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<th>Answer Key</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Multiple Choice</td>
<td>Physical Science</td>
<td>The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted.</td>
<td>C</td>
<td>1 point</td>
</tr>
<tr>
<td>6</td>
<td>Graphic Response</td>
<td>Physical Science</td>
<td>The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted.</td>
<td>---</td>
<td>2 points</td>
</tr>
<tr>
<td>8</td>
<td>Multi-Interaction</td>
<td>Earth and Space Science</td>
<td>Most of the cycles and patterns of motion between Earth and the sun are predictable.</td>
<td>B; A</td>
<td>2 points</td>
</tr>
<tr>
<td>9</td>
<td>Multiple Choice</td>
<td>Physical Science</td>
<td>Light and sound are forms of energy that behave in predictable ways.</td>
<td>C</td>
<td>1 point</td>
</tr>
<tr>
<td>10</td>
<td>Graphic Response</td>
<td>Physical Science</td>
<td>The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted.</td>
<td>---</td>
<td>2 points</td>
</tr>
<tr>
<td>16</td>
<td>Graphic Response</td>
<td>Earth and Space Science</td>
<td>Most of the cycles and patterns of motion between Earth and the sun are predictable.</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>19</td>
<td>Multi-Select</td>
<td>Physical Science</td>
<td>The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted.</td>
<td>B, F</td>
<td>1 point</td>
</tr>
<tr>
<td>21</td>
<td>Graphic Response</td>
<td>Life Science</td>
<td>All of the processes that take place within organisms require energy.</td>
<td>---</td>
<td>1 point</td>
</tr>
</tbody>
</table>

* The question number matches the item number in the Item Level Report in the Online Reporting System. The items are numbered sequentially in the practice site.
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>24</td>
<td>Multi-Interaction</td>
<td>Physical Science</td>
<td>Light and sound are forms of energy that behave in predictable ways.</td>
<td>B; C</td>
<td>1 point</td>
</tr>
<tr>
<td>27</td>
<td>Graphic Response</td>
<td>Life Science</td>
<td>All of the processes that take place within organisms require energy.</td>
<td>---</td>
<td>2 points</td>
</tr>
<tr>
<td>28</td>
<td>Table Item</td>
<td>Life Science</td>
<td>Organisms perform a variety of roles in an ecosystem.</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>29</td>
<td>Multi-Select</td>
<td>Life Science</td>
<td>Organisms perform a variety of roles in an ecosystem.</td>
<td>A, D</td>
<td>1 point</td>
</tr>
<tr>
<td>30</td>
<td>Graphic Response</td>
<td>Earth and Space Science</td>
<td>The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics.</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>33</td>
<td>Multi-Interaction</td>
<td>Life Science</td>
<td>All of the processes that take place within organisms require energy.</td>
<td>C; D</td>
<td>2 points</td>
</tr>
<tr>
<td>35</td>
<td>Graphic Response</td>
<td>Life Science</td>
<td>All of the processes that take place within organisms require energy.</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>38</td>
<td>Multi-Interaction</td>
<td>Earth and Space Science</td>
<td>Most of the cycles and patterns of motion between Earth and the sun are predictable.</td>
<td>D; B</td>
<td>1 point</td>
</tr>
</tbody>
</table>

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<th>Content Statement</th>
<th>Answer Key</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>46</td>
<td>Multiple Choice</td>
<td>Earth and Space Science</td>
<td>The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics.</td>
<td>B</td>
<td>1 point</td>
</tr>
</tbody>
</table>

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Grade 5
Science
Spring 2018 Item Release

Question 1

Question and Scoring Guidelines
Question 1

Four boxes are lifted straight up from the ground to a shelf. Each box has a different mass, as shown in the table.

<table>
<thead>
<tr>
<th>Box</th>
<th>Mass (kilograms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>4.5</td>
</tr>
<tr>
<td>M</td>
<td>10</td>
</tr>
<tr>
<td>N</td>
<td>3.5</td>
</tr>
<tr>
<td>O</td>
<td>5</td>
</tr>
</tbody>
</table>

Which box requires the smallest force to lift it off the ground?

A  L
B  M
C  N
D  O

Points Possible: 1
See Alignment for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. This box has the second lowest mass and therefore would require the second smallest force to lift it off the ground.

Rationale for Option B: This is incorrect. This box has the highest mass and therefore would require the largest force to lift it off the ground.

Rationale for Option C: Key - This box has the lowest mass and therefore would require the smallest force to lift it off the ground.

Rationale for Option D: This is incorrect. This box has the second highest mass and therefore would require the second largest force to lift it off the ground.
**Alignment**

**Content Strand**
Physical Science

**Content Statement**
The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted.

**Content Elaboration**
Generally, the greater the force acting on an object, the greater the change in motion. Generally, the more mass an object has, the less influence a given force will have on its motion.

**Cognitive Demand**
Recalling Accurate Science (R)

Requires students to provide accurate statements about scientifically valid facts, concepts and relationships. Recall only requires students to provide a rote response, declarative knowledge or perform routine mathematical tasks. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures (being able to describe how) and basic principles.

**Explanation of the Item**
This item requires the student to determine the box that requires the smallest force to be lifted off the ground, given the mass of the boxes. The box that has the smallest mass, 3.5 kg will require the smallest force to be lifted off the ground. The box with the largest mass, 10 kg will require the largest force to be lifted off the ground. The more mass an object has, the greater the force required to lift it.
Sample Response: 1 point

Four boxes are lifted straight up from the ground to a shelf. Each box has a different mass, as shown in the table.

<table>
<thead>
<tr>
<th>Box</th>
<th>Mass (kilograms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>4.5</td>
</tr>
<tr>
<td>M</td>
<td>10</td>
</tr>
<tr>
<td>N</td>
<td>3.5</td>
</tr>
<tr>
<td>O</td>
<td>5</td>
</tr>
</tbody>
</table>

Which box requires the **smallest** force to lift it off the ground?

- A. L
- B. M
- C. N
- D. O
Grade 5
Science
Spring 2018 Item Release

Question 6

Question and Scoring Guidelines
Question 6

Students slide three different weights across a sheet of ice by giving each a brief push.

A. Select lines on the bar graph to show the relative speed of each weight after the same amount of force is applied to each weight.

B. Select lines on the bar graph to show the relative amount of force that should be applied to each weight so that all weights slide at the same speed.

• There may be more than one correct answer.

Points Possible: 2

See Alignment for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

• In Part A, three bars selected AND the bar selected for “Heavy” is shorter than the bar selected for “Medium” AND the bar selected for “Medium” is shorter than the bar selected for “Light” (1 point);

AND

• In Part B, three bars selected AND the bar selected for “Light” is shorter than the bar selected for “Medium” AND the bar selected for “Medium” is shorter than the bar selected for “Heavy” (1 point).
Alignment
Content Strand
Physical Science

Content Statement
The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted.

Content Elaboration
The motion of an object can change by speeding up, slowing down or changing direction. Forces cause changes in motion. If a force is applied in the same direction of an object’s motion, the speed will increase. Generally, the greater the force acting on an object, the greater the change in motion. Generally, the more mass* an object has, the less influence a given force will have on its motion.

Movement is measured by speed (how fast or slow the movement is). Speed is measured by time and distance traveled (how long it took the object to go a specific distance). Speed is calculated by dividing distance by time. Speed must be investigated through testing and experimentation. Real-world settings are recommended for the investigations when possible.

An object that moves with constant speed travels the same distance in each successive unit of time. In the same amount of time, a faster object moves a greater distance than a slower object. When an object is speeding up, the distance it travels increases with each successive unit of time. When an object is slowing down, the distance it travels decreases with each successive unit of time.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.
Explanation of the Item
This item requires the student to graph the relationship between speed, force, and weight in two different ways. In Part A the weights experience the same force. With the same force, the speed of the weights will differ. In this case the light weight will travel the fastest. This rate should be represented by the longest bar. The medium weight will travel slower than the light weight and be represented by a bar length that falls between light and heavy bar length. The heavy weight will travel the slowest and be represented by the shortest bar.

In Part B the weights travel at the same speed so they will require different forces. In this case the heavy weight will require the greatest force to make it move at the same speed as the other weights. This force is represented by the longest bar. The light weight will require the least force to make it travel at the speed of the other weights. This force is represented by the shortest bar. The medium weight will require a force that falls between the other two weights. The bar length that represents this force will fall between the other two weights.
Grade 5 Science Spring 2018 Item Release

Question 6

Sample Responses
Sample Response: 2 points

Students slide three different weights across a sheet of ice by giving each a brief push.

Top Down View of Ice
- Light
- Medium
- Heavy

A. Select lines on the bar graph to show the relative speed of each weight after the same amount of force is applied to each weight.

B. Select lines on the bar graph to show the relative amount of force that should be applied to each weight so that all weights slide at the same speed.

- There may be more than one correct answer.

A. Speed of weights after same force applied

<table>
<thead>
<tr>
<th>Weight</th>
<th>Relative Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td></td>
</tr>
</tbody>
</table>

B. Force needed to move weights the same speed

<table>
<thead>
<tr>
<th>Weight</th>
<th>Relative Force</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td></td>
</tr>
</tbody>
</table>
Notes on Scoring

This response earns full credit (2 points). Part A correctly indicates the speed each weight will travel with the same amount of force applied. The light weight has the longest bar representing the fastest speed with the force applied. The medium weight will travel slower than the light weight and is represented by a bar length that falls between the light and heavy bar lengths. The heavy weight will travel the slowest and is represented by the shortest bar.

