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# Grade 5 Science

## Spring 2019 Item Release

### Content Summary and Answer Key

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<th>Item Type</th>
<th>Content Strand</th>
<th>Content Statement</th>
<th>Cognitive Demand</th>
<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>A</td>
<td>1 point</td>
</tr>
<tr>
<td>3</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>R</td>
<td>B</td>
<td>1 point</td>
</tr>
<tr>
<td>4</td>
<td>Multiple Choice</td>
<td>Earth and Space Science</td>
<td>The sun is one of the many stars that exist in the universe.</td>
<td>R</td>
<td>C</td>
<td>1 point</td>
</tr>
<tr>
<td>6</td>
<td>Multiple Choice</td>
<td>Life Science</td>
<td>All of the processes that take place within organisms require energy.</td>
<td>R</td>
<td>C</td>
<td>1 point</td>
</tr>
<tr>
<td>8</td>
<td>Multiple Choice</td>
<td>Earth and Space Science</td>
<td>The sun is one of the many stars that exist in the universe.</td>
<td>R</td>
<td>D</td>
<td>1 point</td>
</tr>
<tr>
<td>11</td>
<td>Graphic Response</td>
<td>Life Science</td>
<td>All of the processes that take place within organisms require energy.</td>
<td>C</td>
<td>---</td>
<td>2 points</td>
</tr>
<tr>
<td>12</td>
<td>Multiple Choice</td>
<td>Earth and Space Science</td>
<td>Most of the cycles and patterns of motion between the Earth and sun are predictable.</td>
<td>R</td>
<td>C</td>
<td>1 point</td>
</tr>
<tr>
<td>16</td>
<td>Graphic Response</td>
<td>Physical Science</td>
<td>Light and sound are forms of energy that behave in predictable ways.</td>
<td>C</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>20</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>R</td>
<td>C</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>
<th>Question No.*</th>
<th>Item Type</th>
<th>Content Strand</th>
<th>Content Statement</th>
<th>Cognitive Demand</th>
<th>Answer Key</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Table Match</td>
<td>Earth and Space Science</td>
<td>Most of the cycles and patterns of motion between the Earth and sun are predictable.</td>
<td>C</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>22</td>
<td>Table Input</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>---</td>
<td>1 point</td>
</tr>
<tr>
<td>29</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>R</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>34</td>
<td>Multiple Choice</td>
<td>Life Science</td>
<td>Organisms perform a variety of roles in an ecosystem.</td>
<td>D</td>
<td>C</td>
<td>1 point</td>
</tr>
<tr>
<td>35</td>
<td>Multi-Interaction</td>
<td>Life Science</td>
<td>Organisms perform a variety of roles in an ecosystem.</td>
<td>C</td>
<td>D; A, B, C, D</td>
<td>2 points</td>
</tr>
<tr>
<td>36</td>
<td>Multiple Choice</td>
<td>Earth and Space Science</td>
<td>Most of the cycles and patterns of motion between the Earth and sun are predictable.</td>
<td>R</td>
<td>A</td>
<td>1 point</td>
</tr>
<tr>
<td>38</td>
<td>Multiple Choice</td>
<td>Earth and Space Science</td>
<td>The sun is one of many stars that exist in the universe.</td>
<td>R</td>
<td>A</td>
<td>1 point</td>
</tr>
<tr>
<td>42</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>A</td>
<td>1 point</td>
</tr>
<tr>
<td>43</td>
<td>Multiple Choice</td>
<td>Earth and Space Science</td>
<td>Most of the cycles and patterns of motion between the Earth and sun are predictable.</td>
<td>C</td>
<td>C</td>
<td>1 point</td>
</tr>
<tr>
<td>45</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>B</td>
<td>1 point</td>
</tr>
<tr>
<td>48</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>C</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.*
## Cognitive Demands: Expectations for Learning

Cognitive demand refers to the type of thinking required of students to successfully engage with and solve the task. Ohio’s Cognitive Demands relate to current understanding and research about the ways people learn and are important aspects to the overall understanding of science concepts. As with all other frameworks and cognitive demand systems, Ohio’s system has overlap between the categories. For example, *Recalling Accurate Science*, is a component of all the other cognitive demands included in Ohio’s Learning Standards for Science.

<table>
<thead>
<tr>
<th>Cognitive Demand</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designing Technological/Engineering Solutions Using Science Concepts (T)</td>
<td>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.</td>
</tr>
<tr>
<td>Demonstrating Science Knowledge (D)</td>
<td>Requires students to use scientific practices and develop the ability to think and act in ways associated with inquiry, including asking questions, planning and conducting investigations, using appropriate tools and techniques to gather and organize data, thinking critically and logically about relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments.</td>
</tr>
<tr>
<td>Interpreting and Communicating Science Concepts (C)</td>
<td>Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experience using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge.</td>
</tr>
<tr>
<td>Recalling Accurate Science (R)</td>
<td>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.</td>
</tr>
</tbody>
</table>
Grade 5 Science
Spring 2019 Item Release

Question 1

Question and Scoring Guidelines
Question 1

A teacher is pushing a cart filled with books down a hallway with a wooden floor.

Which change would help the teacher move the cart more easily?

A. putting fewer books in the cart
B. removing the wheels from the cart
C. carrying the cart instead of rolling it
D. laying carpet over the wooden floor

Points Possible: 1
See Alignment for more detail.

Scoring Guidelines

Rationale for Option A: Key – Reducing the mass of the cart will reduce the amount of force required to move the cart.

Rationale for Option B: This is incorrect. Removing the wheels greatly increases the friction force working against the teacher's push and makes it more difficult to move the cart.

Rationale for Option C: This is incorrect. Carrying the cart is much more difficult than rolling it.

Rationale for Option D: This is incorrect. Laying carpet increases the friction between the wheels and the floor and makes it more difficult to move the cart.
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. 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.

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 understand the forces that directly affect the cart and its motion. The wheeled cart filled with books is pushed on a wooden floor with a given force. Removing the wheels from the cart or laying carpet on the floor would increase friction and make the cart harder to move. To carry the cart with the given load would not make it easier to move. If some of the books are removed, it will reduce the mass of the cart and make it easier to move.
Sample Response: 1 point

A teacher is pushing a cart filled with books down a hallway with a wooden floor.

Which change would help the teacher move the cart more easily?

- putting fewer books in the cart
- removing the wheels from the cart
- carrying the cart instead of rolling it
- laying carpet over the wooden floor
Question 3

The diagram shows three celestial objects and the orbital paths of two of the objects.

Which table correctly identifies the objects in this diagram?

<table>
<thead>
<tr>
<th></th>
<th>Object</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>X</td>
<td>Planet</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>Moon</td>
</tr>
<tr>
<td></td>
<td>Z</td>
<td>Comet</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Object</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>X</td>
<td>Sun</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>Planet</td>
</tr>
<tr>
<td></td>
<td>Z</td>
<td>Moon</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Object</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>X</td>
<td>Sun</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>Moon</td>
</tr>
<tr>
<td></td>
<td>Z</td>
<td>Planet</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Object</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>X</td>
<td>Planet</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>Comet</td>
</tr>
<tr>
<td></td>
<td>Z</td>
<td>Moon</td>
</tr>
</tbody>
</table>

**Points Possible:** 1

See Alignment for more detail.
Scoring Guidelines

Rationale for Option A: This is incorrect. Comets orbit the sun in a highly elliptical pattern. They do not orbit a planet or lesser celestial body.

Rationale for Option B: Key – Planets orbit the sun and moons orbit planets.

Rationale for Option C: This is incorrect. Moons orbit planets rather than a planet orbiting a moon.

Rationale for Option D: This is incorrect. Moons do not orbit comets.

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
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.

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 interpret a diagram using their knowledge of sizes and orbit patterns to identify three celestial objects. The sun is represented by X, which is the center of the solar system. Body Y is a planet which orbits the sun. Body Z is a moon which orbits the planet, and both the planet and moon orbit the sun.
Sample Response: 1 point

The diagram shows three celestial objects and the orbital paths of two of the objects.

