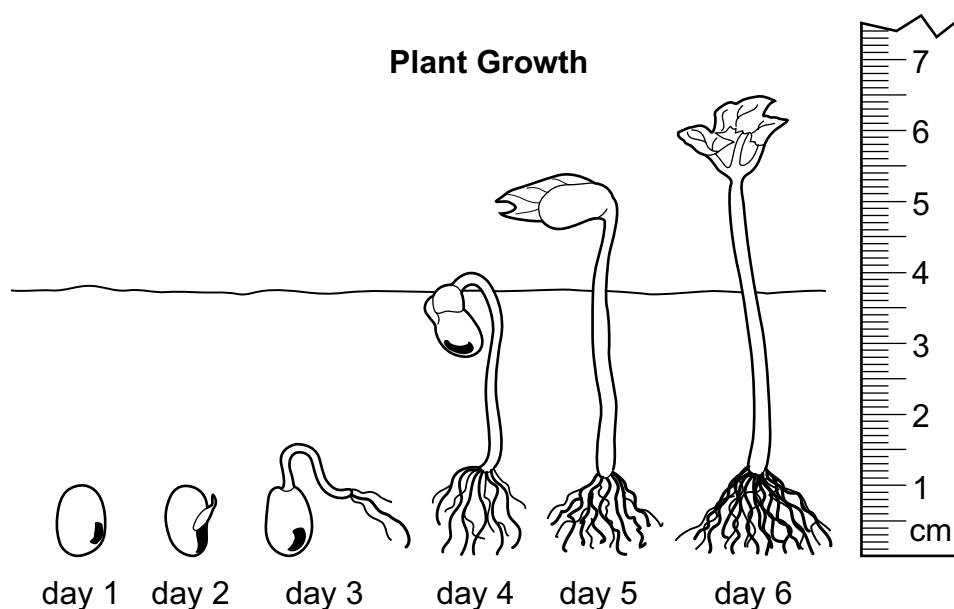
**Off Task**.....Makes no reference to the item but is not an intentional refusal

**Foreign Language** .....Written entirely in a language other than English

**Illegible**.....Illegible or incoherent

## MULTIPLE-CHOICE QUESTIONS

1. Use the drawing below to answer the question.



How much did the plant grow in height from day 4 to day 6?

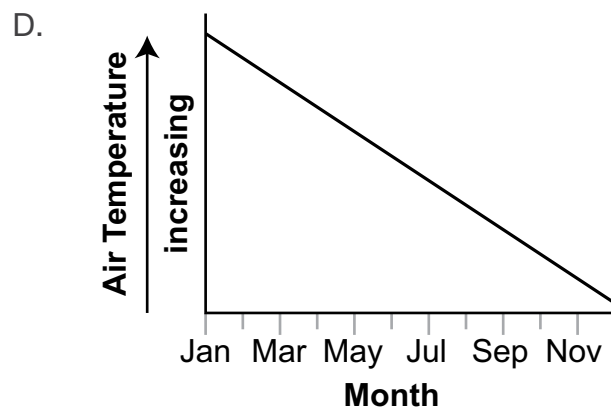
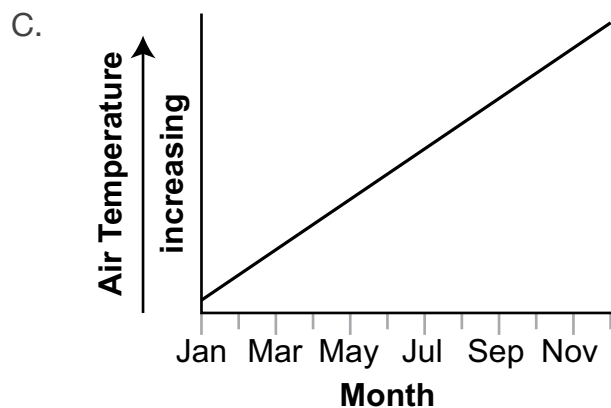
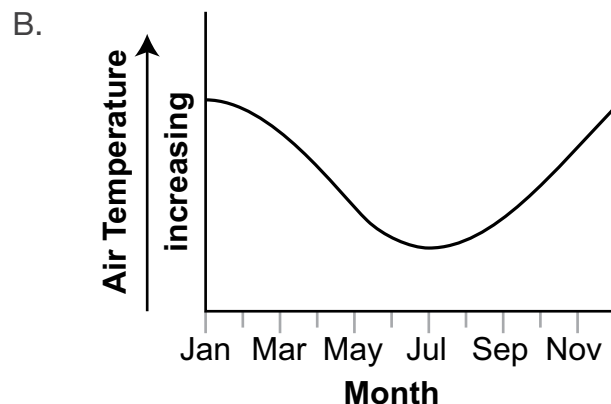
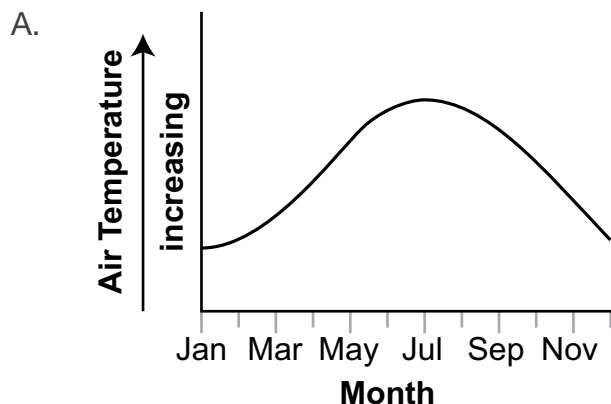
- A. 1.0 cm
- B. 2.5 cm
- C. 4.0 cm
- D. 6.5 cm