In Part B, the weights travel at the same speed, so they will require different forces. The heavy weight will require the greatest force to make it move at the same speed as the other weights. This force is represented by the longest bar. The light weight will require the least force to make it travel at the speed of the other weights. This force is represented by the shortest bar. The medium weight will require a force that falls between the other two weights. The bar length that represents this force will fall between the other two weights.
**Sample Response: 1 point**

Students slide three different weights across a sheet of ice by giving each a brief push.

**Top Down View of Ice**

<table>
<thead>
<tr>
<th>Weight</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td><img src="image" alt="Light" /></td>
</tr>
<tr>
<td>Medium</td>
<td><img src="image" alt="Medium" /></td>
</tr>
<tr>
<td>Heavy</td>
<td><img src="image" alt="Heavy" /></td>
</tr>
</tbody>
</table>

A. Select lines on the bar graph to show the relative speed of each weight after the same amount of force is applied to each weight.

B. Select lines on the bar graph to show the relative amount of force that should be applied to each weight so that all weights slide at the same speed.

- There may be more than one correct answer.

**Bar Graphs**

<table>
<thead>
<tr>
<th></th>
<th>Light</th>
<th>Medium</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Speed of weights after same force applied</strong></td>
<td><img src="image" alt="Graph A" /></td>
<td><img src="image" alt="Graph A" /></td>
<td><img src="image" alt="Graph A" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Light</th>
<th>Medium</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B. Force needed to move weights the same speed</strong></td>
<td><img src="image" alt="Graph B" /></td>
<td><img src="image" alt="Graph B" /></td>
<td><img src="image" alt="Graph B" /></td>
</tr>
</tbody>
</table>
Notes on Scoring

This response earns partial credit (1 point). Part A correctly indicates the speed each weight will travel with the same amount of force applied. The light weight has the longest bar representing the fastest speed with the force applied. The medium weight will travel slower than the light weight and is represented by a bar length that falls between the light and heavy bar lengths. The heavy weight will travel the slowest and is represented by the shortest bar.

No credit is earned for Part B. The weights travel at the same speed so they will require different forces. This response incorrectly indicates that the force required to move all three weights will be the same.
Sample Response: 1 point

Students slide three different weights across a sheet of ice by giving each a brief push.

A. Select lines on the bar graph to show the relative speed of each weight after the same amount of force is applied to each weight.

B. Select lines on the bar graph to show the relative amount of force that should be applied to each weight so that all weights slide at the same speed.

- There may be more than one correct answer.
Notes on Scoring

This response earns partial credit (1 point) for Part B. The weights travel at the same speed so they will require different forces. The heavy weight will require the greatest force to make it move at the same speed as the other weights. This force is represented by the longest bar. The light weight will require the least force to make it travel at the speed of the other weights. This force is represented by the shortest bar. The medium weight will require a force that falls between the other two weights. The bar length that represents this force will fall between the other two weights.

No credit is earned for Part A. This response incorrectly indicates the speed each weight will travel with the same amount of force applied. The response indicates the opposite of what is expected, heavy weight traveling the fastest. This is not accurate, the heavy weight will travel the slowest and the lightest weight will travel the fastest.
Students slide three different weights across a sheet of ice by giving each a brief push.

A. Select lines on the bar graph to show the relative speed of each weight after the same amount of force is applied to each weight.

B. Select lines on the bar graph to show the relative amount of force that should be applied to each weight so that all weights slide at the same speed.

- There may be more than one correct answer.

Notes on Scoring

This response earns no credit (0 points). This response incorrectly reverses the relative speed for Part A and force for Part B.
Sample Response: 0 points

Students slide three different weights across a sheet of ice by giving each a brief push.

A. Select lines on the bar graph to show the relative speed of each weight after the same amount of force is applied to each weight.

B. Select lines on the bar graph to show the relative amount of force that should be applied to each weight so that all weights slide at the same speed.

- There may be more than one correct answer.

Notes on Scoring

This response earns no credit (0 points). This response incorrectly reverses the relative speed for Part A. In Part B, the weights travel at the same speed so they will require different forces. This response incorrectly indicates that the force required to move all three weights will be the same.
Question 8

The following question has two parts. First, answer part A. Then, answer part B.

**Part A**

The picture shows the positions of four stars relative to Earth's axis and equator.

When viewed from the Northern Hemisphere, which star appears to stay in the same place in the sky throughout the night?

- 1
- 2
- 3
- 4

**Part B**

What causes some stars to appear to stay in the same place, while other stars appear to move across the sky throughout a single night?

- Earth rotates on its axis.
- Earth revolves around the sun.
- Half of Earth faces away from the sun at all times.
- The length of nighttime changes as the seasons change.

Points Possible: 2

See Alignment for more detail.
Scoring Guidelines

Part A
Rationale for Option A: This is incorrect. Because this star is not aligned with a pole, it would appear to move across the sky throughout the night as it rises in the eastern sky and sets in the western sky.

Rationale for Option B: Key - This star is almost located directly over the northern pole so it appears to stay still as other stars appear to move across the sky due to Earth’s rotation on its axis.

Rationale for Option C: This is incorrect. This star aligns with the equator. Therefore, its apparent motion fully crosses the sky at night.

Rationale for Option D: This is incorrect. Because this star is not located near a pole, it would appear to rise in the east and move across the sky throughout the night to set in the west.

Part B
Rationale for Option A: Key - As Earth rotates on its axis, stars appear to move across the sky. A star aligning with the axis would have no apparent motion.

Rationale for Option B: This is incorrect. This motion makes different stars visible during different seasons, but does not affect the apparent nightly motion of the stars.

Rationale for Option C: This is incorrect. Although this phenomenon makes stars visible at night, it does not affect their apparent motion.

Rationale for Option D: This is incorrect. Apparent motion of the stars does not depend on the length of hours of night or day as stars appear to make a full circle in the sky every 24 hours. Even though the hours of daylight may increase, blocking the stars from view, the apparent motion of the stars across the sky remains the same.
Alignment

Content Strand
Earth and Space Science

Content Statement
Most of the cycles and patterns of motion between Earth and the sun are predictable.

Content Elaboration
Earth completes one rotation on its axis in a 24-hour period, producing day and night. This rotation makes the sun, stars and moon appear to change position in the sky. Earth’s axis is tilted at an angle of 23.5°.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Explanation of the Item
This item requires the student to identify stars that seem to have no apparent motion and to relate this to the regular cycle and patterns on Earth resulting from Earth’s motion and angled axis. In the diagram shown, star 2 is almost located directly over the northern pole so it appears to remain stationary as the other stars (1, 3 and 4) appear to move across the sky (east to west) due to Earth’s rotation on its axis.
Grade 5
Science
Spring 2018 Item Release

Question 8

Sample Responses
Sample Response: 2 points

The following question has two parts. First, answer part A. Then, answer part B.

**Part A**
The picture shows the positions of four stars relative to Earth’s axis and equator.

When viewed from the Northern Hemisphere, which star appears to stay in the same place in the sky throughout the night?

- 1
- 2
- 3
- 4

**Part B**
What causes some stars to appear to stay in the same place, while other stars appear to move across the sky throughout a single night?

- Earth rotates on its axis.
- Earth revolves around the sun.
- Half of Earth faces away from the sun at all times.
- The length of nighttime changes as the seasons change.

**Notes on Scoring**

This response earns full credit (2 points). It correctly identifies star 2 as appearing in the same place in the night sky throughout the night due to the Earth’s rotation on its axis.
Sample Response: 1 point

The following question has two parts. First, answer part A. Then, answer part B.

Part A
The picture shows the positions of four stars relative to Earth’s axis and equator.

When viewed from the Northern Hemisphere, which star appears to stay in the same place in the sky throughout the night?

- 1
- 2
- 3
- 4

Part B
What causes some stars to appear to stay in the same place, while other stars appear to move across the sky throughout a single night?

- Earth rotates on its axis.
- Earth revolves around the sun.
- Half of Earth faces away from the sun at all times.
- The length of nighttime changes as the seasons change.

Notes on Scoring

This response earns partial credit (1 point). It correctly identifies star 2 as appearing in the same place in the night sky throughout the night but fails to identify the reason as Earth’s rotation on its axis.
Sample Response: 0 points

The following question has two parts. First, answer part A. Then, answer part B.

**Part A**
The picture shows the positions of four stars relative to Earth’s axis and equator.

When viewed from the Northern Hemisphere, which star appears to stay in the same place in the sky throughout the night?

- 1
- 2
- 3
- 4

**Part B**
What causes some stars to appear to stay in the same place, while other stars appear to move across the sky throughout a single night?

- Earth rotates on its axis.
- Earth revolves around the sun.
- Half of Earth faces away from the sun at all times.
- The length of nighttime changes as the seasons change.

**Notes on Scoring**

This response earns no credit (0 points). It incorrectly identifies star 3 as appearing in the same place in the night sky. Star 3 will appear to move across the sky from the eastern sky to the western sky. The response also incorrectly relates number of daylight hours for the appearance of the star in one location.
Sample Response: 0 points

The following question has two parts. First, answer part A. Then, answer part B.

Part A

The picture shows the positions of four stars relative to Earth’s axis and equator.

![Diagram of stars and Earth's axis](image)

When viewed from the Northern Hemisphere, which star appears to stay in the same place in the sky throughout the night?

- 1
- 2
- 3
- 4

Part B

What causes some stars to appear to stay in the same place, while other stars appear to move across the sky throughout a single night?

- Earth rotates on its axis.
- Earth revolves around the sun.
- Half of Earth faces away from the sun at all times.
- The length of nighttime changes as the seasons change.

Notes on Scoring

This response earns no credit (0 points). It incorrectly identifies star 4 as appearing in the same place in the night sky. Star 4 will appear to move across the sky from the eastern sky to the western sky. The response also incorrectly relates number of daylight hours for the appearance of the star in one location.
Grade 5
Science
Spring 2018 Item Release

Question 9

Question and Scoring Guidelines
Question 9

A student fills three identical glasses with different amounts of water as shown. She taps each one with a spoon and observes that each produces a sound with a different pitch.