Orbital Paths

Which table correctly identifies the objects in this diagram?

<table>
<thead>
<tr>
<th>Object</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Planet</td>
</tr>
<tr>
<td>Y</td>
<td>Moon</td>
</tr>
<tr>
<td>Z</td>
<td>Comet</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Object</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Sun</td>
</tr>
<tr>
<td>Y</td>
<td>Planet</td>
</tr>
<tr>
<td>Z</td>
<td>Moon</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Object</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Sun</td>
</tr>
<tr>
<td>Y</td>
<td>Moon</td>
</tr>
<tr>
<td>Z</td>
<td>Planet</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Object</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Planet</td>
</tr>
<tr>
<td>Y</td>
<td>Comet</td>
</tr>
<tr>
<td>Z</td>
<td>Moon</td>
</tr>
</tbody>
</table>
Grade 5 Science
Spring 2019 Item Release

Question 4

Question and Scoring Guidelines
Question 4

The table shows the actual sizes of four stars and how bright each star appears from Earth.

<table>
<thead>
<tr>
<th>Star</th>
<th>Actual Size of Star</th>
<th>Apparent Brightness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Medium</td>
<td>Very dim</td>
</tr>
<tr>
<td>2</td>
<td>Small</td>
<td>Bright</td>
</tr>
<tr>
<td>3</td>
<td>Medium</td>
<td>Brightest</td>
</tr>
<tr>
<td>4</td>
<td>Large</td>
<td>Dim</td>
</tr>
</tbody>
</table>

Which star from the table could be the sun?

- [A] star 1
- [B] star 2
- [C] star 3
- [D] star 4

Points Possible: 1

See Alignment for more detail.

Scoring Guidelines

**Rationale for Option A:** This is incorrect. The sun is a medium-sized star and is the brightest star observed from Earth. While star 1 is a medium-sized star, it appears very dim from Earth.

**Rationale for Option B:** This is incorrect. The sun is a medium-sized star and is the brightest star observed from Earth. While star 2 appears bright from Earth, it is a small-sized star.

**Rationale for Option C:** **Key** – The sun is a medium-sized star and is the brightest star observed from Earth. Star 3 meets both criteria.

**Rationale for Option D:** This is incorrect. The sun is a medium-sized star and is the brightest star observed from Earth. Star 4 is a large, dim star.
Alignment
Content Strand
Earth and Space Science

Content Statement
The sun is one of the many stars that exist in the universe.

Content Elaboration
The sun is the closest star to the Earth. Scaled models (3-D or virtual) and graphics can be used to show the vast difference in size between the sun and the Earth. The sun is a medium-sized star and is the only star in our solar system. There are many other stars of different sizes in the universe. Stars appear in patterns called constellations, which can be used for navigation. Because they are so far away, they do not appear as large as the sun.

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 compare the sizes and apparent brightness of stars to identify which is the sun. The sun is a medium-sized star that appears brightest from Earth due to its proximity.
The table shows the actual sizes of four stars and how bright each star appears from Earth.

<table>
<thead>
<tr>
<th>Star</th>
<th>Actual Size of Star</th>
<th>Apparent Brightness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Medium</td>
<td>Very dim</td>
</tr>
<tr>
<td>2</td>
<td>Small</td>
<td>Bright</td>
</tr>
<tr>
<td>3</td>
<td>Medium</td>
<td>Brightest</td>
</tr>
<tr>
<td>4</td>
<td>Large</td>
<td>Dim</td>
</tr>
</tbody>
</table>

Which star from the table could be the sun?

- star 1
- star 2
- star 3
- star 4
Grade 5 Science
Spring 2019 Item Release

Question 6

Question and Scoring Guidelines
Question 6

The table shows the source of energy for some organisms in a food web.

<table>
<thead>
<tr>
<th>Organism</th>
<th>Source of Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caterpillar</td>
<td>Dandelion</td>
</tr>
<tr>
<td>Cricket</td>
<td>Dandelion</td>
</tr>
<tr>
<td>Dandelion</td>
<td>Sun</td>
</tr>
<tr>
<td>Fungi</td>
<td>All organisms</td>
</tr>
<tr>
<td>Grass</td>
<td>Sun</td>
</tr>
<tr>
<td>Sparrow</td>
<td>Caterpillar</td>
</tr>
</tbody>
</table>

Which organisms use photosynthesis as a source of energy?

A  Sparrow and fungi
B  Dandelion and fungi
C  Grass and dandelion
D  Caterpillar and cricket

Points Possible: 1
See Alignment for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. Sparrows are consumers and fungi are decomposers; neither use photosynthesis.

Rationale for Option B: This is incorrect. Fungi are decomposers and do not use photosynthesis.

Rationale for Option C: Key – Grass and dandelions (plants) are producers that use photosynthesis.

Rationale for Option D: This is incorrect. Caterpillars and crickets are consumers and neither use photosynthesis.
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.

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 organisms whose immediate source of energy is the sun. Grass and dandelions are producers that use the sun’s energy for photosynthesis.
Sample Response: 1 point

The table shows the source of energy for some organisms in a food web.

<table>
<thead>
<tr>
<th>Organism</th>
<th>Source of Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caterpillar</td>
<td>Dandelion</td>
</tr>
<tr>
<td>Cricket</td>
<td>Dandelion</td>
</tr>
<tr>
<td>Dandelion</td>
<td>Sun</td>
</tr>
<tr>
<td>Fungi</td>
<td>All organisms</td>
</tr>
<tr>
<td>Grass</td>
<td>Sun</td>
</tr>
<tr>
<td>Sparrow</td>
<td>Caterpillar</td>
</tr>
</tbody>
</table>

Which organisms use photosynthesis as a source of energy?

A. Sparrow and fungi
B. Dandelion and fungi
C. Grass and dandelion
D. Caterpillar and cricket
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Question 8

Question and Scoring Guidelines
Question 8

Scoring Guidelines

Rationale for Option A: This is incorrect. The sun has a much larger diameter than the moon.

Rationale for Option B: This is incorrect. The sun is farther from Earth than the moon.

Rationale for Option C: This is incorrect. The sun is larger than the moon but farther away from Earth.

Rationale for Option D: Key — The sun is larger than the moon but farther away from Earth. The distance from Earth makes it appear smaller.

Points Possible: 1
See Alignment for more detail.
Alignment
Content Strand
Earth and Space Science

Content Statement
The sun is one of the many stars that exist in the universe.

Content Elaboration
The sun is the closest star to the Earth. Scaled models (3-D or virtual) and graphics can be used to show the vast difference in size between the sun and the Earth. The sun is a medium-sized star and is the only star in our solar system.

The emphasis should be on general characteristics of stars and beginning to understand the size and distance of the sun in relationship to the Earth and other planets.

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 understand why the sun and moon appear to be the same size in the sky. The sun is a large celestial body that is a large distance from Earth, and the moon is much smaller; but because it is closer to Earth, it appears to be the same size in the given scenario. Objects that are closer appear larger. Objects that are farther away appear smaller. Even though the sun is the largest object in the solar system, it appears to be the size of the much smaller moon due to its distance from Earth.
Sample Response: 1 point

A student takes a picture of the sky from her window once during the day and once again at night.

Why do the sun and the moon appear to be the same size in the pictures?

A  The sun and the moon have the same diameter.
B  The sun and the moon are the same distance from Earth.
C  Although the moon is larger, it is farther away than the sun.
D  Although the sun is larger, it is farther away than the moon.
Grade 5 Science
Spring 2019 Item Release

Question 11

Question and Scoring Guidelines
Question 11

In Ohio, swarms of cicadas hatch from the ground every 17 years. When the cicada population appears, the populations of moles and wild turkeys increase.