Item Information	
Alignment	S4.A.1.3.1
Answer Key	B
Depth of Knowledge	2
p-value A	6%
p-value B	52% (correct answer)
p-value C	15%
p-value D	27%
Option Annotations	<p>A. The plant grew 1.0 cm from day 5 (5.5 cm) to day 6 (6.5 cm).</p> <p>B. Key: The plant grew 2.5 cm from day 4 (4.0 cm) to day 6 (6.5 cm).</p> <p>C. The plant was 4.0 cm on day 4.</p> <p>D. The plant grew a total of 6.5 cm.</p>

2. Which change in an animal's food supply is the **most likely** cause of annual migration?
- A. The food supply is reduced as seasons change.
  - B. A disease permanently reduces the food supply.
  - C. The food supply gradually increases over several years.
  - D. A new organism begins eating from the same food supply.

Item Information	
Alignment	S4.A.1.3.4
Answer Key	A
Depth of Knowledge	2
p-value A	55% (correct answer)
p-value B	12%
p-value C	13%
p-value D	20%
Option Annotations	<p>A. Key: A regular yearly pattern of reduced food availability during the coldest months is most likely to result in migration behavior in certain animal species.</p> <p>B. The animal is not likely to return each year to a location where the food supply is permanently reduced.</p> <p>C. A long term increase in food supply is not likely to affect annual migration behavior.</p> <p>D. A new organism eating from the same food supply is unlikely to have a predictable, regular pattern in its effect. Therefore, it is unlikely to result in annual migration behavior.</p>

3. Many trees in Pennsylvania forests lose their leaves in autumn and regrow their leaves in spring. Which graph **best** shows a weather change that results in this pattern?



Item Information	
Alignment	S4.A.2.1.4
Answer Key	A
Depth of Knowledge	3
p-value A	49% (correct answer)
p-value B	20%
p-value C	16%
p-value D	15%
Option Annotations	<p>A. Key: The graph shows the normal average monthly temperature pattern of Pennsylvania, which gradually increases starting in spring and peaks in summer, and then gradually decreases through fall and into winter.</p> <p>B. This graph shows the opposite of a normal pattern of monthly air temperature in Pennsylvania.</p> <p>C. This graph shows the average monthly air temperature consistently increasing from January through the end of the year.</p> <p>D. This graph shows the average monthly air temperature consistently decreasing from January through the end of the year.</p>



4. Which characteristic of the Moon can a student **best** study using a telescope?
- A. the Moon's distance from Earth
  - B. why the Moon has different phases
  - C. the shapes of the Moon's surface features
  - D. how the Moon's motion affects Earth's tides

Item Information	
Alignment	S4.A.2.2.1
Answer Key	C
Depth of Knowledge	2
p-value A	26%
p-value B	16%
p-value C	48% (correct answer)
p-value D	10%
Option Annotations	<p>A. An instrument such as a laser or camera and a measuring tool is needed to calculate the distance to the Moon from Earth.</p> <p>B. A telescope is not required to determine why the Moon has different phases.</p> <p>C. Key: Surface features of the Moon, such as mountains and craters, can be observed with the use of a telescope.</p> <p>D. The study of gravitational forces is required to determine how the Moon's motion affects Earth's tides.</p>

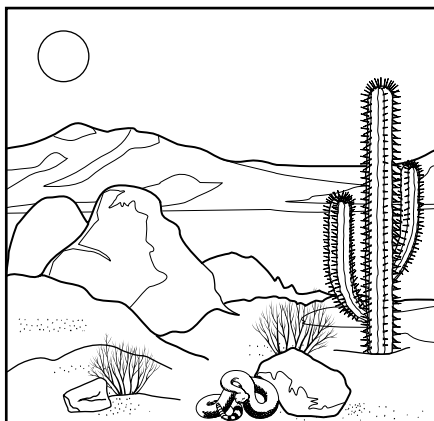
5. Which object is **most likely** part of a human-made system?

- A. the milk people drink
- B. the clothes people wear
- C. the air in the atmosphere
- D. the vegetables in the ground

Item Information	
Alignment	S4.A.3.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	9%
p-value B	63% (correct answer)
p-value C	13%
p-value D	15%
Option Annotations	<p>A. Milk comes from an animal source such as a cow or goat.</p> <p>B. Key: Clothes made from synthetic materials, such as polyester and nylon, can be made by people.</p> <p>C. The air in the atmosphere is part of a natural system.</p> <p>D. Vegetables come from plants, which are organisms.</p>

6. Use the drawing below to answer the question.

**Desert Ecosystem**



Which chart **best** describes a part of the desert ecosystem?

A.

Part	Living or Nonliving	Role
rattlesnake	nonliving	produces energy for other organisms

B.

Part	Living or Nonliving	Role
the Sun	living	produces energy for many organisms

C.

Part	Living or Nonliving	Role
rock	nonliving	produces energy for many organisms

D.

Part	Living or Nonliving	Role
cactus	living	produces energy for other organisms

Item Information	
Alignment	S4.A.3.1.3
Answer Key	D
Depth of Knowledge	2
p-value A	7%
p-value B	30%
p-value C	14%
p-value D	49% (correct answer)
Option Annotations	<p>A. The rattlesnake is living.</p> <p>B. The Sun is nonliving.</p> <p>C. The rock does not provide energy to organisms.</p> <p>D. Key: The cactus is a living part of the ecosystem that provides food and energy to other organisms.</p>

7. Which step **most likely** happens first in the process of making clothes from cotton?
- A. Cotton fabric is made in a factory.
  - B. Cotton is grown and harvested on a farm.
  - C. A person makes a shirt from cotton fabric.
  - D. A truck is used to transport cotton to a factory.