Which statement explains the student’s observations?

A. The tapping creates different sounds that echo.
B. Sound travels faster through larger amounts of water.
C. The amount of water in the glass affects vibration rate.
D. Some of the glasses were tapped harder with the spoon.

Points Possible: 1
See Alignment for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. The pitch is determined by vibration rate, not a sound that echoes.

Rationale for Option B: This is incorrect. Changing the amount of water does not affect the speed of sound traveling through it. Pitch is determined by vibration rate, not the speed the sound is traveling.

Rationale for Option C: Key - The amount of water in the glass affects the rate of vibration. Vibration rate affects the pitch.

Rationale for Option D: This is incorrect. A harder tap would cause a louder sound, not one with a different pitch.
Alignment
Content Strand
Physical Science

Content Statement
Light and sound are forms of energy that behave in predictable ways.

Content Elaboration
Sound is produced by vibrating objects and requires a medium through which to travel. The rate of vibration is related to the pitch of the sound.

Pitch can be changed by changing how fast an object vibrates. Objects that vibrate slowly produce low pitches; objects that vibrate quickly produce high pitches. Audible sound can only be detected within a certain range of pitches.

Cognitive Demand
Recalling Accurate Science (R)

Requires students to provide accurate statements about scientifically valid facts, concepts and relationships. Recall only requires students to provide a rote response, declarative knowledge or perform routine mathematical tasks. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures (being able to describe how) and basic principles.

Explanation of the Item
This item requires the student to recognize that pitch is related to speed of vibration. The varying amounts of water will impact the rate of vibration for each glass with water. The glass with the most water will have the lowest pitch because the vibration is the slowest. The glass with the least water will have the highest pitch because the vibration is the fastest.
Sample Response: 1 point

A student fills three identical glasses with different amounts of water as shown. She taps each one with a spoon and observes that each produces a sound with a different pitch.

Which statement explains the student’s observations?

A. The tapping creates different sounds that echo.
B. Sound travels faster through larger amounts of water.
C. The amount of water in the glass affects vibration rate.
D. Some of the glasses were tapped harder with the spoon.
Grade 5
Science
Spring 2018 Item Release

Question 10

Question and Scoring Guidelines
Question 10

Two carts are at rest on straight, frictionless tracks. A student applies a brief force to move an empty cart on one track. A second student applies the same force for the same amount of time to an identical cart that is carrying bricks across an identical track. The force is removed when the carts cross the start line and a stopwatch starts timing.

Use the Add Point button to place three points to show the positions of each cart at 1 second, 2 seconds, and 3 seconds after the carts cross the start line.

- There may be more than one correct answer.

Points Possible: 2
See Alignment for more detail.

Scoring Guidelines

For this item, a full-credit (2 point) response includes:
- only 3 points in which all 3 points and the start point are equally spaced apart for each cart;
  AND
- the distance between the 3 points for the “Cart Carrying Bricks” is less than the distance between the points of the “Empty Cart.”

For this item, a partial-credit (1 point) response includes
- only 3 points in which all 3 points and the start point are equally spaced apart for each cart;
  OR
- only 3 points placed for both carts;
  AND
- the right point for the “Empty Cart” is farther to the right than the right point for the “Cart Carrying Bricks.”
Content Statement
The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted.

Content Elaboration
Any change in speed or direction of an object requires a force and is affected by the mass* of the object and the amount of force applied. The motion of an object can change by speeding up, slowing down or changing direction. Forces cause changes in motion. If a force is applied in the same direction of an object’s motion, the speed will increase. If a force is applied in the opposite direction of an object’s motion, the speed will decrease. Generally, the greater the force acting on an object, the greater the change in motion. Generally, the more mass* an object has, the less influence a given force will have on its motion. If no forces act on an object, the object does not change its motion and moves at constant speed in a given direction. If an object is not moving and no force acts on it, the object will remain at rest.

An object that moves with constant speed travels the same distance in each successive unit of time. In the same amount of time, a faster object moves a greater distance than a slower object. When an object is speeding up, the distance it travels increases with each successive unit of time. When an object is slowing down, the distance it travels decreases with each successive unit of time.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.
**Explanation of the Item**

This item requires the student to select the locations of two moving carts with different masses over a period of three seconds. Each cart moves with constant speed on the frictionless surface. The distance traveled in each successive unit of time is equal. Each cart should have 3 points indicated on the line and the points need to be equally spaced because the carts are moving at constant speed.

Equal force is applied to both carts. This force will cause the lighter cart to travel at a faster speed than the heavier cart. The distance between the 3 points for the “Cart Carrying Bricks” is less than the distance between the points of the “Empty Cart.” The cart with bricks has more mass which means it will travel slower than the empty cart. In the same amount of time, a lighter cart will move a greater distance than the cart with bricks.
Grade 5 Science
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Question 10

Sample Responses
Two carts are at rest on straight, frictionless tracks. A student applies a brief force to move an empty cart on one track. A second student applies the same force for the same amount of time to an identical cart that is carrying bricks across an identical track. The force is removed when the carts cross the start line and a stopwatch starts timing.

Use the Add Point button to place three points to show the positions of each cart at 1 second, 2 seconds, and 3 seconds after the carts cross the start line.

- There may be more than one correct answer.
Notes on Scoring

This response earns full credit (2 points). This response correctly selects the locations of two moving carts for three seconds with different masses over a period of three seconds. Equal force is applied to both carts. Each cart moves with constant speed on the frictionless surface so the distance traveled in each successive unit of time is equal. Each cart should have 3 points indicated on the line and the points need to be equally spaced because the carts are moving at constant speed.

The distance between the 3 points for the “Cart Carrying Bricks” is less than the distance between the points of the “Empty Cart.” The cart with bricks has more mass which means it will travel slower than the empty cart. In the same amount of time, a lighter cart will move a greater distance than the cart with bricks.
Two carts are at rest on straight, frictionless tracks. A student applies a brief force to move an empty cart on one track. A second student applies the same force for the same amount of time to an identical cart that is carrying bricks across an identical track. The force is removed when the carts cross the start line and a stopwatch starts timing.

Use the Add Point button to place three points to show the positions of each cart at 1 second, 2 seconds, and 3 seconds after the carts cross the start line.

• There may be more than one correct answer.
Notes on Scoring

This response earns partial credit (1 point). This response correctly indicates that the carts are moving at a constant speed. The distance traveled in each successive unit of time is equal. Each cart should have 3 points indicated on the line and the points need to be equally spaced because the carts are moving at constant speed.

No credit is earned for incorrectly indicating that the carts would travel at the same speed and distance. The distance between the 3 points for the “Cart Carrying Bricks” should be less than the distance between the points of the “Empty Cart.” The cart with bricks has more mass which means it will travel slower than the empty cart. In the same amount of time, a lighter cart will move a greater distance than the cart with bricks.
Two carts are at rest on straight, frictionless tracks. A student applies a brief force to move an empty cart on one track. A second student applies the same force for the same amount of time to an identical cart that is carrying bricks across an identical track. The force is removed when the carts cross the start line and a stopwatch starts timing.

Use the Add Point button to place three points to show the positions of each cart at 1 second, 2 seconds, and 3 seconds after the carts cross the start line.

- There may be more than one correct answer.
Notes on Scoring

This response earns partial credit (1 point). This response correctly indicates the distance between the 3 points for the “Cart Carrying Bricks” should be less than the distance between the points of the “Empty Cart.” The cart with bricks has more mass which means it will travel slower than the empty cart. In the same amount of time, a lighter cart will move a greater distance than the cart with bricks.

This response earns no credit for indicating the carts are traveling at constant speed because it shows the empty cart speeding up. For carts traveling at constant speed the distance traveled in each successive unit of time should be equal. Each cart should have 3 points indicated on the line and the points need to be equally spaced because the carts are moving at constant speed.
Sample Response: 0 points

Two carts are at rest on straight, frictionless tracks. A student applies a brief force to move an empty cart on one track. A second student applies the same force for the same amount of time to an identical cart that is carrying bricks across an identical track. The force is removed when the carts cross the start line and a stopwatch starts timing.

Use the Add Point button to place three points to show the positions of each cart at 1 second, 2 seconds, and 3 seconds after the carts cross the start line.

• There may be more than one correct answer.

Notes on Scoring

This response earns no credit (0 points). The response incorrectly indicates that the cart carrying bricks moves faster and there is no indication that the carts are moving at a constant speed.
Sample Response: 0 points

Two carts are at rest on straight, frictionless tracks. A student applies a brief force to move an empty cart on one track. A second student applies the same force for the same amount of time to an identical cart that is carrying bricks across an identical track. The force is removed when the carts cross the start line and a stopwatch starts timing.

Use the Add Point button to place three points to show the positions of each cart at 1 second, 2 seconds, and 3 seconds after the carts cross the start line.

• There may be more than one correct answer.

Notes on Scoring

This response earns no credit (0 points). The response incorrectly indicates that the cart carrying bricks moves faster than the empty cart. More than three dots are provided which exceeds what was requested to illustrate the movement at 1 second, 2 seconds and 3 seconds after the carts cross the start line.
Grade 5
Science
Spring 2018 Item Release

Question 16

Question and Scoring Guidelines
Question 16

The sun appears in different positions in the sky throughout the year. Two days when the sun is in very different positions are December 21 and June 21.

A. Click on either December 21 or June 21.

B. Move the sun to the position where it would appear in the sky on your chosen date at noon.

C. Move the shadow of the flagpole into the blank box to show the length it would be on the day you chose.

- Place only one label in each blank box.
- You do not need to use all the objects.
- There may be more than one correct answer.