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

B. Click on the role that cicadas play in this food web.

Points Possible: 2

See Alignment for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- Part A – From top to bottom: Wild Turkey, Cicada, Plants/Trees (1 point) AND
- Part B – “Herbivore” selected (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.

Energy flows through an ecosystem in one direction, from photosynthetic organisms to consumers (herbivores, omnivores to 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 create a food web illustrating the flow of energy based on an Ohio environment when the cicadas hatch. The role of the cicada is also identified as herbivore. Plants are the foundation organism for the food web. Squirrels, cicadas and snails feed off the plants. Moles, wild turkeys and squirrels eat the cicadas. The squirrels and wild turkey are eaten by the coyotes.
Sample Response: 2 points

In Ohio, swarms of cicadas hatch from the ground every 17 years. When the cicada population appears, the populations of moles and wild turkeys increase.

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

B. Click on the role that cicadas play in this food web.

Notes on Scoring

This response earns full credit (2 points) for correctly creating a food web when the cicadas hatch. Plants are the foundation organism for the food web. Squirrels, cicadas and snails feed off the plants. Moles, wild turkeys and squirrels eat the cicadas. The squirrels and wild turkey are eaten by the coyotes. The response also correctly identifies the role of the cicadas in the food web.
Notes on Scoring

This response earns partial credit (1 point) for correctly creating a food web when the cicadas hatch. Plants are the foundation organism for the food web. Squirrels, cicadas and snails feed off the plants. Moles, wild turkeys and squirrels will eat the cicadas. The squirrels and wild turkey will be eaten by the coyotes. The response incorrectly identifies the role of the cicadas in the food web. Cicadas are herbivores, not carnivores.
Sample Response: 1 point

In Ohio, swarms of cicadas hatch from the ground every 17 years. When the cicada population appears, the populations of moles and wild turkeys increase.

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

B. Click on the role that cicadas play in this food web.

Notes on Scoring

This response earns partial credit (1 point) for correctly identifying the role of the cicadas in the food web. The response incorrectly creates a food web for when the cicadas hatch. Plants are the foundation organism for the food web. Squirrels, cicadas and snails feed off the plants. Moles, wild turkeys and squirrels will eat the cicadas. The squirrels and wild turkey will be eaten by the coyotes.
Sample Response: 0 points

In Ohio, swarms of cicadas hatch from the ground every 17 years. When the cicada population appears, the populations of moles and wild turkeys increase.

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

B. Click on the role that cicadas play in this food web.

Notes on Scoring

This response earns no credit (0 points) for an incorrect food web and cicada role identification. Plants are the foundation organism for the food web. Squirrels, cicadas and snails feed off the plants. Moles, wild turkeys and squirrels will eat the cicadas. The squirrels and wild turkey will be eaten by the coyotes. The role of the cicadas in the food web is herbivore.
In Ohio, swarms of cicadas hatch from the ground every 17 years. When the cicada population appears, the populations of moles and wild turkeys increase.

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

B. Click on the role that cicadas play in this food web.

Notes on Scoring
This response earns no credit (0 points) for an incorrect food web and cicada role identification. Plants are the foundation organism for the food web. Squirrels, cicadas and snails feed off the plants. Moles, wild turkeys and squirrels will eat the cicadas. The squirrels and wild turkey will be eaten by the coyotes. The role of the cicadas in the food web is herbivore.
Grade 5 Science
Spring 2019 Item Release

Question 12

Question and Scoring Guidelines
**Question 12**

Which motion causes the change from day to night on Earth?

- **A** Earth orbiting the sun
- **B** the moon orbiting Earth
- **C** Earth rotating on its axis
- **D** the moon rotating on its axis

**Points Possible:** 1

See Alignment for more detail.

**Scoring Guidelines**

**Rationale for Option A:** This is incorrect. Earth does not orbit the sun on a daily basis. Earth moving around the sun does not cause day and night.

**Rationale for Option B:** This is incorrect. The moon orbiting Earth results in different parts of the illuminated side of the moon to be seen from Earth. This motion results in the phases of the moon.

**Rationale for Option C:** Key – Earth having a daytime and a nighttime is caused by Earth rotating on its axis. Locations on Earth's surface move into and out of sunlight every 24 hours.

**Rationale for Option D:** This is incorrect. The moon does rotate on its axis; however, this is not the cause of day and night on Earth.
Content Statement
Most of the cycles and patterns of motion between the Earth and 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.

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 explain the characteristic cycles and patterns involving Earth and its place in the solar system by explaining that day and night are caused by Earth rotating on its axis.

Sample Response: 1 point

Which motion causes the change from day to night on Earth?

A. Earth orbiting the sun
B. the moon orbiting Earth
C. Earth rotating on its axis
D. the moon rotating on its axis
Grade 5 Science
Spring 2019 Item Release

Question 16

Question and Scoring Guidelines
Question 16

Students are observing the highest pitches that different instruments can reach. The graph shows the students’ observations. The higher the instrument’s pitch, the higher the mark on the graph.

Place the instruments in the blank boxes on the line so that they are in order from the fastest to slowest vibration rate.

Points Possible: 1
See Alignment for more detail.

Scoring Guidelines
For this item, a full-credit response includes:

- moving all four instruments into the correct order, (left to right) D, A, C, B (1 point).
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
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 the pitch of a sound to the vibration rate of the source. Based on the instrument pitch data, instrument D produces the highest pitch, which means it has the fastest vibration rate. The next highest pitch comes from instrument A, followed by instrument C. Instrument B has the lowest pitch and the slowest vibration rate.
Grade 5 Science
Spring 2019 Item Release

Question 16

Sample Responses
Sample Response: 1 point

Students are observing the highest pitches that different instruments can reach. The graph shows the students’ observations. The higher the instrument’s pitch, the higher the mark on the graph.

Place the instruments in the blank boxes on the line so that they are in order from the fastest to slowest vibration rate.

Notes on Scoring

This response earns full credit (1 point) for correctly ranking the instruments from highest pitch to lowest pitch based on vibration rate. Based on the instrument pitch data, instrument D produces the highest pitch, which means it has the fastest vibration rate. The next highest pitch comes from instrument A, followed by instrument C. Instrument B has the lowest pitch and the slowest vibration rate.
Students are observing the highest pitches that different instruments can reach. The graph shows the students’ observations. The higher the instrument’s pitch, the higher the mark on the graph.

Place the instruments in the blank boxes on the line so that they are in order from the fastest to slowest vibration rate.

Notes on Scoring

This response earns no credit (0 points) for incorrectly ranking the instruments from highest pitch to lowest pitch based on vibration rate. Based on the instrument pitch data, instrument D produces the highest pitch, which means it has the fastest vibration rate. The next highest pitch comes from instrument A, followed by instrument C. Instrument B has the lowest pitch and the slowest vibration rate.
Students are observing the highest pitches that different instruments can reach. The graph shows the students’ observations. The higher the instrument’s pitch, the higher the mark on the graph.

Place the instruments in the blank boxes on the line so that they are in order from the fastest to slowest vibration rate.

### Notes on Scoring

This response earns no credit (0 points) for incorrectly reversing the ranking of instruments from highest pitch to lowest pitch based on vibration rate. Based on the instrument pitch data, instrument D produces the highest pitch, which means it has the fastest vibration rate. The next highest pitch comes from instrument A, followed by instrument C. Instrument B has the lowest pitch and the slowest vibration rate.
Question 20

Students design toy cars and then race them against each other. They record the following measurements during the competition.

- Distance traveled
- Weight of car
- Time traveled
- Volume of car

What should students do to calculate the average speed of each toy car?

A. Divide the weight of each toy car by its volume.
B. Divide the volume of each toy car by its weight.
C. Divide the distance traveled by each toy car by the time traveled.
D. Divide the time traveled by each toy car by the distance traveled.

Points Possible: 1

See Alignment for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. The density of the car is the mass of the car, which can be determined from the weight divided by the volume of the car.

Rationale for Option B: This is incorrect. Volume and weight can be used to find the density of an object.