Item Information	
Alignment	S4.A.3.1.4
Answer Key	B
Depth of Knowledge	2
p-value A	14%
p-value B	68% (correct answer)
p-value C	7%
p-value D	11%
Option Annotations	<p>A. Cotton must first be grown in a field.</p> <p>B. Key: Cotton fiber is produced by plants.</p> <p>C. Cotton must be grown and processed into fabric before a shirt can be made.</p> <p>D. The cotton fiber is grown on a farm and then transported to a factory.</p>

8. Which process follows a pattern that lasts about one year?
- A. the change from a new moon to a full moon
  - B. the movement of Earth in its orbit around the Sun
  - C. the change from high to low ocean tides on a beach
  - D. the movement of a drop of water through the water cycle

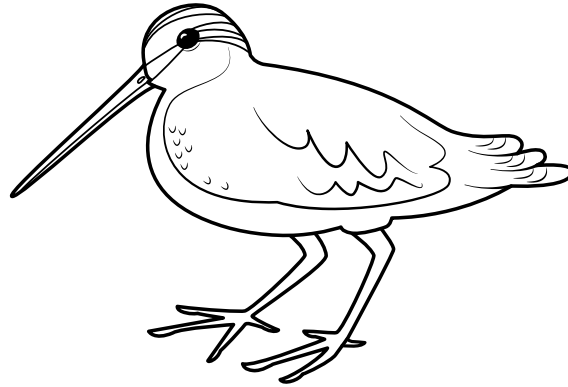
Item Information	
Alignment	S4.A.3.3.1
Answer Key	B
Depth of Knowledge	2
p-value A	16%
p-value B	67% (correct answer)
p-value C	9%
p-value D	8%
Option Annotations	<p>A. The phases of the Moon change throughout each month of the year.</p> <p>B. Key: Earth takes one year to complete its orbit around the Sun.</p> <p>C. Tides change on a daily basis.</p> <p>D. The amount of time it takes water to move through its cycle is variable.</p>

9. Mussels are simple organisms that have shells. They attach themselves to rocks to keep strong waves from washing them away. Which types of environments are **most likely** to include mussels?
- A. oceans and lakes
  - B. rivers and deserts
  - C. prairies and tundras
  - D. forests and wetlands

Item Information	
Alignment	S4.B.2.1.1
Answer Key	A
Depth of Knowledge	2
p-value A	78% (correct answer)
p-value B	7%
p-value C	7%
p-value D	8%
Option Annotations	<p>A. Key: Mussels are aquatic organisms that most commonly live in large bodies of water, such as oceans and lakes.</p> <p>B. Mussels could not survive in non-aquatic environments, such as deserts.</p> <p>C. Mussels could not survive in non-aquatic environments, such as prairies or tundras.</p> <p>D. Mussels could not survive in non-aquatic environments, such as forests.</p>

10. Use the drawing below to answer the question.

Common Snipe



The common snipe of some Pennsylvania wetlands can often be found wading through the soft, marshy soil. The snipe feeds on insects, worms, and some plant materials. How does the shape of its beak **most likely** help the snipe survive?

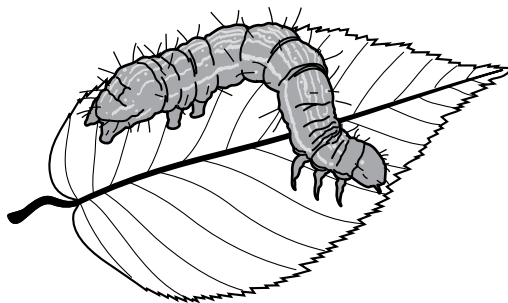
- A. It helps the bird attract mates.
- B. It helps the bird find and pick up food.
- C. It helps the bird move through soft soil.
- D. It helps the bird blend into its environment.

Item Information	
Alignment	S4.B.2.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	5%
p-value B	72% (correct answer)
p-value C	16%
p-value D	7%
Option Annotations	<p>A. There is no information provided that indicates that having a sharp, pointy beak is needed for the bird to attract mates.</p> <p>B. Key: A sharp pointy beak could help this bird to capture small prey found in the soil of a marshy environment.</p> <p>C. The bird's legs would be most useful in helping it move within its environment.</p> <p>D. The bird's feathers would help it blend into its environment.</p>



11. Use the drawing below to answer the question.

**Cabbage Worm**



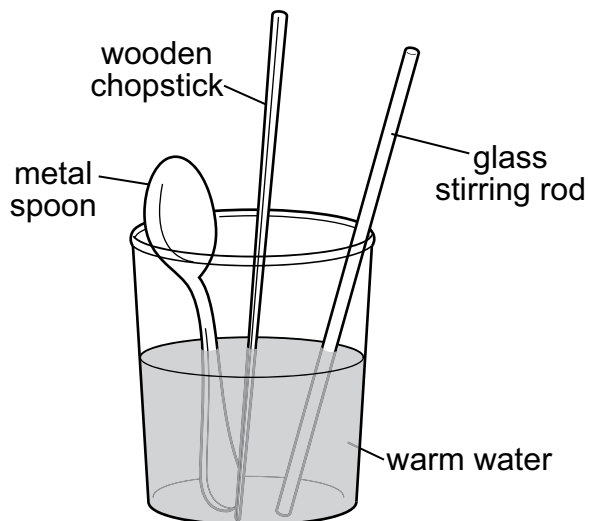
Cabbage worms are insect larvae that eat cabbage plants. They cause serious damage to cabbage plants. Which statement **best** explains how these insects affect humans?