Points Possible: 1

See Alignment for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- December 21 selected AND the sun in the bottom position AND the longest shadow in right box (1 point);
  OR
- June 21 selected AND the sun in the top position AND the shortest shadow in the right box. (1 point).
Alignment

Content Strand
Earth and Space Science

Content Statement
Most of the cycles and patterns of motion between Earth and the sun are predictable.

Content Elaboration
Earth’s revolution around the sun takes approximately 365 days. Earth completes one rotation on its axis in a 24-hour period, producing day and night. This rotation makes the sun, stars, and moon appear to change position in the sky. Earth’s axis is tilted at an angle of 23.5°. This tilt, along with Earth’s revolution around the sun, affects the amount of direct sunlight that the Earth receives in a single day and throughout the year.

Note: The amount of direct sunlight that Earth receives is related to the altitude of the sun, which affects the angle of the sun’s rays, and the amount of time the sun is above the horizon each day.

Seasonal change should be expanded in grade 5 to include regions of the world that experience specific seasonal weather patterns and natural weather hazards (e.g., hurricane season, monsoon season, rainy season, dry season). This builds upon making observations of the seasons throughout the school year in the earlier grades and prepares students for understanding the difference between weather and climate.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This item requires the student to demonstrate how the sun’s position changes in the sky throughout the year. June 21st is summer in Ohio and the sun is located at the highest point in the sky producing the shortest shadow. December 21st is winter in Ohio and the sun is located at the lowest point in the sky producing the longest shadow. The student can demonstrate either position to address the task.
Sample Response: 1 point

The sun appears in different positions in the sky throughout the year. Two days when the sun is in very different positions are December 21 and June 21.

A. Click on either December 21 or June 21.

B. Move the sun to the position where it would appear in the sky on your chosen date at noon.

C. Move the shadow of the flagpole into the blank box to show the length it would be on the day you chose.

- Place only one label in each blank box.
- You do not need to use all the objects.
- There may be more than one correct answer.

Notes on Scoring

This response earns full credit (1 point). December 21 is selected with the sun at the lowest position in the sky and the longest shadow selected.
Sample Response: 0 points

The sun appears in different positions in the sky throughout the year. Two days when the sun is in very different positions are December 21 and June 21.

A. Click on either December 21 or June 21.

B. Move the sun to the position where it would appear in the sky on your chosen date at noon.

C. Move the shadow of the flagpole into the blank box to show the length it would be on the day you chose.
   - Place only one label in each blank box.
   - You do not need to use all the objects.
   - There may be more than one correct answer.

Notes on Scoring

This response earns no credit (0 points). December 21 is selected with the sun at the highest position in the sky and the shortest shadow selected. The sun and shadow selected would indicate the positions for June 21.
Sample Response: 0 points

The sun appears in different positions in the sky throughout the year. Two days when the sun is in very different positions are December 21 and June 21.

A. Click on either December 21 or June 21.

B. Move the sun to the position where it would appear in the sky on your chosen date at noon.

C. Move the shadow of the flagpole into the blank box to show the length it would be on the day you chose.

- Place only one label in each blank box.
- You do not need to use all the objects.
- There may be more than one correct answer.

Notes on Scoring

This response earns no credit (0 points). The sun and shadow positions selected would indicate spring or fall not summer or winter.
Grade 5 Science
Spring 2018 Item Release

Question 19

Question and Scoring Guidelines
Question 19

Scientists use electronic devices to collect data about birds during a migration. These data are shared on the Internet for anyone to view. A student analyzes the data and concludes that one bird flies at a speed of 20 meters per second during a portion of its migration.

Select the two types of data that the student needed to form this conclusion.

☐ the bird’s weight
☐ the bird’s locations
☐ the direction of wind
☐ the bird’s wing length
☐ the direction the bird flies
☐ the time interval between data points

Points Possible: 1
See Alignment for more detail.

Scoring Guidelines

Rationale for First Option: This is incorrect. The bird’s weight may affect the speed of the bird, but only distance and time measurements can be used to determine the bird’s speed in order to support the conclusion.

Rationale for Second Option: Key – In order to determine the speed at which the bird moves, the distance it travels within a time interval must be measured and recorded. Distance can be determined by knowing the bird’s starting and finishing locations.

Rationale for Third Option: This is incorrect. The direction of wind may affect the speed of the bird, but only distance and time measurements can be used to determine the bird’s speed in order to support the conclusion.

Rationale for Fourth Option: This is incorrect. The wingspan of the bird may affect its speed, but it is not a measurement needed to determine its speed of travel in order to support the conclusion.

Rationale for Fifth Option: This is incorrect. The bird can be flying in any direction, so this data is not necessary to determine its speed.

Rationale for Sixth Option: Key – In order to determine the speed at which the bird moves, the distance traveled during a period of time must be measured and recorded.
Alignment
Content Strand
Physical Science

Content Statement
The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted.

Content Elaboration
Movement is measured by speed (how fast or slow the movement is). Speed is measured by time and distance traveled (how long it took the object to go a specific distance). Speed is calculated by dividing distance by time. Speed must be investigated through testing and experimentation. Real-world settings are recommended for the investigations when possible.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This item requires the student to determine the types of data that are relevant to forming a conclusion about the speed of a migrating bird. In order to determine the speed at which the bird moves, the distance it travels within a time interval must be measured and recorded. The distance is then divided by the time it takes the bird to travel that distance.
Sample Response: 1 point

Scientists use electronic devices to collect data about birds during a migration. These data are shared on the Internet for anyone to view. A student analyzes the data and concludes that one bird flies at a speed of 20 meters per second during a portion of its migration.

Select the two types of data that the student needed to form this conclusion.

☐ the bird’s weight
☑️ the bird’s locations
☐ the direction of wind
☐ the bird’s wing length
☐ the direction the bird flies
☑️ the time interval between data points
Grade 5
Science
Spring 2018 Item Release

Question 21

Question and Scoring Guidelines
Question 21

Cheetahs are predators that can run very fast. Cheetahs eat impalas. Impalas are mammals that eat grasses.

Move a number next to each step to show the order of events that leads to the cheetah getting energy.

- All of the numbers should be used.
- You do not need to fill all the blank boxes.

How a Cheetah Gets Energy

1. An impala eats grass.
2. Grass is stepped on and begins to decompose.
3. Grasses use energy to grow taller.
4. A cheetah hunts an impala.
5. The sun shines on a field of grass.

Points Possible: 1

See Alignment for more detail.

Scoring Guidelines

For this item, a full-credit response includes correctly identifying all four of the following:

- step 1 as the sun shines on a field of grass;
  AND
- step 2 as grasses use energy to grow taller;
  AND
- step 3 as an impala eats grass;
  AND
- step 4 as a cheetah hunts an impala (1 point).
Alignment

Content Strand
Life Science

Content Statement
All of the processes that take place within organisms require energy.

Content Elaboration
For ecosystems, the major source of energy is sunlight.

Energy entering ecosystems as sunlight is transferred and transformed by producers into energy that organisms use through the process of photosynthesis. That energy then passes from organism to organism as illustrated in food webs.

In most ecosystems, energy derived from the sun is transferred and transformed into energy that organisms use by the process of photosynthesis in plants and other photosynthetic organisms.

Energy flows through an ecosystem in one direction, from photosynthetic organisms to consumers (herbivores, omnivores and carnivores) and decomposers. The exchange of energy that occurs in an ecosystem can be represented as a food web. The exchange of energy in an ecosystem is essential because all processes of life for all organisms require a continual supply of energy.

Cognitive Demand
Recalling Accurate Science (R)

Requires students to provide accurate statements about scientifically valid facts, concepts and relationships. Recall only requires students to provide a rote response, declarative knowledge or perform routine mathematical tasks. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures (being able to describe how) and basic principles.

Explanation of the Item
This item requires the student to identify how energy flows through an ecosystem from the sun to a cheetah. In this item, step one is the sun shining on a field of grass. The grass then uses energy to grow taller, step 2. An impala can then eat the grass, step 3. The final step for the energy flow to the cheetah is when the impala is hunted and consumed by the cheetah. The grass being stepped on and decomposing provides no energy to the cheetah.
Sample Response: 1 point

Cheetahs are predators that can run very fast. Cheetahs eat impalas. Impalas are mammals that eat grasses.

Move a number next to each step to show the order of events that leads to the cheetah getting energy.

- All of the numbers should be used.
- You do not need to fill all the blank boxes.

<table>
<thead>
<tr>
<th></th>
<th>How a Cheetah Gets Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The sun shines on a field of grass.</td>
</tr>
<tr>
<td>2</td>
<td>Grasses use energy to grow taller.</td>
</tr>
<tr>
<td>3</td>
<td>An impala eats grass.</td>
</tr>
<tr>
<td>4</td>
<td>A cheetah hunts an impala.</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns full credit (1 point) for correctly sequencing the steps to order the events that lead to the cheetah getting energy.
Sample Response: 0 points

Cheetahs are predators that can run very fast. Cheetahs eat impalas. Impalas are mammals that eat grasses.

Move a number next to each step to show the order of events that leads to the cheetah getting energy.

- All of the numbers should be used.
- You do not need to fill all the blank boxes.

How a Cheetah Gets Energy

3. An impala eats grass.
4. Grass is stepped on and begins to decompose.
2. Grasses use energy to grow taller.
1. A cheetah hunts an impala.

Notes on Scoring

This response earns no credit (0 points) for incorrectly sequencing the steps to order the events that lead to the cheetah getting energy. Grass being stepped on and decomposing does not provide energy to the cheetah.
Sample Response: 0 points

Cheetahs are predators that can run very fast. Cheetahs eat impalas. Impalas are mammals that eat grasses.