Rationale for Option C: Key – The speed of an object can be calculated by dividing the distance traveled by the time traveled.

Rationale for Option D: This is incorrect. This calculation is backward and divides time by distance rather than distance by time.
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
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
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 to calculate the speed of toy cars. Speed is determined by taking the distance travelled and dividing it by the time it takes the car to travel that distance.
**Sample Response: 1 point**

Students design toy cars and then race them against each other. They record the following measurements during the competition.

- Distance traveled
- Weight of car
- Time traveled
- Volume of car

What should students do to calculate the average speed of each toy car?

- Divide the weight of each toy car by its volume.
- Divide the volume of each toy car by its weight.
- Divide the distance traveled by each toy car by the time traveled.
- Divide the time traveled by each toy car by the distance traveled.
Grade 5 Science
Spring 2019 Item Release

Question 21

Question and Scoring Guidelines
Question 21

The table shows the sun’s distance and the average angle of sunlight from the horizon at local noon for a city in the northern hemisphere during two different seasons.

<table>
<thead>
<tr>
<th>Data for a City During Two Seasons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Sun’s Angle at Noon</td>
</tr>
<tr>
<td>Season 1: 78.5°</td>
</tr>
<tr>
<td>Season 2: 31.5°</td>
</tr>
<tr>
<td>Distance from the Sun</td>
</tr>
<tr>
<td>Season 1: 152 million kilometers</td>
</tr>
<tr>
<td>Season 2: 147 million kilometers</td>
</tr>
</tbody>
</table>

Select each box that is supported by the data provided for Season 1 and Season 2.

<table>
<thead>
<tr>
<th>Season 1</th>
<th>Season 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colder season</td>
<td></td>
</tr>
<tr>
<td>More direct sunlight</td>
<td></td>
</tr>
<tr>
<td>Shortest average day length</td>
<td></td>
</tr>
<tr>
<td>Highest average daily temperature</td>
<td></td>
</tr>
</tbody>
</table>

**Points Possible: 1**

See Alignment for more detail.

**Scoring Guidelines**

For this item, a full-credit response includes:

- “Season 2” selected for “Colder season” and “Shortest average day length”
  
  AND

- “Season 1” selected for “More direct sunlight” and “Highest average daily temperature” (1 point).
Alignment
Content Strand
Earth and Space Science

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

Content Elaboration
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 1: 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.

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 interpret data of the sun’s angle and distance from the sun during different seasons to select statements that describe the seasons. Season 1 indicates more direct sunlight, which produces the highest average daily temperature. Season 2 indicates less direct sunlight, which produces a colder season and the shortest average day length.
Grade 5 Science
Spring 2019 Item Release

Question 21

Sample Responses
Sample Response: 1 point

The table shows the sun’s distance and the average angle of sunlight from the horizon at local noon for a city in the northern hemisphere during two different seasons.

<table>
<thead>
<tr>
<th>Data for a City During Two Seasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun’s Angle at Noon</td>
</tr>
<tr>
<td>Season 1: 78.5°</td>
</tr>
<tr>
<td>Season 2: 31.5°</td>
</tr>
<tr>
<td>Distance from the Sun</td>
</tr>
<tr>
<td>Season 1: 152 million kilometers</td>
</tr>
<tr>
<td>Season 2: 147 million kilometers</td>
</tr>
</tbody>
</table>

Select each box that is supported by the data provided for Season 1 and Season 2.

<table>
<thead>
<tr>
<th>Colder season</th>
<th>Season 1</th>
<th>Season 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>More direct sunlight</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Shortest average day length</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Highest average daily temperature</td>
<td>✔️</td>
<td></td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns full credit (1 point) for correctly noting that Season 1’s sun angle at noon produces more direct sunlight on Earth’s surface resulting in the highest average daily temperature. It also indicates that the angle at noon for Season 2 results in a colder season with the shortest average day length.
Sample Response: 0 points

The table shows the sun’s distance and the average angle of sunlight from the horizon at local noon for a city in the northern hemisphere during two different seasons.

<table>
<thead>
<tr>
<th></th>
<th>Season 1</th>
<th>Season 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun's Angle at Noon</td>
<td>78.5°</td>
<td>31.5°</td>
</tr>
<tr>
<td>Distance from the Sun</td>
<td>1.52 million kilometers</td>
<td>1.47 million kilometers</td>
</tr>
</tbody>
</table>

Select each box that is supported by the data provided for Season 1 and Season 2.

<table>
<thead>
<tr>
<th></th>
<th>Season 1</th>
<th>Season 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colder season</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>More direct sunlight</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Shortest average day length</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Highest average daily temperature</td>
<td></td>
<td>✔️</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) for reversing the effects of the sun’s angle at noon for the seasons.
Sample Response: 0 points

The table shows the sun’s distance and the average angle of sunlight from the horizon at local noon for a city in the northern hemisphere during two different seasons.

<table>
<thead>
<tr>
<th></th>
<th>Season 1</th>
<th>Season 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun’s Angle at Noon</td>
<td>78.5°</td>
<td>31.5°</td>
</tr>
<tr>
<td>Distance from the Sun</td>
<td>152 million kilometers</td>
<td>147 million kilometers</td>
</tr>
</tbody>
</table>

Select each box that is supported by the data provided for Season 1 and Season 2.

<table>
<thead>
<tr>
<th></th>
<th>Season 1</th>
<th>Season 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colder season</td>
<td>☑️</td>
<td></td>
</tr>
<tr>
<td>More direct sunlight</td>
<td></td>
<td>☑️</td>
</tr>
<tr>
<td>Shortest average day length</td>
<td></td>
<td>☑️</td>
</tr>
<tr>
<td>Highest average daily temperature</td>
<td>☐️</td>
<td></td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) for incorrectly selecting the effects of the sun’s angle at noon for the seasons.
Grade 5 Science
Spring 2019 Item Release

Question 22

Question and Scoring Guidelines
Question 22

Students investigate how mass and force affect the motion of a cart. For trial 1, they use an empty cart. They place the cart on a straight, smooth track. A student applies a brief force to the resting cart to move it on the track. When the cart crosses the start line, the force is removed and a stopwatch starts timing. The students record that for trial 1 the cart travels 25 centimeters (cm) in 5 seconds. The diagram shows the setup of the investigation.

![Investigation Setup](image)

The students perform two more trials. For trial 2, they change the amount of force used to push the cart. For trial 3, they change the mass of the cart by adding bricks.

Enter a number in the table to predict the distance traveled by the cart in 5 seconds after it crosses the start line for trials 2 and 3.

- There may be more than one correct answer.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Force Applied (N)</th>
<th>Distance at 5 s (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty Cart</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Empty Cart</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Cart Carrying Blocks</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Points Possible: 1

See Alignment for more detail.
Scoring Guidelines

For this item, a full-credit response includes:

- any number greater than 25 entered in the “Empty Cart, 2 N” box
  AND
- any number less than 25 entered in the “Cart Carrying Bricks, 1 N” box
  (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
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 compare the distances traveled in equal amounts of time by carts with varying masses and applied forces. The empty cart with twice the force travels a greater distance than the cart given in the charts. The cart with bricks and the same amount of force as the given cart travels a lesser distance than the given cart.
Grade 5 Science
Spring 2019 Item Release

Question 22

Sample Responses
Sample Response: 1 point

Students investigate how mass and force affect the motion of a cart. For trial 1, they use an empty cart. They place the cart on a straight, smooth track. A student applies a brief force to the resting cart to move it on the track. When the cart crosses the start line, the force is removed and a stopwatch starts timing. The students record that for trial 1 the cart travels 25 centimeters (cm) in 5 seconds. The diagram shows the setup of the investigation.

Investigation Setup

The students perform two more trials. For trial 2, they change the amount of force used to push the cart. For trial 3, they change the mass of the cart by adding bricks.

Enter a number in the table to predict the distance traveled by the cart in 5 seconds after it crosses the start line for trials 2 and 3.