- A. They compete with humans for cabbage plants.
- B. They improve the soil that humans use for growing cabbage plants.
- C. They eat other insects that compete with humans for cabbage plants.
- D. They pollute water sources that humans use for growing cabbage plants.

Item Information	
Alignment	S4.B.3.3.3
Answer Key	A
Depth of Knowledge	2
p-value A	50% (correct answer)
p-value B	15%
p-value C	11%
p-value D	24%
Option Annotations	<p>A. Key: The cabbage worm and humans both eat cabbage, therefore they are competing for the same food source.</p> <p>B. Based on the information provided, cabbage worms do not directly contribute to soil health.</p> <p>C. The cabbage worm eats cabbage. It does not eat other insects.</p> <p>D. The cabbage worm does not affect the quality of water sources.</p>

12. Use the drawing below to answer the question.

### Investigation



A student places three objects in a glass with warm water. After a few minutes, the student touches the top of each object. Which characteristic of the objects is the student **most likely** investigating?

- A. mass
- B. shape
- C. magnetism
- D. conductivity

Item Information	
Alignment	S4.C.1.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	20%
p-value B	10%
p-value C	14%
p-value D	56% (correct answer)
Option Annotations	<p>A. A balance would be required to measure the mass of each object.</p> <p>B. Determining the shape of each object through touch would require touching each object entirely.</p> <p>C. A magnet would be required to determine the magnetism of each object.</p> <p>D. Key: By touching the end of each object, the student can determine if heat from the warm water has been conducted through each object.</p>

13. Use the list below to answer the question.

**Classroom Objects**

- |  |
|--|
| <ol style="list-style-type: none"> <li>1. wooden door</li> <li>2. plastic ruler</li> <li>3. metal stapler</li> <li>4. rubber band</li> </ol> |
|--|

A student makes a list of some objects in a classroom. Which characteristic is the same among **all** of the objects?

- A. mass
- B. volume
- C. state of matter
- D. ability to conduct heat

Item Information	
Alignment	S4.C.1.1.2
Answer Key	C
Depth of Knowledge	2
p-value A	25%
p-value B	16%
p-value C	46% (correct answer)
p-value D	13%
Option Annotations	<p>A. Mass is a measurement and the list does not include the mass of each object, it may be inferred that the objects would not have the same mass.</p> <p>B. Volume is a measurement and the list does not include the volume of each object, it may be inferred that the objects would not have the same volume.</p> <p>C. Key: Based on the information provided, it may be inferred that each of the objects in the classroom is in a solid state of matter.</p> <p>D. The objects in the list are all made from different materials and would conduct heat differently.</p>

14. A student wants to investigate whether changes in air pressure affect the amount of rainfall produced by a weather system. Which tools would **best** help the student perform this investigation?
- A. a barometer and a rain gauge
  - B. a weather vane and a barometer
  - C. a rain gauge and an anemometer
  - D. an anemometer and a weather vane

Item Information	
Alignment	S4.D.2.1.3
Answer Key	A
Depth of Knowledge	2
p-value A	35% (correct answer)
p-value B	20%
p-value C	26%
p-value D	19%
Option Annotations	<p>A. Key: A barometer is a weather tool used to measure air pressure in the atmosphere, and a rain gauge is a weather tool used to measure rainfall.</p> <p>B. A weather vane is a weather tool used to measure wind direction.</p> <p>C. An anemometer is a weather tool used to measure wind speed.</p> <p>D. An anemometer is a weather tool used to measure wind speed, and a weather vane is a weather tool used to measure wind direction.</p>

15. Use the table below to answer the question.

**Motion in the Sun-Earth-Moon System**

Statement	Description of Motion
1	Earth travels around the Sun once.
2	Earth spins around on its axis once.
3	The Moon travels around Earth once.
4	From a location on Earth, the Sun appears to rise and set.

A student is given four statements about motion in the Sun-Earth-Moon system. The student is asked to arrange the statements in order of how long each motion takes to occur. Which list arranges the statements from **shortest to longest** amount of time?

- A. 2, 1, 3, 4
- B. 2, 4, 3, 1
- C. 4, 1, 2, 3
- D. 4, 2, 3, 1

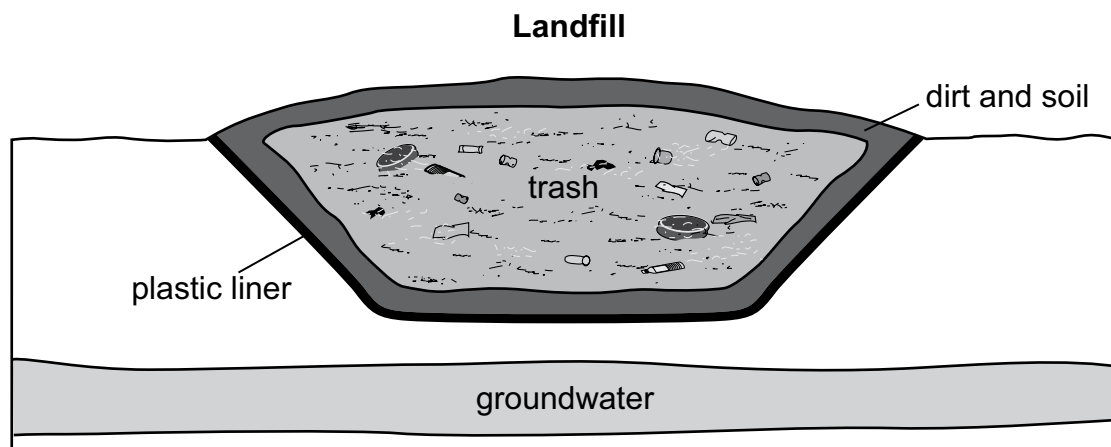
Item Information	
Alignment	S4.D.3.1.2
Answer Key	D
Depth of Knowledge	2
p-value A	25%
p-value B	20%
p-value C	18%
p-value D	37% (correct answer)
Option Annotations	<p>A. Statement 4 should be first in the list and Statement 1 should be last in the list.</p> <p>B. Statements 2 and 4 should be switched with each other in the list.</p> <p>C. Statement 1 should be last in the order.</p> <p>D. Key: The Sun rises and sets each day. It takes Earth about 24 hours to spin on its axis. It takes the Moon about 27–28 days to orbit Earth. It takes Earth about 365 days to orbit the Sun.</p>