Move a number next to each step to show the order of events that lead to the cheetah getting energy.

- All of the numbers should be used.
- You do not need to fill all the blank boxes.

### How a Cheetah Gets Energy

1. The sun shines on a field of grass.
2. Grasses use energy to grow taller.
3. A cheetah hunts an impala.
4. An impala eats grass.
5. Grass is stepped on and begins to decompose.

Notes on Scoring

This response earns no credit (0 points) for incorrectly sequencing the steps to order the events that lead to the cheetah getting energy. Energy flows from the grass to the impala to the cheetah. After the impala is hunted and consumed it will no longer be able to eat grass.
## Question 24

The following question has two parts. First, answer part A. Then, answer part B.

### Part A

Students observe that the sound of their voices echoes in an empty classroom. They fill the room with soft objects like coats and backpacks and notice that the sounds of their voices change.

How will the sound of their voices change if the room is filled with soft objects?

- A. The sounds will combine.
- B. The sounds will become quieter.
- C. The sounds will travel more slowly.
- D. The sounds will have a higher pitch.

### Part B

Why do the sounds of the students’ voices change after the classroom is filled with soft objects?

- A. The objects cause sound vibrations to bounce back.
- B. The objects allow sound vibrations to pass through them.
- C. The objects absorb the sound vibrations that reach them.
- D. The objects move when the sound vibrations reach them.

### Points Possible: 1

See Alignment for more detail.
Scoring Guidelines

Part A
Rationale for Option A: This is incorrect. Sound travels outward in all directions instead of combining in a focused direction.

Rationale for Option B: **Key** – The volume of sound will decrease since more sound waves will be absorbed by the objects filling the classroom.

Rationale for Option C: This is incorrect. The speed of sound may change as it moves from one medium into another, but the speed of sound in the air inside the classroom will not change.

Rationale for Option D: This is incorrect. The pitch of the sound will only change if the vibration rates of the sounds change. Filling the classroom with objects does not change the pitch of the students’ voices.

Part B
Rationale for Option A: This is incorrect. If the objects caused the sound waves to bounce back, there would be more echo in the classroom instead of less.

Rationale for Option B: This is incorrect. Some of the objects may allow sound waves to pass through them, but it is the absorption of the sound that causes a decrease in echo within the classroom.

Rationale for Option C: **Key** – The objects in the classroom absorb sound, causing less reflection of sound.

Rationale for Option D: This is incorrect. The vibration rate of an object may change when a sound wave strikes it, but it is the absorption of the sound that causes a decrease in echo in the classroom.
Alignment
Content Strand
Physical Science

Content Statement
Light and sound are forms of energy that behave in predictable ways.

Content Elaboration
Sound is produced by vibrating objects and requires a medium through which to travel.

Sound must travel through a material (medium) to move from one place to another. This medium may be a solid, liquid or gas. Sound travels at different speeds through different media. Once sound is produced, it travels outward in all directions until it reaches a different medium. When it encounters this new medium, the sound can continue traveling through the new medium, become absorbed by the new medium, bounce back into the original medium (reflected) or engage in some combination of these possibilities.

Cognitive Demand
Recalling Accurate Science (R)

Requires students to provide accurate statements about scientifically valid facts, concepts and relationships. Recall only requires students to provide a rote response, declarative knowledge or perform routine mathematical tasks. This cognitive demand refers to students’ knowledge of science fact, information, concepts, tools, procedures (being able to describe how) and basic principles.

Explanation of the Item
This item requires the student to predict the effect the addition of soft objects will have on the sound of voices in a classroom. The student then provides an explanation for the change in sound caused by the addition of the soft objects. When sound waves interact with soft objects some of the sound energy is absorbed by the soft objects. This decrease in sound energy causes the classroom to become quieter.
Sample Response: 1 point

The following question has two parts. First, answer part A. Then, answer part B.

**Part A**

Students observe that the sound of their voices echoes in an empty classroom. They fill the room with soft objects like coats and backpacks and notice that the sounds of their voices change.

How will the sound of their voices change if the room is filled with soft objects?

A. The sounds will combine.
B. The sounds will become quieter.
C. The sounds will travel more slowly.
D. The sounds will have a higher pitch.

**Part B**

Why do the sounds of the students’ voices change after the classroom is filled with soft objects?

A. The objects cause sound vibrations to bounce back.
B. The objects allow sound vibrations to pass through them.
C. The objects absorb the sound vibrations that reach them.
D. The objects move when the sound vibrations reach them.
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Stimulus for Questions 27 - 29
A table of feeding relationships in a partial ecosystem is shown.

### Ecosystem Feeding Relationships

<table>
<thead>
<tr>
<th>Organism</th>
<th>Food Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cougar</td>
<td>Raccoon, mouse, snake</td>
</tr>
<tr>
<td>Mouse</td>
<td>Sunflower</td>
</tr>
<tr>
<td>Raccoon</td>
<td>Mouse, sunflower</td>
</tr>
<tr>
<td>Snake</td>
<td>Mouse</td>
</tr>
</tbody>
</table>
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Question 27

Question and Scoring Guidelines
Question 27

The diagram shows a blank food and energy chain for this ecosystem. Use the diagram to build a food and energy chain that includes the main source of energy in the ecosystem.

A. Place a label into each blank box to construct the food chain.
B. Place an arrow between each blank box to show the direction of energy flow in the ecosystem.

- There may be more than one correct answer.

Points Possible: 2
See Alignment for more detail.
Scoring Guidelines

For this item, a full-credit response includes:

- “Sun” placed in the “Main Energy Source” box;
  AND
- “Sunflower” placed in box 2;
  AND
- “Mouse” placed in box 3;
  AND
- “Cougar” or “Raccoon” or “Snake” placed in box 4;
  AND
- Arrow placed between box 2 and box 3 with arrow ending on box 3;
  AND
- Arrow placed between box 3 and box 4 with arrow ending on box 4 (2 points);
  OR
- “Sun” placed in the “Main Energy Source” box;
  AND
- “Sunflower” placed in box 2;
  AND
- “Raccoon” placed in box 3;
  AND
- “Cougar” placed in box 4;
  AND
- Arrow drawn from box 2 to box 3 with arrow ending on box 3;
  AND
- Arrow drawn from box 3 to box 4 with arrow ending on box 4 (2 points).

For this item, a partial-credit response includes:

- “Sunflower” placed in the “Main Energy Source” box;
  AND
- “Mouse” placed in box 2;
AND
• “Snake” or “Raccoon” placed in box 3;
  AND
• “Cougar” placed in box 4;
  AND
• no incorrect arrows (1 point);
  OR
• “Sun” placed in the “Main Energy Source” box;
  AND
• Arrow drawn from box 2 to box 3 with arrow ending on box 3;
  AND
• Arrow drawn from box 3 to box 4 with arrow ending on box 4 (1 point);
  OR
• “Sunflower” placed in the “Main Energy Source” box;
  AND
• “Mouse” placed in box 2;
  AND
• “Snake” or “Raccoon” placed in box 3;
  AND
• “Cougar” placed in box 4;
  AND
• Arrow drawn from box 2 to box 3 with arrow ending on box 3;
  AND
• Arrow drawn from box 3 to box 4 with arrow ending on box 4 (1 point).
Alignment

Content Strand
Life Science

Content Statement
All of the processes that take place within organisms require energy.

Content Elaboration
For ecosystems, the major source of energy is sunlight.

Energy flows through an ecosystem in one direction, from photosynthetic organisms to consumers (herbivores, omnivores and carnivores) and decomposers. The exchange of energy that occurs in an ecosystem can be represented as a food web. The exchange of energy in an ecosystem is essential because all processes of life for all organisms require a continual supply of energy.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This item requires the student to model the flow of energy from sunlight to other organisms in the food chain. The sun is the major energy source. The sun provides energy for the sunflower which can be consumed by the mouse. The mouse can be consumed by the raccoon or snake which can then be consumed by the cougar. The arrows in the middle of the boxes should have the arrow pointing to the right to indicate the direction of energy flow from one organism to another.
Sample Response: 2 points

The diagram shows a blank food and energy chain for this ecosystem. Use the diagram to build a food and energy chain that includes the main source of energy in the ecosystem.

A. Place a label into each blank box to construct the food chain.

B. Place an arrow between each blank box to show the direction of energy flow in the ecosystem.

- There may be more than one correct answer.
Notes on Scoring

This response earns full credit (2 points) for correctly building the food chain in the ecosystem. The sun provides energy to the sunflower. The mouse eats the sunflower and the raccoon eats the mouse. All arrows are pointing in the direction of energy flow for these organisms.
Sample Response: 1 point

The diagram shows a blank food and energy chain for this ecosystem. Use the diagram to build a food and energy chain that includes the main source of energy in the ecosystem.

A. Place a label into each blank box to construct the food chain.

B. Place an arrow between each blank box to show the direction of energy flow in the ecosystem.
   
   - There may be more than one correct answer.

```
Ecosystem Food and Energy Chain

Sunflower → Mouse → Snake → Cougar

Main Energy Source
```
Notes on Scoring

This response earns partial credit (1 point) for correctly sequencing the organisms in the food chain. The mouse eats the sunflower and the snake eats the mouse. The cougar eats the snake. All arrows are pointing in the direction of energy flow for these organisms. However, the sun is the main energy source for the ecosystem, not the sunflower.
Sample Response: 1 point

The diagram shows a blank food and energy chain for this ecosystem. Use the diagram to build a food and energy chain that includes the main source of energy in the ecosystem.