- There may be more than one correct answer.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Force Applied (N)</th>
<th>Distance at 5 s (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty Cart</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Empty Cart</td>
<td>2</td>
<td>45</td>
</tr>
<tr>
<td>Cart Carrying</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns full credit (1 point) for correctly indicating that the empty cart with twice the force of the given cart will travel a greater distance (45 cm) and the cart carrying bricks will travel a lesser distance (10 cm) with the same force as the given cart.
Sample Response: 1 point

Students investigate how mass and force affect the motion of a cart. For trial 1, they use an empty cart. They place the cart on a straight, smooth track. A student applies a brief force to the resting cart to move it on the track. When the cart crosses the start line, the force is removed and a stopwatch starts timing. The students record that for trial 1 the cart travels 25 centimeters (cm) in 5 seconds. The diagram shows the setup of the investigation.

Investigation Setup

![Cart Setup Diagram]

The students perform two more trials. For trial 2, they change the amount of force used to push the cart. For trial 3, they change the mass of the cart by adding bricks.

Enter a number in the table to predict the distance traveled by the cart in 5 seconds after it crosses the start line for trials 2 and 3.

- There may be more than one correct answer.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Force Applied (N)</th>
<th>Distance at 5 s (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty Cart</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Empty Cart</td>
<td>2</td>
<td>32</td>
</tr>
<tr>
<td>Cart Carrying Bricks</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns full credit (1 point) for correctly indicating that the empty cart with twice the force of the given cart will travel a greater distance (32 cm) and the cart carrying bricks will travel a lesser distance (5 cm) with the same force as the given cart.
Sample Response: 0 points

Students investigate how mass and force affect the motion of a cart. For trial 1, they use an empty cart. They place the cart on a straight, smooth track. A student applies a brief force to the resting cart to move it on the track. When the cart crosses the start line, the force is removed and a stopwatch starts timing. The students record that for trial 1 the cart travels 25 centimeters (cm) in 5 seconds. The diagram shows the setup of the investigation.

The students perform two more trials. For trial 2, they change the amount of force used to push the cart. For trial 3, they change the mass of the cart by adding bricks.

Enter a number in the table to predict the distance traveled by the cart in 5 seconds after it crosses the start line for trials 2 and 3.

- There may be more than one correct answer.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Force Applied (N)</th>
<th>Distance at 5 s (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty Cart</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Empty Cart</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>Cart Carrying Bricks</td>
<td>1</td>
<td>15</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) for incorrectly indicating that the empty cart with twice the force of the given cart will travel a lesser distance (24 cm). The response does correctly indicate the cart carrying bricks travels a lesser distance (15 cm) with the same force as the given cart. Both parts must be correct to earn credit.
Sample Response: 0 points

Students investigate how mass and force affect the motion of a cart. For trial 1, they use an empty cart. They place the cart on a straight, smooth track. A student applies a brief force to the resting cart to move it on the track. When the cart crosses the start line, the force is removed and a stopwatch starts timing. The students record that for trial 1 the cart travels 25 centimeters (cm) in 5 seconds. The diagram shows the setup of the investigation.

The students perform two more trials. For trial 2, they change the amount of force used to push the cart. For trial 3, they change the mass of the cart by adding bricks.

Enter a number in the table to predict the distance traveled by the cart in 5 seconds after it crosses the start line for trials 2 and 3.

- There may be more than one correct answer.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Force Applied (N)</th>
<th>Distance at 5 s (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty Cart</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Empty Cart</td>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>Cart Carrying Bricks</td>
<td>1</td>
<td>27</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points). The response correctly indicates that the empty cart with twice the force of the given cart will travel a further distance (30 cm). The response incorrectly indicates the cart carrying bricks will travel a further distance (27 cm) with the same force as the given cart. Both parts must be correct to earn credit.
Grade 5 Science
Spring 2019 Item Release

Question 29

Question and Scoring Guidelines
Question 29

A ball moves across a table. The ball moves from right to left as shown by the blue arrow. Forces can be applied to the moving ball. The red arrows indicate those forces and show the direction each force would act on the ball.

Place the correct Force Effect label that each force would have on the ball’s motion into each blank box.

- Place only one label in each box.

Points Possible: 1

See Alignment for more detail.

Scoring Guidelines

- “Change Direction” in the bottom box
  AND
- “Speed Up” in the upper right box (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
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.

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
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 use conceptual knowledge to determine the effect of an applied force on a moving object, knowing the direction of the applied force and the direction of the initial motion. If the force is applied from the right, the ball’s motion speeds up. If the force is applied from the bottom arrow, the ball’s motion changes direction.
Grade 5 Science
Spring 2019 Item Release

Question 29

Sample Responses
Sample Response: 1 point

A ball moves across a table. The ball moves from right to left as shown by the blue arrow. Forces can be applied to the moving ball. The red arrows indicate those forces and show the direction each force would act on the ball.

Place the correct Force Effect label that each force would have on the ball’s motion into each blank box.

- Place only one label in each box.

Notes on Scoring

This response earns full credit (1 point) for correctly indicating the right arrow would cause the ball’s motion to speed up and the bottom arrow would cause the ball’s motion to change direction.
Sample Response: 0 points

A ball moves across a table. The ball moves from right to left as shown by the blue arrow. Forces can be applied to the moving ball. The red arrows indicate those forces and show the direction each force would act on the ball.

Place the correct Force Effect label that each force would have on the ball’s motion into each blank box.

- Place only one label in each box.

Notes on Scoring

This response earns no credit (0 points) for incorrectly labeling the action of the forces on the ball’s motion. The right arrow causes the ball’s motion to speed up and the bottom arrow causes the ball’s motion to change direction, not slow down. Both actions must be correct to earn credit.
Sample Response: 0 points

A ball moves across a table. The ball moves from right to left as shown by the blue arrow. Forces can be applied to the moving ball. The red arrows indicate those forces and show the direction each force would act on the ball.

Place the correct Force Effect label that each force would have on the ball’s motion into each blank box.

- Place only one label in each box.

Notes on Scoring

This response earns no credit (0 points) for incorrectly labeling the action of the forces on the ball’s motion. The right arrow causes the ball’s motion to speed up, not slow down. The bottom arrow causes the ball’s motion to change direction. Both actions must be correct to earn credit.
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Stimulus for Questions 34 – 35
The Lionfish Invasion

Lionfish are native to coral reefs in tropical areas. They can thrive in new environments, like the Atlantic Ocean, for the following reasons.

- They have no natural predators.
- Their spines protect them from possible predators.
- They blend in with their surroundings.
- They hunt in packs and herd their prey of small fish, shrimp, and octopus.
- One female produces 2,000,000 eggs per year.

Students model the introduction and spread of lionfish in the Atlantic Ocean. They use a circle of 10 chairs, 7 blue cards, and 3 yellow cards. Blue cards represent native species and yellow cards represent lionfish. They use the following procedure in their model.

1. Seven students receive a blue card and 3 students receive a yellow card.
2. Students walk around the chairs for 15 seconds.
3. After 15 seconds, students sit in the chair nearest to them.
4. Students with a yellow card tear off a piece of the card and leave it on the chair.
5. The students stand up and repeat steps 2–4. This time, “native species” can only sit on empty chairs. However, “lionfish” can sit on both empty chairs and chairs with pieces of yellow cards.
6. “Native species” without a chair to sit in are removed from the circle.

The picture shows the model results after the first round, steps 1–4.

Students repeat the procedure until there are no chairs without pieces of yellow cards.
Question 34

Which statement describes how the students’ procedures model the effects of the introduction of lionfish into the Atlantic Ocean?

- A. The lionfish take a long time to spread through the ecosystem.
- B. The ecosystem thrives with so many consumers in the food web.
- C. The lionfish population continues to grow until the native species are gone.
- D. There are more native species for the lionfish to compete with as the lionfish population grows.