16. How does the tilt of Earth's axis cause seasonal change?
- A. by increasing the amount of energy produced by the Sun during summer
  - B. by exposing some parts of Earth to fewer hours of sunlight during winter
  - C. by making Earth travel greater distances around the Sun during some months
  - D. by increasing the speed at which Earth rotates on its axis during some months

Item Information	
Alignment	S4.D.3.1.3
Answer Key	B
Depth of Knowledge	2
p-value A	23%
p-value B	40% (correct answer)
p-value C	19%
p-value D	18%
Option Annotations	<p>A. The Sun always produces about the same amount of energy throughout the year.</p> <p>B. Key: During summer, Earth's Northern Hemisphere is tilted on an angle toward the Sun's direct rays. During winter, Earth's Northern Hemisphere is tilted on an angle away from the Sun's direct rays.</p> <p>C. Earth is always about 92.96 million miles from the Sun.</p> <p>D. Locations at various latitudes on Earth spin at a constant speed throughout the year.</p>

## OPEN-ENDED ITEM

17. Use the drawing below to answer the question.



Many cities around the world place their trash in landfills or dumps. Dumps are large holes in the ground where trash is buried. Landfills are similar to dumps, but they have a special liner on the bottom that helps to separate the trash from the environment.

**Part A:** Describe how humans can benefit from placing trash in landfills instead of placing it in dumps.

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**Part B:** Describe one way that people could reduce the amount of trash that ends up in dumps or landfills.

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



## Item-Specific Scoring Guideline

### #17 Item Information

Alignment	S4.A.1.3.5	Depth of Knowledge	3	Mean Score	1.02
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### Scoring Guide

Score	Description
2	<p>The response demonstrates a <i>thorough</i> understanding of how everyday human activities (e.g., solid waste production, food production and consumption, transportation, water consumption, energy production and use) may change the environment by</p> <ul style="list-style-type: none"> <li>describing how humans can benefit from placing trash in landfills instead of placing it in dumps</li> </ul> <p><b>and</b></p> <ul style="list-style-type: none"> <li>describing one way that people could reduce the amount of trash that ends up in dumps or landfills.</li> </ul> <p>The response is clear, complete, and correct.</p>
1	<p>The response demonstrates a <i>partial</i> understanding of how everyday human activities (e.g., solid waste production, food production and consumption, transportation, water consumption, energy production and use) may change the environment by</p> <ul style="list-style-type: none"> <li>describing how humans can benefit from placing trash in landfills instead of placing it in dumps</li> </ul> <p><b>or</b></p> <ul style="list-style-type: none"> <li>describing one way that people could reduce the amount of trash that ends up in dumps or landfills.</li> </ul> <p>The response may contain some work that is incomplete or unclear.</p>
0	<p>The response provides <i>insufficient</i> evidence to demonstrate any understanding of the concept being tested.</p>

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



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

- Placing trash in landfills instead of dumps protects groundwater from pollution because landfills have liners.
- Placing trash in landfills instead of dumps protects the soil around the landfill from pollution because landfills have liners.
- Placing trash in landfills instead of dumps protects the organisms that live in the soil around the landfill from pollution because landfills have liners.
- Any other response that correctly describes how humans can benefit from placing trash in landfills.

**Part B (1 point):**

- People could reduce the amount of trash that ends up in dumps or landfills by recycling.
- People could reduce the amount of trash that ends up in dumps or landfills by composting food and yard waste.
- People could reduce the amount of trash that ends up in dumps or landfills by producing less waste.
- People could reduce the amount of trash that ends up in dumps or landfills by donating things to others that can still be used.
- People could reduce the amount of trash that ends up in dumps or landfills by choosing and using products with less packaging.
- Any other response that correctly describes how people could reduce the amount of trash in dumps or landfills.

## STUDENT RESPONSE

Response Score: 2 points



## PART A

Question 17  
Page 1 of 2

Use the drawing below to answer the question.

**Landfill**

Labels in the diagram: dirt and soil, trash, plastic liner, groundwater.

Many cities around the world place their trash in landfills or dumps. Dumps are large holes in the ground where trash is buried. Landfills are similar to dumps, but they have a special liner on the bottom that helps to separate the trash from the environment.