A. Place a label into each blank box to construct the food chain.

B. Place an arrow between each blank box to show the direction of energy flow in the ecosystem.

- There may be more than one correct answer.
Notes on Scoring

This response earns partial credit (1 point) for correctly indicating that the sun is the main energy source for the ecosystem and all arrows are pointing in the direction of energy flow.
Sample Response: 0 points

The diagram shows a blank food and energy chain for this ecosystem. Use the diagram to build a food and energy chain that includes the main source of energy in the ecosystem.

A. Place a label into each blank box to construct the food chain.

B. Place an arrow between each blank box to show the direction of energy flow in the ecosystem.
   • There may be more than one correct answer.

Ecosystem Food and Energy Chain

Sun → Sunflower → Cougar → Mouse

Main Energy Source
Notes on Scoring

This response earns no credit (0 points) for incorrectly indicating energy flow in the ecosystem. The arrows are pointing in the wrong direction between the sunflower, cougar and mouse.
Sample Response: 0 points

The diagram shows a blank food and energy chain for this ecosystem. Use the diagram to build a food and energy chain that includes the main source of energy in the ecosystem.

A. Place a label into each blank box to construct the food chain.

B. Place an arrow between each blank box to show the direction of energy flow in the ecosystem.

- There may be more than one correct answer.
Notes on Scoring

This response earns no credit (0 points). There are an inadequate number of arrows to indicate energy flow. The mouse is not the main energy source for the ecosystem; however, it does serve as an energy source for the snake. This is not enough information to earn credit.
Grade 5 Science
Spring 2018 Item Release

Question 28

Question and Scoring Guidelines
Question 28

Select the boxes to classify the role of each organism in the ecosystem.

<table>
<thead>
<tr>
<th></th>
<th>Consumer</th>
<th>Producer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cougar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mouse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raccoon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sunflower</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Points Possible: 1

See Alignment for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- “Consumer” selected for “Cougar,” “Mouse,” “Raccoon,” and “Snake”; AND
- “Producer” selected for “Sunflower”; AND
- nothing else selected (1 point).
**Alignment**

**Content Strand**
Life Science

**Content Statement**
Organisms perform a variety of roles in an ecosystem.

**Content Elaboration**
Populations of organisms can be categorized by how they acquire energy.

Food webs can be used to identify the relationships among producers, consumers and decomposers in an ecosystem.

Plants and some microorganisms are producers. They are the foundation of the food web. Producers transform energy from the sun and make food through a process called photosynthesis. Animals get their energy by eating plants and other animals that eat plants. Animals are consumers and many form predator-prey relationships. Decomposers (primarily bacteria and fungi) are consumers that use waste materials and dead organisms for food. Decomposers also return nutrients to the ecosystem.

One way ecosystem populations interact is centered on relationships for obtaining energy. Food webs are defined in many ways, including as a scheme of feeding relationships, which resemble a web. This web serves as a model for feeding relationships of member species within a biological community. Members of a species may occupy different positions during their lives. Food chains and webs are schematic representations of real-world interactions. For this grade level, it is enough to recognize that food webs represent an intertwining of food chains within the same biological community.

**Cognitive Demand**
Interpreting and Communicating Science Concepts (C)

Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.
Explanation of the Item
This item requires the student to classify organisms in a food web as a consumer or a producer. In the list of organisms provided, the sunflower is the producer. It is a plant that conducts photosynthesis which produces energy. That energy flows to the other organisms through the food chain. The mouse, raccoon, snake and cougar are all consumers.

Sample Response: 1 point

Select the boxes to classify the role of each organism in the ecosystem.

<table>
<thead>
<tr>
<th></th>
<th>Consumer</th>
<th>Producer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cougar</td>
<td>✔️</td>
<td>□</td>
</tr>
<tr>
<td>Mouse</td>
<td>✔️</td>
<td>□</td>
</tr>
<tr>
<td>Raccoon</td>
<td>✔️</td>
<td>□</td>
</tr>
<tr>
<td>Snake</td>
<td>✔️</td>
<td>□</td>
</tr>
<tr>
<td>Sunflower</td>
<td>□</td>
<td>✔️</td>
</tr>
</tbody>
</table>
Question 29

Select the two organisms that are carnivores.

- cougar
- mouse
- raccoon
- snake
- sunflower

Points Possible: 1

See Alignment for more detail.

Scoring Guidelines

Rationale for First Option: **Key** - Cougars only gain energy by eating other animals and are carnivores.

Rationale for Second Option: This is incorrect. Mice gain their energy by eating plants and animals and are omnivores.

Rationale for Third Option: This is incorrect. Although raccoons do eat other animals, they also eat plants and are omnivores.

Rationale for Fourth Option: **Key** - Snakes only gain their energy by eating other animals and are carnivores.

Rationale for Fifth Option: This is incorrect. Sunflowers are plants and do not consume other organisms. They gain their energy through photosynthesis of sunlight.
Alignment

Content Strand
Life Science

Content Statement
Organisms perform a variety of roles in an ecosystem.

Content Elaboration
Populations of organisms can be categorized by how they acquire energy. Food webs can be used to identify the relationships among producers, consumers and decomposers in an ecosystem.

Plants and some microorganisms are producers. They are the foundation of the food web. Producers transform energy from the sun and make food through a process called photosynthesis. Animals get their energy by eating plants and other animals that eat plants. Animals are consumers and many form predator-prey relationships. Decomposers (primarily bacteria and fungi) are consumers that use waste materials and dead organisms for food. Decomposers also return nutrients to the ecosystem.

One way ecosystem populations interact is centered on relationships for obtaining energy. Food webs are defined in many ways, including as a scheme of feeding relationships, which resemble a web. This web serves as a model for feeding relationships of member species within a biological community. Members of a species may occupy different positions during their lives. Food chains and webs are schematic representations of real-world interactions. For this grade level, it is enough to recognize that food webs represent an intertwining of food chains within the same biological community.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.
Explanation of the Item
This item requires the student to determine which animals are carnivores. The cougar and snake are the two organisms that consume other animals for energy. The mouse and raccoon are omnivores. The sunflower conducts photosynthesis and is a producer.

Sample Response: 1 point

Select the two organisms that are carnivores.
- [x] cougar
- [ ] mouse
- [ ] raccoon
- [x] snake
- [ ] sunflower
Grade 5 Science
Spring 2018 Item Release

Question 30

Question and Scoring Guidelines
Question 30

The table shows properties of several objects in the solar system.

<table>
<thead>
<tr>
<th>Object</th>
<th>Earth Days to Orbit Sun</th>
<th>Object Size (diameter in km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>59,800</td>
<td>49,528</td>
</tr>
<tr>
<td>W</td>
<td>225</td>
<td>12,104</td>
</tr>
<tr>
<td>X</td>
<td>687</td>
<td>6,792</td>
</tr>
<tr>
<td>Y</td>
<td>365</td>
<td>3,475</td>
</tr>
<tr>
<td>Z</td>
<td>90,560</td>
<td>2,370</td>
</tr>
</tbody>
</table>

Enter a number from 1 to 5 to rank the objects from closest (1) to farthest (5) from the sun based on the data in the table.

<table>
<thead>
<tr>
<th>Object</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td></td>
</tr>
<tr>
<td>W</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td></td>
</tr>
</tbody>
</table>

Points Possible: 1

See Alignment for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- ranking objects based on the size of their orbit and the number of Earth days to complete their orbit, which correlates with the object’s distance from the sun (1 point).
Alignment

Content Strand
Earth and Space Science

Content Statement
The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics.

Content Elaboration
The distance from the sun, size, composition and movement of each planet are unique. Planets revolve around the sun in elliptical orbits. Some of the planets have moons and/or debris that orbit them. Comets, asteroids and meteoroids orbit the sun.

Eight major planets in the solar system orbit the sun. Some of the planets have a moon or moons that orbit them. Earth is a planet that has a moon that orbits it. The planets' orbits are because of their gravitational attraction to the sun. Moons orbit around planets because of their gravitational attraction to the planets.

General information regarding planetary positions, orbital patterns, planetary composition and recent discoveries and projects (e.g., missions to Mars) are included in this content. Tools and technology are an essential part of understanding the workings within the solar system.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This item requires the student to analyze the properties of objects in the solar system and rank each object by its distance from the sun based on those properties. From the data provided, the students can use the number of Earth days to orbit the sun to determine how close that object is to the sun. Objects closer to the sun take less time to orbit the sun so the ranking of the objects given should be 4, 1, 3, 2 and 5.
Sample Responses
Sample Response: 1 point

The table shows properties of several objects in the solar system.

<table>
<thead>
<tr>
<th>Properties of Objects in the Solar System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>V</td>
</tr>
<tr>
<td>W</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td>Y</td>
</tr>
<tr>
<td>Z</td>
</tr>
</tbody>
</table>

Enter a number from 1 to 5 to rank the objects from closest (1) to farthest (5) from the sun based on the data in the table.

<table>
<thead>
<tr>
<th>Object</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>4</td>
</tr>
<tr>
<td>W</td>
<td>1</td>
</tr>
<tr>
<td>X</td>
<td>3</td>
</tr>
<tr>
<td>Y</td>
<td>2</td>
</tr>
<tr>
<td>Z</td>
<td>5</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns full credit (1 point) for correctly ranking the objects in order of increasing distance from the sun. Objects closer to the sun take less time to orbit the sun.
Sample Response: 0 points

The table shows properties of several objects in the solar system.

<table>
<thead>
<tr>
<th>Object</th>
<th>Earth Days to Orbit Sun</th>
<th>Object Size (diameter in km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>59,800</td>
<td>49,528</td>
</tr>
<tr>
<td>W</td>
<td>225</td>
<td>12,104</td>
</tr>
<tr>
<td>X</td>
<td>687</td>
<td>6,792</td>
</tr>
<tr>
<td>Y</td>
<td>365</td>
<td>3,475</td>
</tr>
<tr>
<td>Z</td>
<td>90,560</td>
<td>2,370</td>
</tr>
</tbody>
</table>

Enter a number from 1 to 5 to rank the objects from closest (1) to farthest (5) from the sun based on the data in the table.