Points Possible: 1
See Alignment for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. Because there is no natural predator modeled in the procedure and there is no natural predator in the actual ecosystem, the lionfish spread quickly.

Rationale for Option B: This is incorrect. The ecosystem suffers from the lack of biodiversity caused by the introduction and spread of lionfish.

Rationale for Option C: Key – As modeled in the procedure, the lionfish outcompete the native organisms that feed on the same energy sources. They uncontrollably multiply due to the lack of predators, until there are only lionfish and no native species left, represented by no more chairs without yellow cards.

Rationale for Option D: This is incorrect. The lionfish population growth puts pressures on the native species until they are ultimately forced out of the ecosystem.
Alignment
Content Strand
Life Science

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

Content Elaboration
Animals are consumers and many form predator-prey relationships.

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
Demonstrating Science Knowledge (D)

Requires student to use scientific inquiry and develop the ability to think and act in ways associated with inquiry, including asking questions, planning and conducting investigations, using appropriate tools and techniques to gather and organize data, thinking critically and logically about relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments.

(Slightly altered from National Science Education Standards)

Note: Procedural knowledge (knowing how) is included in Recalling Accurate Science.

Explanation of the Item
This item requires the student to examine the results of a simulation/model in order to account for an observable phenomenon. As modeled in the procedure, the lionfish outcompete the native organisms that feed on the same energy sources. They multiply in large numbers due to the lack of predators until there are only lionfish and no native species left, represented by no more chairs without yellow cards.
Sample Response: 1 point

Which statement describes how the students’ procedures model the effects of the introduction of lionfish into the Atlantic Ocean?

A. The lionfish take a long time to spread through the ecosystem.
B. The ecosystem thrives with so many consumers in the food web.
C. The lionfish population continues to grow until the native species are gone.
D. There are more native species for the lionfish to compete with as the lionfish population grows.
Grade 5 Science
Spring 2019 Item Release

Question 35

Question and Scoring Guidelines
Question 35

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

**Part A**
The table shows the feeding relationships among the organisms native to the Atlantic Ocean.

<table>
<thead>
<tr>
<th>Organism</th>
<th>Food Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrimp</td>
<td>Aquatic plants, decaying fish and plants</td>
</tr>
<tr>
<td>Octopus</td>
<td>Small fish, shrimp</td>
</tr>
<tr>
<td>Small Fish</td>
<td>Aquatic plants, phytoplankton</td>
</tr>
<tr>
<td>Large Fish</td>
<td>Small fish, shrimp, octopus</td>
</tr>
</tbody>
</table>

Which diagram represents a native food chain that is interrupted by the lionfish introduction into the Atlantic Ocean?

A. Large fish → Shrimp → Aquatic Plants
B. Octopus → Aquatic Plants → Shrimp
C. Shrimp → Large fish → Phytoplankton
D. Decaying Matter → Shrimp → Octopus

**Part B**
Select the four native populations that decrease as the introduced lionfish population increases in the Atlantic Ocean.

- [ ] shrimp
- [ ] octopus
- [ ] large fish
- [ ] small fish
- [ ] phytoplankton
- [ ] aquatic plants

**Points Possible:** 2

See **Alignment** for more detail.
Scoring Guidelines

Part A

Rationale for Option A: This is incorrect. Energy in a food chain flows from the food to the consumer, so this food chain shows energy flowing in the opposite direction.

Rationale for Option B: This is incorrect. Although shrimp consume aquatic plants as a source of energy, the sun is the source of energy for aquatic plants, not octopus.

Rationale for Option C: This is incorrect. Although large fish consume shrimp as a source of energy, shrimp consume phytoplankton as a source of energy. Furthermore, phytoplankton do not consume large fish as a source of energy.

Rationale for Option D: **Key** – The octopus eats the shrimp, which eats the decaying organic matter. Therefore, this food chain shows energy flowing in the right direction. Additionally, the lionfish prey upon shrimp and octopus. Therefore, its introduction into the ecosystem will interrupt this flow of energy.

Part B

Rationale for First Option: **Key** – The shrimp population decreases with a new predator in the ecosystem.

Rationale for Second Option: **Key** – The octopus population decreases with increased competition and a new predator in the ecosystem.

Rationale for Third Option: **Key** – The large fish population decreases with a new competitor in the ecosystem.

Rationale for Fourth Option: **Key** – The small fish population decreases with a new predator in the ecosystem.

Rationale for Fifth Option: This is incorrect. As the small fish population decreases, the phytoplankton population should increase.

Rationale for Sixth Option: This is incorrect. With decreasing shrimp and small fish populations, the aquatic plants thrive.
Alignment

Content Strand
Life Science

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

Content Elaboration
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 evaluate how feeding relationships are affected and populations change after the introduction of an invasive species. The octopus eats the shrimp, which eats the decaying organic matter. The lionfish prey upon shrimp and octopus. Therefore, its introduction into the ecosystem will interrupt this flow of energy. The four native populations that decrease due to the introduction of the lionfish are small and large fish, shrimp and octopus.
Grade 5 Science
Spring 2019 Item Release

Question 35

Sample Responses
Sample Response: 2 points

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

Part A
The table shows the feeding relationships among the organisms native to the Atlantic Ocean.

Feeding Relationships Among Native Organisms

<table>
<thead>
<tr>
<th>Organism</th>
<th>Food Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrimp</td>
<td>Aquatic plants, decaying fish and plants</td>
</tr>
<tr>
<td>Octopus</td>
<td>Small fish, shrimp</td>
</tr>
<tr>
<td>Small Fish</td>
<td>Aquatic plants, phytoplankton</td>
</tr>
<tr>
<td>Large Fish</td>
<td>Small fish, shrimp, octopus</td>
</tr>
</tbody>
</table>

Which diagram represents a native food chain that is interrupted by the lionfish introduction into the Atlantic Ocean?

- Large Fish → Shrimp → Aquatic Plants
- Octopus → Aquatic Plants → Shrimp
- Shrimp → Large Fish → Phytoplankton
- Decaying Matter → Shrimp → Octopus

Part B
Select the four native populations that decrease as the introduced lionfish population increases in the Atlantic Ocean.

- [x] shrimp
- [x] octopus
- [x] large fish
- [ ] small fish
- [ ] phytoplankton
- [ ] aquatic plants

Notes on Scoring

This response earns full credit (2 points) for correctly identifying the native food chain that is interrupted by the lionfish and the four native populations that decrease. The octopus eats the shrimp, which eats the decaying organic matter. The lionfish prey upon shrimp and octopus. Therefore, its introduction into the ecosystem will interrupt this flow of energy. The four native populations that decrease due to the introduction of the lionfish are small and large fish, shrimp and octopus.
Sample Response: 1 point

Notes on Scoring

This response earns partial credit (1 point) for correctly identifying the native food chain that is interrupted by the lionfish. The octopus eats the shrimp, which eats the decaying organic matter. The lionfish prey upon shrimp and octopus. Therefore, its introduction into the ecosystem will interrupt this flow of energy. This response fails to select four correct native populations that decrease due to the introduction of the lionfish. The large fish population is missed, and aquatic plants do not decrease. Aquatic plants increase due to decreased consumption by the other populations.
Sample Response: 1 point

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

**Part A**
The table shows the feeding relationships among the organisms native to the Atlantic Ocean.

<table>
<thead>
<tr>
<th>Organism</th>
<th>Food Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrimp</td>
<td>Aquatic plants, decaying fish and plants</td>
</tr>
<tr>
<td>Octopus</td>
<td>Small fish, shrimp</td>
</tr>
<tr>
<td>Small Fish</td>
<td>Aquatic plants, phytoplankton</td>
</tr>
<tr>
<td>Large Fish</td>
<td>Small fish, shrimp, octopus</td>
</tr>
</tbody>
</table>

Which diagram represents a native food chain that is interrupted by the lionfish introduction into the Atlantic Ocean?