**Part A:** Describe how humans can benefit from placing trash in landfills instead of placing it in dumps.

104/1000

Next

Options

Flag

Pause

Review/End Test

## PART B

Question 17  
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Item ID

Calculator

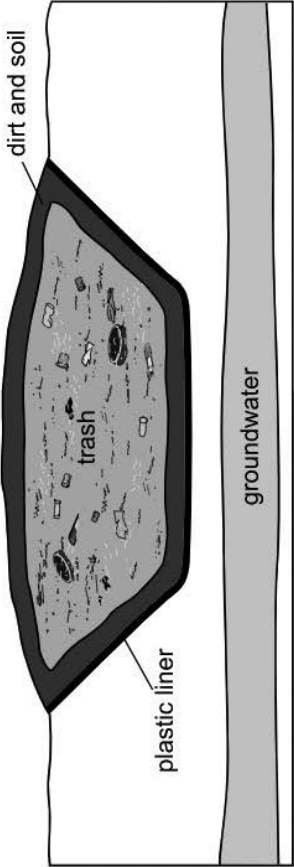
Line Guide

Eraser

Highlighter

Selection

Landfill



Many cities around the world place their trash in landfills or dumps. Dumps are large holes in the ground where trash is buried. Landfills are similar to dumps, but they have a special liner on the bottom that helps to separate the trash from the environment.

**Part B:** Describe one way that people could reduce the amount of trash that ends up in dumps or landfills.

recycle because its good for the envirmint.

43/1000

Review/End Test

Pause

Flag

Options

Back

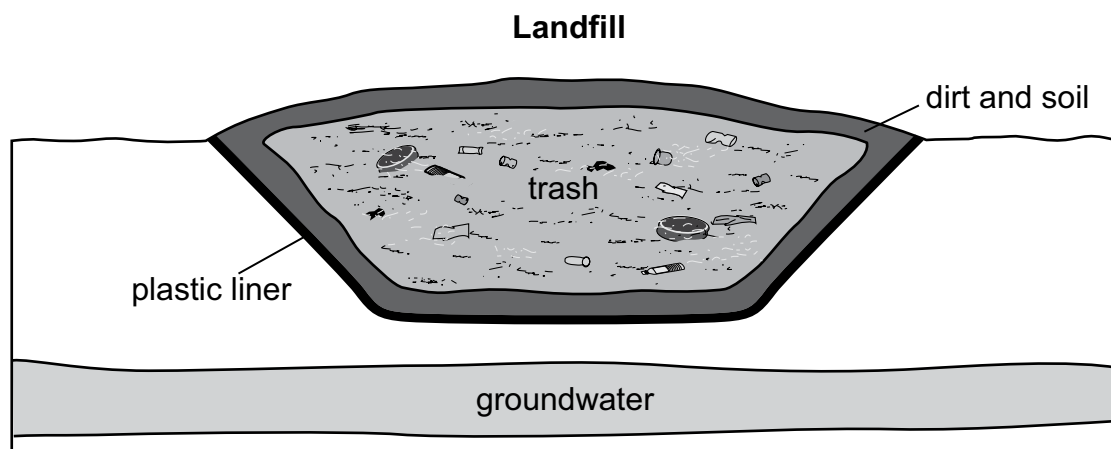
Next

This response demonstrates a thorough understanding of how everyday human activities may change the environment. In Part A, the response describes how humans can benefit from placing trash in landfills instead of placing it in dumps (*Landfills can't get into groundwater because it has a special liner*). In Part B, the response accurately describes one way that people could reduce the amount of trash that ends up in landfills or dumps (*recycle*). The response is clear, complete, and correct.

## STUDENT RESPONSE

Response Score: 1 point

17. Use the drawing below to answer the question.



Many cities around the world place their trash in landfills or dumps. Dumps are large holes in the ground where trash is buried. Landfills are similar to dumps, but they have a special liner on the bottom that helps to separate the trash from the environment.

**Part A:** Describe how humans can benefit from placing trash in landfills instead of placing it in dumps.

*The landfills help the environment and dumps hurt the environment.*

**Part B:** Describe one way that people could reduce the amount of trash that ends up in dumps or landfills.

*They could think which one is better.*

This response demonstrates a partial understanding of how everyday human activities may change the environment. In Part A, the response accurately describes how humans can benefit from placing trash in landfills instead of placing it in dumps (*The landfills help the environment and dumps hurt the environment*). In Part B, the response (*They could think which one is better*) does not describe one way that people could reduce the amount of trash that ends up in landfills or dumps and receives no credit.

## STUDENT RESPONSE

Response Score: 0 points



## PART A

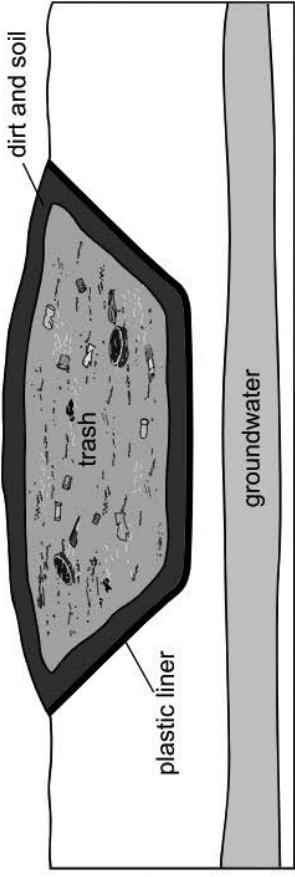
Question 17  
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Item ID

Line Guide

Use the drawing below to answer the question.

**Landfill**



Many cities around the world place their trash in landfills or dumps. Dumps are large holes in the ground where trash is buried. Landfills are similar to dumps, but they have a special liner on the bottom that helps to separate the trash from the environment.

**Part A:** Describe how humans can benefit from placing trash in landfills instead of placing it in dumps.

They could reduce the amount of trash that ends up in dumps or landfills.

