

Ohio's State Tests

**PRACTICE TEST ANSWER KEY &
SCORING GUIDELINES**

**GRADE 8
SCIENCE**

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**Grade 8 Science
Practice Test
Content Summary and Answer Key**

Question No.	Item Type	Content Strand	Content Statement	Answer Key	Points
1	Graphic Response	Physical Science	Forces have magnitude and direction.	---	2 points
2	Graphic Response	Earth and Space Science	A combination of constructive and destructive geologic processes formed Earth's surface.	---	2 points
3	Short Response	Earth and Space Science	Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.	---	2 points
4	Extended Response	Earth and Space Science	Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.	---	4 points
5	Multiple Choice	Earth and Space Science	The composition and properties of Earth's interior are identified by the behavior of seismic waves.	C	1 point
6	Multiple Choice	Physical Science	Forces have magnitude and direction.	C	1 point
7	Multiple Choice	Physical Science	There are different types of potential energy.	D	1 point
8	Table	Physical Science	Forces between objects act when the objects are in direct contact or when they are not touching.	---	1 point
9	Multiple Choice	Physical Science	Forces between objects act when the objects are in direct contact or when they are not touching.	C	1 point
10	Evidence-Based Selected Response	Earth and Space Science	The composition and properties of Earth's interior are identified by the behavior of seismic waves.	B; A, B	1 point
11	Simulation*	Life Science	The characteristics of an organism are a result of inherited traits received from parent(s).	---	---
12	Graphic Response	Life Science	The characteristics of an organism are a result of inherited traits received from parent(s).	---	1 point

*The Simulation is numbered but not scored.

**Grade 8 Science
Practice Test
Content Summary and Answer Key**

Question No.	Item Type	Content Strand	Content Statement	Answer Key	Points
13	Graphic Response	Life Science	Reproduction is necessary for the continuation of every species.	---	2 points
14	Graphic Response	Life Science	The characteristics of an organism are a result of inherited traits received from parent(s).	---	1 point
15	Multiple Choice	Earth and Space Science	Earth's crust consists of major and minor tectonic plates that move relative to each other.	B	1 point
16	Graphic Response	Earth and Space Science	The composition and properties of Earth's interior are identified by the behavior of seismic waves.	---	1 point
17	Multi-Select	Life Science	Diversity of species occurs through gradual processes over many generations. Fossil records provide evidence that changes have occurred in number and types of species.	C; D; E; F	1 point
18	Graphic Response	Earth and Space Science	The composition and properties of Earth's interior are identified by the behavior of seismic waves.	---	1 point
19	Multiple Choice	Physical Science	Forces have magnitude and direction.	A	1 point
20	Matching	Earth and Space Science	Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.	---	1 point
21	Multiple Choice	Physical Science	There are different types of potential energy.	A	1 point
22	Multiple Choice	Physical Science	Forces have magnitude and direction.	A	1 point
23	Matching Item	Earth and Space Science	Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.	---	1 point
24	Matching Item	Physical Science	Forces have magnitude and direction.	---	1 point
25	Multi-Interaction Item	Physical Science	There are different types of potential energy.	---	1 point

Grade 8 Science Practice Test

Question 1

Question and Scoring Guidelines

Question 1

A car and two buses are driving on a highway. The blue arrows represent the direction and magnitude of each vehicle's motion relative to the ground.

Place a red arrow or "No Motion" label in each blank box to show the relative direction and magnitude of each vehicle's motion from the reference point of the car.

- Place only **one** arrow/label in each blank box.
- You may use each arrow/label more than once.

Diagram showing a car and two buses (labeled 1 and 2) on a highway. The car is in the top lane, moving left. Bus 2 is in the middle lane, moving left. Bus 1 is in the bottom lane, moving right. Blue arrows indicate motion relative to the ground. Red arrows and "No Motion" labels indicate motion relative to the car.

Key:

- Blue arrow: Motion with respect to ground
- Red arrow: Motion with respect to car

Points Possible: 2

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes

- "No Motion" in the car's box
- AND
- shortest right arrow in the Bus 2 box
- AND
- longest right arrow in the Bus 1 box (2 points).