<table>
<thead>
<tr>
<th>Object</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>2</td>
</tr>
<tr>
<td>W</td>
<td>5</td>
</tr>
<tr>
<td>X</td>
<td>3</td>
</tr>
<tr>
<td>Y</td>
<td>4</td>
</tr>
<tr>
<td>Z</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) for incorrectly ranking the objects in order of increasing distance from the sun. Objects closer to the sun take less time to orbit the sun. This response reverses the ranking order.
Sample Response: 0 points

The table shows properties of several objects in the solar system.

<table>
<thead>
<tr>
<th>Object</th>
<th>Earth Days to Orbit Sun</th>
<th>Object Size (diameter in km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
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<td>X</td>
<td>687</td>
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<td>Y</td>
<td>365</td>
<td>3,475</td>
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<tr>
<td>Z</td>
<td>90,560</td>
<td>2,370</td>
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</tbody>
</table>

Enter a number from 1 to 5 to rank the objects from closest (1) to farthest (5) from the sun based on the data in the table.

<table>
<thead>
<tr>
<th>Object</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>5</td>
</tr>
<tr>
<td>W</td>
<td>4</td>
</tr>
<tr>
<td>X</td>
<td>3</td>
</tr>
<tr>
<td>Y</td>
<td>2</td>
</tr>
<tr>
<td>Z</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) for incorrectly ranking the objects in order of increasing distance from the sun. Objects closer to the sun take less time to orbit the sun.
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Science
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Question 33

Question and Scoring Guidelines
Question 33

The following question has two parts. First, answer part A. Then, answer part B.

Part A

Leafcutter ants collect small leaf pieces and carry them back to their nest. The ants do not eat the leaf pieces.

The leaf pieces are used as a food source for a fungus that grows in the ants’ nest. The fungus grows by breaking down the leaf pieces for energy, and the ants eat the fungus for food.

Which diagram models the flow of energy in this small ecosystem?

Part B

How is the diagram you chose different from diagrams that model most other ecosystems?

A. Consumers act as producers in this diagram.
B. Producers in this diagram provide energy to consumers.
C. Consumers in this diagram get energy directly from the sun.
D. Energy flows from decomposers to consumers in this diagram.

Points Possible: 2

See Alignment for more detail.
Scoring Guidelines

Part A
Rationale for Option A: This is incorrect. Consumers in this micro-ecosystem get their energy from decomposers, not producers.

Rationale for Option B: This is incorrect. Consumers in this micro-ecosystem do not receive their energy directly from the sun.

Rationale for Option C: Key - In this micro-ecosystem, decomposers (the fungus) use producers (leaf pieces) as a source of energy, and consumers (the ants) use the decomposers as a source of energy.

Rationale for Option D: This is incorrect. Consumers in this micro-ecosystem get their energy by consuming decomposers, not by consuming producers.

Part B
Rationale for Option A: This is incorrect. While the ants do cultivate fungus, they are not true producers.

Rationale for Option B: This is incorrect. Producers in this micro-ecosystem provide energy to decomposers, not consumers.

Rationale for Option C: This is incorrect. The consumers in this micro-ecosystem get their energy from a decomposer.

Rationale for Option D: Key - The consumers in this micro-ecosystem get their energy from a decomposer.
Alignment

Content Strand
Life Science

Content Statement
All of the processes that take place within organisms require energy.

Content Elaboration
For ecosystems, the major source of energy is sunlight.

Energy entering ecosystems as sunlight is transferred and transformed by producers into energy that organisms use through the process of photosynthesis. That energy then passes from organism to organism as illustrated in food webs.

In most ecosystems, energy derived from the sun is transferred and transformed into energy that organisms use by the process of photosynthesis in plants and other photosynthetic organisms.

The content statements for fifth-grade life science are each partial components of a larger concept. The parts have been isolated to call attention to the depth of knowledge required to build to one of biology’s foundational theories: dynamic relationships within ecosystems. It is recommended that the content statements be combined and taught as a whole. For example, it is important that the ecological role of organisms is interwoven with a clear understanding that all living things require energy. Virtual simulations and investigations can help demonstrate energy flow through the trophic levels.

Energy flows through an ecosystem in one direction, from photosynthetic organisms to consumers (herbivores, omnivores and carnivores) and decomposers. The exchange of energy that occurs in an ecosystem can be represented as a food web. The exchange of energy in an ecosystem is essential because all processes of life for all organisms require a continual supply of energy.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.
Explanation of the Item
This item requires the student to select a diagram that correctly models the energy flow in a unique microecosystem and compare that flow of energy to the energy flow of a typical large-scale ecosystem. The leafcutter ant collects leaves (plants) to provide energy for a fungus that uses the leaves for energy. Fungi are decomposers. The ant then consumes the fungi for energy. So, in this illustration the consumer gets energy directly from the decomposer.
Sample Response: 2 points

The following question has two parts. First, answer part A. Then, answer part B.

**Part A**

Leafcutter ants collect small leaf pieces and carry them back to their nest. The ants do not eat the leaf pieces.

The leaf pieces are used as a food source for a fungus that grows in the ants’ nest. The fungus grows by breaking down the leaf pieces for energy, and the ants eat the fungus for food.

Which diagram models the flow of energy in this small ecosystem?

- ![Diagram A]
- ![Diagram B]
- ![Diagram C]
- ![Diagram D]

**Part B**

How is the diagram you chose different from diagrams that model most other ecosystems?

- **A** Consumers act as producers in this diagram.
- **B** Producers in this diagram provide energy to consumers.
- **C** Consumers in this diagram get energy directly from the sun.
- **D** Energy flows from decomposers to consumers in this diagram.

**Notes on Scoring**

This response earns full credit (2 points) for correctly identifying the model that illustrates the flow of energy for the leafcutter ants and providing the correct explanation for how this is different than most other ecosystems.
Sample Response: 1 point

The following question has two parts. First, answer part A. Then, answer part B.

**Part A**

Leafcutter ants collect small leaf pieces and carry them back to their nest. The ants do not eat the leaf pieces.

The leaf pieces are used as a food source for a fungus that grows in the ants’ nest. The fungus grows by breaking down the leaf pieces for energy, and the ants eat the fungus for food.

Which diagram models the flow of energy in this small ecosystem?

(A)

(B)

(C)

(D)

**Part B**

How is the diagram you chose different from diagrams that model most other ecosystems?

- Consumers act as producers in this diagram.
- Producers in this diagram provide energy to consumers.
- Consumers in this diagram get energy directly from the sun.
- Energy flows from decomposers to consumers in this diagram.

**Notes on Scoring**

This response earns partial credit (1 point) for correctly identifying the model that illustrates the flow of energy for the leafcutter ants. This response fails to provide the correct explanation for how this is different than most other ecosystems. Consumers are not producers. The consumers get energy directly from the decomposers in this system.
Sample Response: 0 points

The following question has two parts. First, answer part A. Then, answer part B.

Part A

Leafcutter ants collect small leaf pieces and carry them back to their nest. The ants do not eat the leaf pieces. The leaf pieces are used as a food source for a fungus that grows in the ants’ nest. The fungus grows by breaking down the leaf pieces for energy, and the ants eat the fungus for food.

Which diagram models the flow of energy in this small ecosystem?

A

\[ \text{Sun} \rightarrow \text{Producers} \rightarrow \text{Consumers} \rightarrow \text{Decomposers} \]

B

\[ \text{Sun} \rightarrow \text{Consumers} \rightarrow \text{Decomposers} \]

C

\[ \text{Sun} \rightarrow \text{Producers} \rightarrow \text{Decomposers} \rightarrow \text{Consumers} \]

D

\[ \text{Sun} \rightarrow \text{Producers} \rightarrow \text{Consumers} \rightarrow \text{Decomposers} \]

Part B

How is the diagram you chose different from diagrams that model most other ecosystems?

A Consumers act as producers in this diagram.

B Producers in this diagram provide energy to consumers.

C Consumers in this diagram get energy directly from the sun.

D Energy flows from decomposers to consumers in this diagram.

Notes on Scoring

This response earns no credit (0 points) for incorrectly identifying the model that illustrates the flow of energy for the leafcutter ants. The sun does not provide energy to consumers. This response fails to provide the correct explanation for how this is different than most other ecosystems. The consumers get energy directly from the decomposers in this system.
Sample Response: 0 points

The following question has two parts. First, answer part A. Then, answer part B.

**Part A**

Leafcutter ants collect small leaf pieces and carry them back to their nest. The ants do not eat the leaf pieces.

The leaf pieces are used as a food source for a fungus that grows in the ants’ nest. The fungus grows by breaking down the leaf pieces for energy, and the ants eat the fungus for food.

Which diagram models the flow of energy in this small ecosystem?

- [Diagram 1]
- [Diagram 2]
- [Diagram 3]
- [Diagram 4]

**Part B**

How is the diagram you chose different from diagrams that model most other ecosystems?

- Consumers act as producers in this diagram.
- Producers in this diagram provide energy to consumers.
- Consumers in this diagram get energy directly from the sun.
- Energy flows from decomposers to consumers in this diagram.

**Notes on Scoring**

This response earns no credit (0 points) for incorrectly identifying the model that illustrates the flow of energy for the leafcutter ants. This response fails to provide the correct explanation for how this is different than most other ecosystems. Consumers are not producers. The consumers get energy directly from the decomposers in this system.
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Question 35

Question and Scoring Guidelines
Question 35

A model of a Lake Erie food web is shown.