75/1000

Next

Options

Flag

Pause

Review/End Test

## PART B

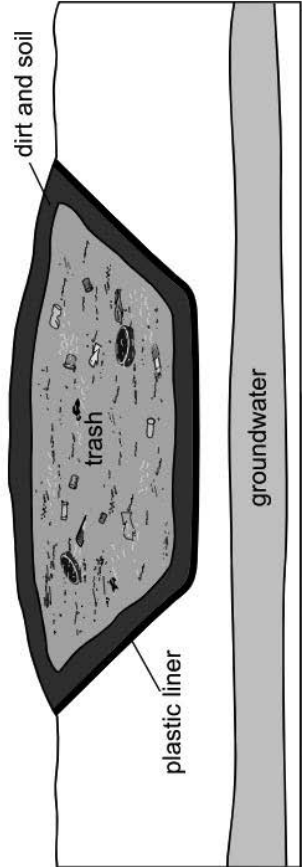
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Item ID

Line Guide

Use the drawing below to answer the question.

**Landfill**



Many cities around the world place their trash in landfills or dumps. Dumps are large holes in the ground where trash is buried. Landfills are similar to dumps, but they have a special liner on the bottom that helps to separate the trash from the environment.

**Part B:** Describe one way that people could reduce the amount of trash that ends up in dumps or landfills.

They could stop littering .

27/1000

Review/End Test

Pause

Flag

Options

Back

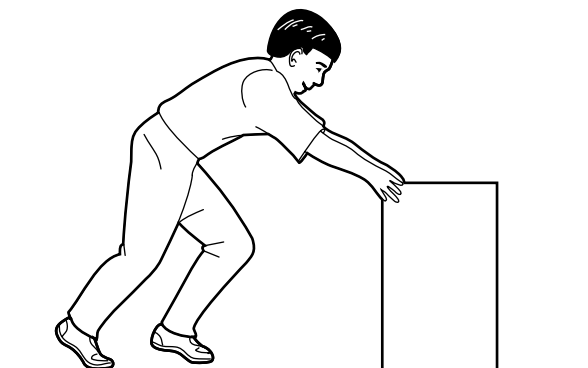
Next

This response provides insufficient evidence to demonstrate any understanding of how everyday human activities may change the environment. In Part A, the response (*They could reduce the amount of trash that ends up in dumps or landfills*) does not describe how humans can benefit from placing trash in landfills instead of placing it in dumps and does not receive any credit. In Part B, the response (*They could stop littering*) does not describe one way that people could reduce the amount of trash that ends up in landfills or dumps and receives no credit.

## OPEN-ENDED ITEM

18. Use the drawing below to answer the question.

Student Pushing a Box



A student is pushing a box across the floor.

**Part A:** Describe how friction affects the motion of the box.

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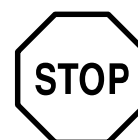
**Part B:** Describe how the student could change the amount of friction acting on the box.

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



## Item-Specific Scoring Guideline

### #18 Item Information

Alignment	S4.C.3.1.1	Depth of Knowledge	3	Mean Score	0.85
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### Scoring Guide

Score	Description
2	<p>The response demonstrates a <i>thorough</i> understanding of how to describe changes in motion caused by forces (e.g., magnetic, pushes or pulls, gravity, friction) by</p> <ul style="list-style-type: none"> <li>describing how friction affects the motion of the box</li> </ul> <p><b>and</b></p> <ul style="list-style-type: none"> <li>describing how the student could change the amount of friction acting on the box.</li> </ul> <p>The response is clear, complete, and correct.</p>
1	<p>The response demonstrates a <i>partial</i> understanding of how to describe changes in motion caused by forces (e.g., magnetic, pushes or pulls, gravity, friction) by</p> <ul style="list-style-type: none"> <li>describing how friction affects the motion of the box</li> </ul> <p><b>or</b></p> <ul style="list-style-type: none"> <li>describing how the student could change the amount of friction acting on the box.</li> </ul> <p>The response may contain some work that is incomplete or unclear.</p>
0	<p>The response provides <i>insufficient</i> evidence to demonstrate any understanding of the concept being tested.</p>

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

### Responses that will receive credit:

#### Part A (1 point):

- Friction slows the motion of the box.
- Friction makes it more difficult for the student to push the box.
- Friction is a force that decreases the motion of the box.

#### Part B (1 point):

- The student could reduce the amount of friction acting on the box by putting the box on an object with wheels (like a wagon) and rolling the box.
- The student could reduce the amount of friction acting on the box by lifting the box.
- The student could reduce the amount of friction on the box by removing items from the box to reduce its weight.
- The student could reduce the amount of friction on the box by coating the floor with a material like oil to make the floor surface even smoother than it appears.
- The student could increase the amount of friction on the box by adding weight to it.
- The student could increase the amount of friction on the box by adding debris to the floor surface that decreases its smoothness.

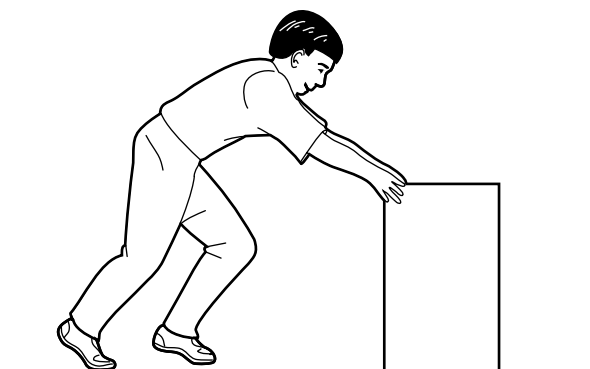


## STUDENT RESPONSE

Response Score: 2 points

18. Use the drawing below to answer the question.

Student Pushing a Box



A student is pushing a box across the floor.