1. Large Fish → Shrimp → Aquatic Plants
2. Octopus → Aquatic Plants → Shrimp
3. Shrimp → Large Fish → Phytoplankton
4. Decaying Matter → Shrimp → Octopus

**Part B**
Select the four native populations that decrease as the introduced lionfish population increases in the Atlantic Ocean.

- [ ] shrimp
- [x] octopus
- [x] large fish
- [x] small fish
- [ ] phytoplankton
- [ ] aquatic plants

**Notes on Scoring**

This response earns partial credit (1 point) for correctly identifying the four native populations that decrease as the lionfish population increases. This response fails to identify a native food chain that is interrupted by the introduction of the lionfish. In the selected food chain, phytoplankton do not eat large fish.
Sample Response: 0 points

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

Part A

The table shows the feeding relationships among the organisms native to the Atlantic Ocean.

<table>
<thead>
<tr>
<th>Organism</th>
<th>Food Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrimp</td>
<td>Aquatic plants, decaying fish and plants</td>
</tr>
<tr>
<td>Octopus</td>
<td>Small fish, shrimp</td>
</tr>
<tr>
<td>Small Fish</td>
<td>Aquatic plants, phytoplankton</td>
</tr>
<tr>
<td>Large Fish</td>
<td>Small fish, shrimp, octopus</td>
</tr>
</tbody>
</table>

Which diagram represents a native food chain that is interrupted by the lionfish introduction into the Atlantic Ocean?

- Large Fish ➔ Shrimp ➔ Aquatic Plants
- Octopus ➔ Aquatic Plants ➔ Shrimp
- Shrimp ➔ Large Fish ➔ Phytoplankton
- Decaying Matter ➔ Shrimp ➔ Octopus

Part B

Select the four native populations that decrease as the introduced lionfish population increases in the Atlantic Ocean.

- shrimp
- octopus
- large fish
- small fish
- phytoplankton
- aquatic plants

Notes on Scoring

This response earns no credit (0 points) for incorrectly identifying the native food chain that is interrupted by the lionfish. Aquatic plants are producers and do not eat shrimp. The large fish eats the shrimp, which eats the aquatic plants. The lionfish prey upon all consumers, shrimp, octopus, large and small fish, in the table decreasing population size for each. The producers, phytoplankton and aquatic plants will increase due to the decrease in shrimp, octopus, and large and small fish.
Grade 5 Science
Spring 2019 Item Release

Question 36

Question and Scoring Guidelines
**Question 36**

One night while camping, a student observes that the moon and stars appear to move across the sky.

Which statement describes why the moon and stars appear to change position?

A. Earth rotates.

B. Earth is tilted.

C. Earth orbits the sun.

D. Earth moves away from the sun.

**Scoring Guidelines**

**Rationale for Option A: Key** – The rotation of Earth causes the moon and stars to appear to move across the sky during a night.

**Rationale for Option B:** This is incorrect. The tilt of Earth, along with Earth’s orbit around the sun, causes the seasons.

**Rationale for Option C:** This is incorrect. The orbit of Earth around the sun results in the apparent motion of the stars over a year.

**Rationale for Option D:** This is incorrect. Earth is slightly farther from the sun in summer for the Northern Hemisphere, but this is unrelated to the apparent motion of the moon and stars across the sky.

**Points Possible:** 1

See Alignment for more detail.
Alignment
Content Strand
Earth and Space Science

Content Statement
Most of the cycles and patterns of motion between the Earth and 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°. 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.

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 the cause of the apparent motion of the moon and stars across the sky over the course of one night. The rotation of the Earth on its axis causes the moon and stars to appear to move across the sky during a night.

Sample Response: 1 point

One night while camping, a student observes that the moon and stars appear to move across the sky. Which statement describes why the moon and stars appear to change position?

- Earth rotates.
- Earth is tilted.
- Earth orbits the sun.
- Earth moves away from the sun.
Grade 5 Science
Spring 2019 Item Release

Question 38

Question and Scoring Guidelines
Question 38

When the sky is clear an observer on Earth can see the star Sirius. From Earth, Sirius appears blue in color but the sun appears yellow.

What is another way Sirius is different from the sun?

A. The sun is inside the solar system, but Sirius is outside it.
B. The sun is made of very hot gases, but Sirius is made of ice.
C. The sun produces its own light and heat, but Sirius reflects light.
D. The sun is at the center of Earth’s orbit, but Sirius orbits around the sun.

Points Possible: 1
See Alignment for more detail.

Scoring Guidelines

Rationale for Option A: Key – The sun and Sirius are both stars. The sun is the center of our solar system, while Sirius is located much farther from Earth.

Rationale for Option B: This is incorrect. Sirius is made of gas just like all other stars. The blue color does not mean it is made of ice.

Rationale for Option C: This is incorrect. Stars such as Sirius produce their own light and heat.

Rationale for Option D: This is incorrect. Sirius does not orbit the sun. People on Earth see Sirius move across the sky because Earth rotates on its axis.
Alignment
Content Strand
Earth and Space Science

Content Statement
The sun is one of many stars that exist in the universe.

Content Elaboration
The sun is the closest star to the Earth. Scaled models (3-D or virtual) and graphics can be used to show the vast difference in size between the sun and the Earth. The sun is a medium-sized star and is the only star in our solar system. There are many other stars of different sizes in the universe. Stars appear in patterns called constellations, which can be used for navigation. Because they are so far away, they do not appear as large as the sun. General facts about the size and composition of the sun are introduced. Details (e.g., age of the sun, specific composition, temperature values) are above grade level. The emphasis should be on general characteristics of stars and beginning to understand the size and distance of the sun in relationship to the Earth and other planets.

Current and new discoveries related to stars and the sun must be included.

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 the sun is the only star in our solar system. Sirius is beyond our solar system.
Sample Response: 1 point

When the sky is clear an observer on Earth can see the star Sirius. From Earth, Sirus appears blue in color but the sun appears yellow.

What is another way Sirus is different from the sun?

- The sun is inside the solar system, but Sirus is outside it.
- The sun is made of very hot gases, but Sirus is made of ice.
- The sun produces its own light and heat, but Sirus reflects light.
- The sun is at the center of Earth’s orbit, but Sirus orbits around the sun.
Grade 5 Science
Spring 2019 Item Release

Question 42

Question and Scoring Guidelines
Question 42

A student shines the light from a flashlight at two different surfaces. Where the light hits the first surface, the light looks just as bright as when it left the flashlight. Where the light hits the second surface, the light looks dimmer than when it left the flashlight.

Which table supports the student’s observations of the light’s behavior as it interacts with each surface?

<table>
<thead>
<tr>
<th>Surface</th>
<th>Behavior of Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Reflects</td>
</tr>
<tr>
<td>Second</td>
<td>Absorbs</td>
</tr>
</tbody>
</table>

Points Possible: 1

See Alignment for more detail.
Scoring Guidelines

**Rationale for Option A: Key** – The first surface appears bright because most of the light is reflected and returns to the student’s eye. The second surface appears dimmer because some of the light has been absorbed by the surface.

**Rationale for Option B:** This is incorrect. If the first surface refracts the light, it passes through the surface at a new angle and does not return to the student’s eye. The second surface allows most of the light to pass through and not return to the student’s eye.

**Rationale for Option C:** This is incorrect. In this case, the second surface looks brighter than the first since it reflects most of the light. The first surface appears dimmer because light that is refracted passes through the surface and does not return to the student’s eye.

**Rationale for Option D:** This is incorrect. The light does not appear bright on either of these surfaces because neither absorbing nor passing through return much light to the student’s eye.

Alignment

Content Strand
Physical Science

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

Content Elaboration
Light can travel through some materials, such as glass or water. Light also can travel through empty space, like from the sun to Earth. When light travels from one location to another, it goes in a straight line until it interacts with another object or material.