For this item, a partial-credit response includes

- any 2 out of 3 correctly placed arrows and/or "No Motion" label (1 point).

Alignment

Content Strand

Physical Science

Content Statement

Forces have magnitude and direction.

Content Elaboration

The motion of an object is always measured with respect to a reference point.

Motion can be described in different ways by different observers (e.g., a pencil held in someone's hand may appear to be at rest, but to an observer in a car speeding by, the pencil may appear to be moving backward).

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 graphic response item requires the student to apply reasoning to determine the motions of two buses relative to a moving car.

In this item, the reference point is the car, which is moving at the fastest speed and to the left. If the driver observes an object inside the car, relative to the car, the object does not appear to be in motion.

Bus 1 and bus 2 are moving at the same speed, but in opposite directions. Since the car is moving faster, but in the same direction as bus 2, the car pulls farther and farther ahead of bus 2; therefore, relative to the car, it appears bus 2 is moving backward or to the right.

Since bus 1 is moving in the opposite direction as the car, the car pulls farther ahead of bus 1 at a faster rate than it pulls ahead of bus 2; therefore, relative to the car, it appears bus 1 is also moving backward or to the right at a faster speed than bus 2.

The student needs to correctly identify all three responses to earn 2 points. Correctly identifying two of the three responses can earn the student 1 point.

Grade 8 Science Practice Test

Question 1

Sample Responses

Sample Response: 2 points

A car and two buses are driving on a highway. The blue arrows represent the direction and magnitude of each vehicle's motion relative to the ground.

Place a red arrow or "No Motion" label in each blank box to show the relative direction and magnitude of each vehicle's motion from the reference point of the car.

- Place only **one** arrow/label in each blank box.
- You may use each arrow/label more than once.

Key

- Motion with respect to ground
- Motion with respect to car

Notes on Scoring

This response earns the full two points. The response correctly indicates that relative to the car, the car has no motion, bus 2 has motion in the opposite direction and bus 1 has a faster motion in the opposite direction.

Sample Response: 1 point

A car and two buses are driving on a highway. The blue arrows represent the direction and magnitude of each vehicle's motion relative to the ground.

Place a red arrow or "No Motion" label in each blank box to show the relative direction and magnitude of each vehicle's motion from the reference point of the car.

- Place only **one** arrow/label in each blank box.
- You may use each arrow/label more than once.

The diagram shows a three-lane highway. A red car is in the top lane, moving left. A yellow bus labeled '2' is in the middle lane, moving left. A yellow bus labeled '1' is in the bottom lane, moving right. A legend indicates that blue arrows represent motion with respect to the ground, and red arrows represent motion with respect to the car. The car's motion is represented by a blue arrow pointing left. Bus 2's motion is represented by a blue arrow pointing left. Bus 1's motion is represented by a blue arrow pointing right. The relative motion of the car and bus 2 is represented by a red arrow pointing left. The relative motion of the car and bus 1 is represented by a red arrow pointing right.

Key

- Blue arrow: Motion with respect to ground
- Red arrow: Motion with respect to car

Notes on Scoring

This response earns one of the two points. The response correctly indicates that relative to the car, the car has no motion and bus 1 has a faster motion in the opposite direction; however, the response incorrectly indicates that relative to the car, bus 2 has a fast motion in the same direction as the car.

Sample Response: 0 points

A car and two buses are driving on a highway. The blue arrows represent the direction and magnitude of each vehicle's motion relative to the ground.

Place a red arrow or "No Motion" label in each blank box to show the relative direction and magnitude of each vehicle's motion from the reference point of the car.

- Place only **one** arrow/label in each blank box.
- You may use each arrow/label more than once.

Key

- Blue arrow: Motion with respect to ground
- Red arrow: Motion with respect to car

Notes on Scoring

This response does not earn any credit. The response correctly indicates that relative to the car, the car has no motion; however, the response incorrectly indicates that relative to the car, bus 2 is moving to the left. While the response correctly indicates the motion of bus 1 is to the right, it incorrectly shows it having a slower speed than bus 2, so this motion is also incorrect. Therefore, only one of the motions is fully correct. The response must correctly indicate two of the three motions to earn one point.