**Part A:** Describe how friction affects the motion of the box.

The friction would effect how the box moves. It would make the box go slower because it is rubbing up against something else.

**Part B:** Describe how the student could change the amount of friction acting on the box.

The studnet could pick the box up. By picking up the box it would reduce all the friction because it is not rubbing on something.

This response demonstrates a thorough understanding of how to describe changes in motion caused by forces. In Part A, the response accurately describes how friction affects the motion of the box (*It would make the box go slower*). In Part B, the response describes how the student could change the amount of friction acting on the box (*The studnet could pick the box up*). The response is clear, complete, and correct.

## STUDENT RESPONSE

Response Score: 1 point



## PART A

Question 18  
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Item ID

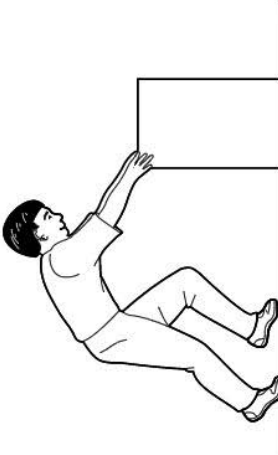
Part A: Describe how friction affects the motion of the box.

The box has friction because two surfaces are rubbing together.

62 / 1000

Use the drawing below to answer the question.

**Student Pushing a Box**



A student is pushing a box across the floor.

Next

Options

Flag

Pause

Review/End Test

## PART B

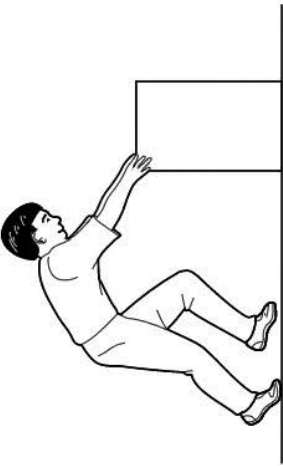
Question 18  
Page 2 of 2

Item ID

Line Guide

Use the drawing below to answer the question.

**Student Pushing a Box**



A student is pushing a box across the floor.

**Part B:** Describe how the student could change the amount of friction acting on the box.

The student could wax the bottom of the box for less friction.

62 / 1000

Back Next

Options

Flag

Pause

Review/End Test

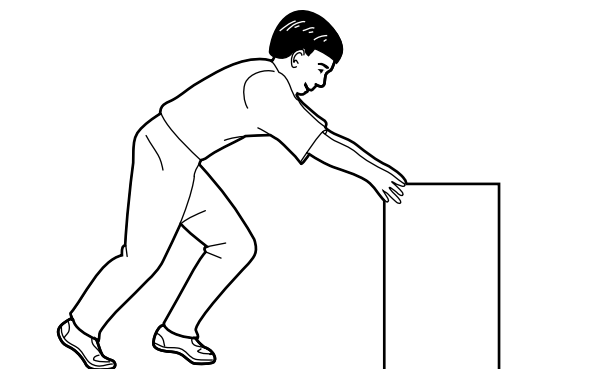
This response demonstrates a partial understanding of how to describe changes in motion caused by forces. In Part A, the response (*The box has friction because two surfaces are rubbing together*) does not describe how friction affects the motion of the box and receives no credit. In Part B, the response accurately describes how the student could change the amount of friction acting on the box (*The student could wax the bottom of the box*).

## STUDENT RESPONSE

Response Score: 0 points

18. Use the drawing below to answer the question.

Student Pushing a Box



A student is pushing a box across the floor.

**Part A:** Describe how friction affects the motion of the box.

Friction affects the motion of the box by giving it the energy or power to move.

**Part B:** Describe how the student could change the amount of friction acting on the box.

The student could change amount of friction by using a inclined plane.

The response provides insufficient evidence to demonstrate any understanding of how to describe changes in motion caused by forces. In Part A, the response (*by giving it the energy or power to move*) does not describe how friction affects the motion of the box and receives no credit. In Part B, the response (*The student could change amount of friction by using a inclined plane*) does not describe how the student could change the amount of friction acting on the box and receives no credit.

## SAMPLE ITEM SUMMARY

## MULTIPLE-CHOICE

Sample Number	Alignment	Answer Key	Depth of Knowledge	p-values A	p-values B	p-values C	p-values D
1	S4.A.1.3.1	B	2	6%	52%	15%	27%
2	S4.A.1.3.4	A	2	55%	12%	13%	20%
3	S4.A.2.1.4	A	3	49%	20%	16%	15%
4	S4.A.2.2.1	C	2	26%	16%	48%	10%
5	S4.A.3.1.1	B	2	9%	63%	13%	15%
6	S4.A.3.1.3	D	2	7%	30%	14%	49%
7	S4.A.3.1.4	B	2	14%	68%	7%	11%
8	S4.A.3.3.1	B	2	16%	67%	9%	8%
9	S4.B.2.1.1	A	2	78%	7%	7%	8%
10	S4.B.2.1.1	B	2	5%	72%	16%	7%
11	S4.B.3.3.3	A	2	50%	15%	11%	24%
12	S4.C.1.1.1	D	2	20%	10%	14%	56%
13	S4.C.1.1.2	C	2	25%	16%	46%	13%
14	S4.D.2.1.3	A	2	35%	20%	26%	19%
15	S4.D.3.1.2	D	2	25%	20%	18%	37%
16	S4.D.3.1.3	B	2	23%	40%	19%	18%

## OPEN-ENDED

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
17	S4.A.1.3.5	2	3	1.02
18	S4.C.3.1.1	2	3	0.85