Move organisms into the blank boxes to show the correct flow of energy in the food web.

- You do not need to use all the organisms.

Points Possible: 1

See Alignment for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- Sun in the box on left side;
  AND
- Algae in the Producers box;
  AND
- Walleye in the top right box (1 point).
All of the processes that take place within organisms require energy.

Energy entering ecosystems as sunlight is transferred and transformed by producers into energy that organisms use through the process of photosynthesis. That energy then passes from organism to organism as illustrated in food webs.

In most ecosystems, energy derived from the sun is transferred and transformed into energy that organisms use by the process of photosynthesis in plants and other photosynthetic organisms.

Energy flows through an ecosystem in one direction, from photosynthetic organisms to consumers (herbivores, omnivores and carnivores) and decomposers. The exchange of energy that occurs in an ecosystem can be represented as a food web. The exchange of energy in an ecosystem is essential because all processes of life for all organisms require a continual supply of energy.

Recalling Accurate Science (R)

Requires students to provide accurate statements about scientifically valid facts, concepts and relationships. Recall only requires students to provide a rote response, declarative knowledge or perform routine mathematical tasks. This cognitive demand refers to students’ knowledge of science fact, information, concepts, tools, procedures (being able to describe how) and basic principles.

This item requires the student to think logically about the relationships and the flow of energy through this Lake Erie ecosystem from the photosynthetic organisms to consumers.
Grade 5
Science
Spring 2018 Item Release

Question 35

Sample Responses
Sample Response: 1 point

A model of a Lake Erie food web is shown.

Move organisms into the blank boxes to show the correct flow of energy in the food web.

- You do **not** need to use all the organisms.

Notes on Scoring

This response earns full credit (1 point) for correctly completing the food web. The sun provides energy for the producers which include algae. The walleye completes the food web because it consumes rainbow smelt.
Sample Response: 0 points

A model of a Lake Erie food web is shown.

Move organisms into the blank boxes to show the correct flow of energy in the food web.

- You do not need to use all the organisms.

Notes on Scoring

This response earns no credit (0 points) for incorrectly completing the food web. Zebra mussels are not producers. The response correctly places the sun and walleye in the food web.
A model of a Lake Erie food web is shown.

Move organisms into the blank boxes to show the correct flow of energy in the food web.

- You do **not** need to use all the organisms.

---

**Notes on Scoring**

This response earns no credit (0 points) for incorrectly completing the food web. The response correctly places the walleye in the food web. *Zebra mussels* are not producers and algae does not provide energy for producers.
Grade 5
Science
Spring 2018 Item Release

Question 38

Question and Scoring Guidelines
Question 38

The following question has two parts. First, answer part A. Then, answer part B.

Part A
Solar panels collect energy from the sun’s rays and convert it to electricity. A school in Ohio wants to construct solar panels on its roof. The position of these panels can change during different times of the year. The picture shows the solar panels in two different positions.

During which season should the panels be in position 2?

- fall
- spring
- summer
- winter

Part B
Why should the solar panels be at position 2 during this season?

- The sun is larger in the sky during this season.
- The sun is lowest in the sky during this season.
- There are more hours of sunlight in a day during this season.
- The hours of night and sunlight in a day are equal during this season.

Points Possible: 1
See Alignment for more detail.
Scoring Guidelines

Part A
Rationale for Option A: This is incorrect. The sun is neither at its lowest nor highest point in the sky during this season. The solar panels would be in between position 1 and position 2.

Rationale for Option B: This is incorrect. The sun is neither at its lowest nor highest point in the sky during this season. The solar panels would be in between position 1 and position 2.

Rationale for Option C: This is incorrect. The sun is highest in the sky during summer, so the solar panels would be at position 1.

Rationale for Option D: Key - The sun is lowest in the sky during winter, shining rays that are close to horizontal. The solar panels would be at position 2 for maximum solar collection.

Part B
Rationale for Option A: This is incorrect. The distance between the sun and Earth does not affect the angle at which the sun’s rays will hit the panels. From Earth, the sun appears to be relatively the same size all year.

Rationale for Option B: Key - The sun is at its lowest position in the sky during this season, which causes the sun’s rays to strike Earth at a near horizontal angle. Therefore, the solar panels should be tilted up to receive as much solar energy as possible.

Rationale for Option C: This is incorrect. The amount of sunlight in a day affects the total hours of solar energy collection. However, it does not determine the angle of incidence.

Rationale for Option D: This is incorrect. The length of day and night are not relevant to the angle of the panels. Instead, the number of hours of sunlight is relevant to the total hours of solar energy collection in a day.
Alignment
Content Strand
Earth and Space Science

Content Statement
Most of the cycles and patterns of motion between Earth and the sun are predictable.

Content Elaboration
Earth’s revolution around the sun takes approximately 365 days. Earth completes one rotation on its axis in a 24-hour period, producing day and night. This rotation makes the sun, stars and moon appear to change position in the sky. Earth’s axis is tilted at an angle of 23.5°. This tilt, along with Earth’s revolution around the sun, affects the amount of direct sunlight that the Earth receives in a single day and throughout the year. The average daily temperature is related to the amount of direct sunlight received. Changes in average temperature throughout the year are identified as seasons.

Note: The amount of direct sunlight that Earth receives is related to the altitude of the sun, which affects the angle of the sun’s rays, and the amount of time the sun is above the horizon each day.

Models, interactive websites and investigations are required to illustrate the predictable patterns and cycles that lead to the understanding of day and night, seasons, years and the amount of direct sunlight Earth receives. Three-dimensional models should be used to demonstrate that the tilt of Earth’s axis is related to the amount of direct sunlight received and seasonal temperature changes.

Cognitive Demand
Designing Technological/Engineering Solutions Using Science Concepts (T)

Requires students to solve science-based engineering or technological problems through application of scientific inquiry. Within given scientific constraints, propose or critique solutions, analyze and interpret technological and engineering problems, use science principles to anticipate effects of technological or engineering design, find solutions using science and engineering or technology, consider consequences and alternatives and/or integrate and synthesize scientific information.
Explanation of the Item
This item requires the student to determine how a solar panel should be positioned to maximize the amount of electricity generated. During winter, the sun is lowest in the sky. This causes the rays to be close to horizontal, which would directly hit the panel in position 2, maximizing the collection of energy. Position 1 would be best for summer when the sun’s position is highest in the sky.

Sample Response: 1 point

The following question has two parts. First, answer part A. Then, answer part B.

Part A
Solar panels collect energy from the sun’s rays and convert it to electricity. A school in Ohio wants to construct solar panels on its roof. The position of these panels can change during different times of the year. The picture shows the solar panels in two different positions.

During which season should the panels be in position 2?
- fall
- spring
- summer
- winter

Part B
Why should the solar panels be at position 2 during this season?
- The sun is larger in the sky during this season.
- The sun is lowest in the sky during this season.
- There are more hours of sunlight in a day during this season.
- The hours of night and sunlight in a day are equal during this season.
Grade 5 Science
Spring 2018 Item Release

Question 46

Question and Scoring Guidelines
Question 46

The table gives the orbital radius of four planets.

<table>
<thead>
<tr>
<th>Planet</th>
<th>Orbital Radius (x 1,000,000 km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth</td>
<td>150</td>
</tr>
<tr>
<td>Mars</td>
<td>228</td>
</tr>
<tr>
<td>Mercury</td>
<td>58</td>
</tr>
<tr>
<td>Venus</td>
<td>108</td>
</tr>
</tbody>
</table>

According to the table, which statement accurately compares the length of one year for two of these planets?

A. Earth has a longer year than Mars.
B. Mars has a longer year than Venus.
C. Venus has a longer year than Earth.
D. Mercury has a longer year than Venus.

Points Possible: 1

See Alignment for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. Mars is farther from the sun than the Earth, so it has a longer year, due to a longer orbital distance.

Rationale for Option B: Key - Mars is farther from the sun than Venus, so its year is longer, due to a longer orbital distance.

Rationale for Option C: This is incorrect. Venus is closer to the sun than the Earth, so it has a shorter year due to a shorter orbital distance.

Rationale for Option D: This is incorrect. Mercury has the shortest year of these four planets due to the shortest orbital distance.
Alignment
Content Strand
Earth and Space Science

Content Statement
The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics.

Content Elaboration
The distance from the sun, size, composition and movement of each planet are unique. Planets revolve around the sun in elliptical orbits. Some of the planets have moons and/or debris that orbit them. Comets, asteroids and meteoroids orbit the sun.

Eight major planets in the solar system orbit the sun. Some of the planets have a moon or moons that orbit them. Earth is a planet that has a moon that orbits it. The planets’ orbits are because of their gravitational attraction to the sun. Moons orbit around planets because of their gravitational attraction to the planets.

General information regarding planetary positions, orbital patterns, planetary composition and recent discoveries and projects (e.g., missions to Mars) are included in this content. Tools and technology are an essential part of understanding the workings within the solar system.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This item requires the student to relate a planet’s orbital radius to the length of time of one revolution. For the planets provided in the table, Mercury has the shortest year because it is closest to the sun with the smallest orbital radius. The next largest orbital radius is Venus, followed by Earth and Mars. Based on this information, Mars has a longer year than Venus.
Sample Response: 1 point

The table gives the orbital radius of four planets.

<table>
<thead>
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</tr>
<tr>
<td>Venus</td>
<td>108</td>
</tr>
</tbody>
</table>

According to the table, which statement accurately compares the length of one year for two of these planets?

A. Earth has a longer year than Mars.
B. Mars has a longer year than Venus.
C. Venus has a longer year than Earth.
D. Mercury has a longer year than Venus.