When light strikes objects through which it cannot pass, shadows are formed. As light reaches a new material, it can be absorbed, refracted, reflected or can continue to travel through the new material; one of these interactions may occur or many may occur simultaneously, depending on the material.
When light passes from one material to another, it is often refracted at the boundary between the two materials and travels in a new direction through the new material (medium). For example, a magnifying lens bends light and focuses it toward a single point. A prism bends white light and separates the different colors of light. Experiment with prisms and magnifying lenses to observe the refraction of light.

**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 evaluate the observations of an experiment and select an explanation of how light behaves when it interacts with unknown surfaces.

**Sample Response: 1 point**

A student shines the light from a flashlight at two different surfaces. Where the light hits the first surface, the light looks just as bright as when it left the flashlight. Where the light hits the second surface, the light looks dimmer than when it left the flashlight.

Which table supports the student’s observations of the light’s behavior as it interacts with each surface?
Grade 5 Science
Spring 2019 Item Release

Question 43

Question and Scoring Guidelines
Question 43

The table shows the rotational and orbital periods for Mars and Earth.

<table>
<thead>
<tr>
<th>Planet</th>
<th>Rotational Period (hours)</th>
<th>Orbital Period (Earth days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth</td>
<td>23.9</td>
<td>365.2</td>
</tr>
<tr>
<td>Mars</td>
<td>24.6</td>
<td>687.0</td>
</tr>
</tbody>
</table>

Which conclusion is supported by the data for Mars and Earth?

A. A day on Mars is longer than a year on Mars.
B. A year on Mars is shorter than a year on Earth.
C. Mars spins on its axis at a rate similar to Earth’s.
D. Mars orbits the sun faster than the Earth orbits the sun.

**Points Possible:** 1

See **Alignment** for more detail.
Scoring Guidelines

**Rationale for Option A:** This is incorrect. A day on Mars is shorter than a year on Mars because the rotational period is much smaller than its orbital period.

**Rationale for Option B:** This is incorrect. A year on Mars is almost twice as long as a year on Earth because the orbital period of Mars is about 1.88 times that of Earth.

**Rationale for Option C:** Key – The rotational period of Mars is just slightly longer than that of Earth, meaning that Mars rotates or spins about as fast as Earth.

**Rationale for Option D:** This is incorrect. Mars’ and Earth’s speeds around the sun can only be determined from the orbital period with additional information about the size of the orbits.

Alignment

**Content Strand**
Earth and Space Science

**Content Statement**
Most of the cycles and patterns of motion between the Earth and 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.

**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 interpret rotational and orbital periods for Mars and Earth and select a conclusion that is supported by the data. The rotational period of Mars is just slightly longer than that of Earth, meaning that Mars rotates or spins about as fast as Earth.

Sample Response: 1 point

The table shows the rotational and orbital periods for Mars and Earth.

<table>
<thead>
<tr>
<th>Planet</th>
<th>Rotational Period (hours)</th>
<th>Orbital Period (Earth days)</th>
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<tbody>
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<tr>
<td>Mars</td>
<td>24.6</td>
<td>687.0</td>
</tr>
</tbody>
</table>

Which conclusion is supported by the data for Mars and Earth?

A. A day on Mars is longer than a year on Mars.
B. A year on Mars is shorter than a year on Earth.
C. Mars spins on its axis at a rate similar to Earth’s.
D. Mars orbits the sun faster than the Earth orbits the sun.
Grade 5 Science
Spring 2019 Item Release

Question 45

Question and Scoring Guidelines
A student sets up an experiment to determine the speed of sound in meters per second (m/s) in different materials. A table of the student’s data is shown.

<table>
<thead>
<tr>
<th>Material</th>
<th>Speed (in m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>343</td>
</tr>
<tr>
<td>Helium Gas</td>
<td>972</td>
</tr>
<tr>
<td>Water</td>
<td>1,493</td>
</tr>
<tr>
<td>Milk</td>
<td>1,548</td>
</tr>
<tr>
<td>Iron Bar</td>
<td>5,130</td>
</tr>
<tr>
<td>Piece of Glass</td>
<td>5,640</td>
</tr>
</tbody>
</table>

Which conclusion can the student make based on the data?

A. Sound travels fastest in empty space.
B. Sound travels faster in solids than gases.
C. Sound can travel anywhere in the universe.
D. Sound travels in water at the same speed it travels in other materials.

Points Possible: 1

See Alignment for more detail.
Scoring Guidelines

**Rationale for Option A:** This is incorrect. Sound needs a medium to travel and since there is no medium in space it cannot move.

**Rationale for Option B:** **Key** – The speed of sound is faster in solids than in gases as shown in the data comparisons.

**Rationale for Option C:** This is incorrect. Sound needs a medium in order to travel, therefore, cannot travel through space.

**Rationale for Option D:** This is incorrect. The speed of sound changes in different materials depending on the properties of the material (elasticity and density). The provided table does not support that sound travels at the same speed in water as it does in other materials.
Alignment
Content Strand
Physical Science

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

Content Elaboration
Audible sound can only be detected within a certain range of pitches. 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
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 conclusion that is supported by specific data on the speed of sound in different materials. The speed of sound is faster in solids than in gasses as shown in the data comparisons.
Sample Response: 1 point

A student sets up an experiment to determine the speed of sound in meters per second (m/s) in different materials. A table of the student's data is shown.

### Speed of Sound in Different Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Speed (in m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>343</td>
</tr>
<tr>
<td>Helium Gas</td>
<td>972</td>
</tr>
<tr>
<td>Water</td>
<td>1,493</td>
</tr>
<tr>
<td>Milk</td>
<td>1,548</td>
</tr>
<tr>
<td>Iron Bar</td>
<td>5,130</td>
</tr>
<tr>
<td>Piece of Glass</td>
<td>5,640</td>
</tr>
</tbody>
</table>

Which conclusion can the student make based on the data?

- A) Sound travels fastest in empty space.
- B) Sound travels faster in solids than gases.
- C) Sound can travel anywhere in the universe.
- D) Sound travels in water at the same speed it travels in other materials.
Question 48

Sunlight shines through a window into Room 1. A student wants to set up a mirror so that sunlight will reflect into Room 2.

Two Rooms in a House

How should the student position the mirror so that sunlight is reflected into Room 2?

Points Possible: 1

See Alignment for more detail.
Scoring Guidelines

**Rationale for Option A:** This is incorrect. Mirror A is parallel to the sunlight rays, therefore, no light reflects off of it.

**Rationale for Option B:** This is incorrect. Mirror B is at a 90 degree angle with the sunlight and therefore all of the sunlight hitting it will be reflected back in the same direction from which the sunlight came.

**Rationale for Option C:** Key – Mirror C is at an angle with the sunlight and is facing towards Room 2. When the sunlight hits mirror C, it reflects at an angle into Room 2.

**Rationale for Option D:** This is incorrect. Mirror D is at an angle with the sunlight and is facing away from Room 2. When the sunlight hits mirror D, it reflects at an angle towards the corner of Room 1.
**Alignment**
Content Strand
Physical Science

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

**Content Elaboration**
Light can travel through some materials, such as glass or water. Light also can travel through empty space, like from the sun to Earth. When light travels from one location to another, it goes in a straight line until it interacts with another object or material.

When light passes from one material to another, it is often refracted at the boundary between the two materials and travels in a new direction through the new material (medium). For example, a magnifying lens bends light and focuses it toward a single point. A prism bends white light and separates the different colors of light. Experiment with prisms and magnifying lenses to observe the refraction of light.

Visible light may be emitted from an object (like the sun) or reflected by an object (like a mirror or the moon).

**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 design a solution to reflecting sunlight to a room without windows. Mirror C is at an angle with the sunlight and is facing towards Room 2. When the sunlight hits mirror C, it reflects at an angle into Room 2.
Sample Response: 1 point

Sunlight shines through a window into Room 1. A student wants to set up a mirror so that sunlight will reflect into Room 2.

Two Rooms in a House

Window

Room 1

Room 2

How should the student position the mirror so that sunlight is reflected into Room 2?