Sample Response: 0 points

A car and two buses are driving on a highway. The blue arrows represent the direction and magnitude of each vehicle's motion relative to the ground.

Place a red arrow or "No Motion" label in each blank box to show the relative direction and magnitude of each vehicle's motion from the reference point of the car.

- Place only **one** arrow/label in each blank box.
- You may use each arrow/label more than once.

Key

- Blue arrow: Motion with respect to ground
- Red arrow: Motion with respect to car

Notes on Scoring

This response does not earn any credit. The response incorrectly indicates that relative to the car, the car has a fast motion to the left. The response also incorrectly indicates that relative to the car, bus 2 is moving to the left. The response correctly indicates the motion of bus 1 is to the right; however, the response must correctly indicate two of the three motions to earn one point.

Grade 8 Science Practice Test

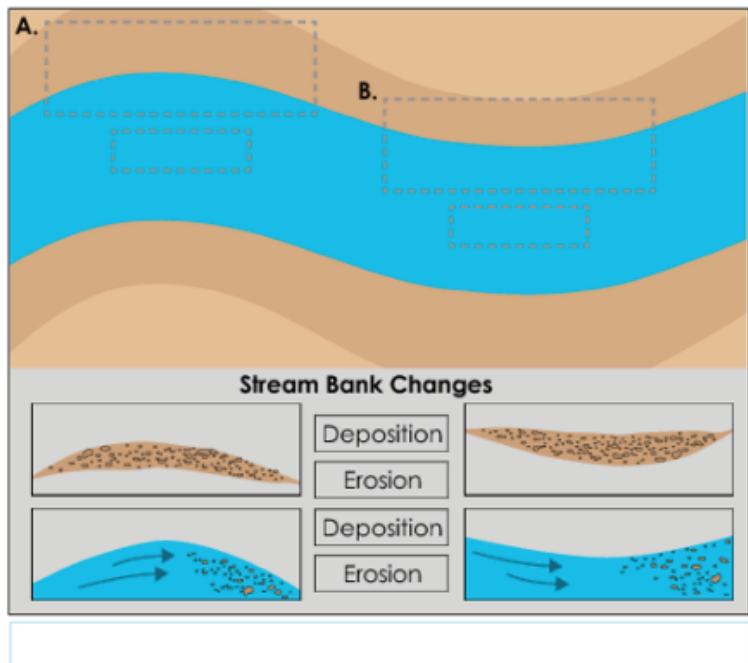
Question 2

Question and Scoring Guidelines

Question 2

The diagram shows a portion of a stream from above. Predict how the banks of the stream will change over time.

- A. Move an image into the blank box to show what bank A will look like over time. Move a label into the box underneath the bank that describes the process occurring.
- B. Move an image into the blank box to show what bank B will look like over time. Move a label into the box underneath the bank that describes the process occurring.
- Use only one object in each blank box.



Points Possible: 2

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes

- The image of sediment moving with the curve in box A AND the image of still sediment sitting in the curve in box B
- AND
- The “erosion” label in box A
- AND
- The “deposition” label in box B (2 points).

For this item, a partial-credit response includes

- The image of still sediment sitting in the curve in box A AND the “deposition” label in box A
- AND
- The image of sediment moving with the curve in box B AND the “erosion” label in box B (1 point).

Alignment

Content Strand

Earth and Space Science

Content Statement

A combination of constructive and destructive geologic processes formed Earth's surface.

Content Elaboration

Distinguishing between major geologic processes (e.g., tectonic activity, erosion, deposition) and the resulting feature on the surface of Earth is the focus of this content statement.

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 task. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures and basic principles.

Explanation of the Item

This item requires the student to recall and distinguish between the constructive and destructive processes of erosion and deposition and how the banks of the stream will change over time as a result of these processes. It requires students to correctly identify erosion as a destructive process and deposition as a constructive process.

At a bend in a stream the water's momentum forces the mass of the water against the outer bank eroding away sediment on the bank. The force of moving water carries the eroded sediments downstream where those sediments are deposited. Deposition of the sediments occurs when the moving water slows down and is unable to carry the sediment.

Grade 8 Science Practice Test

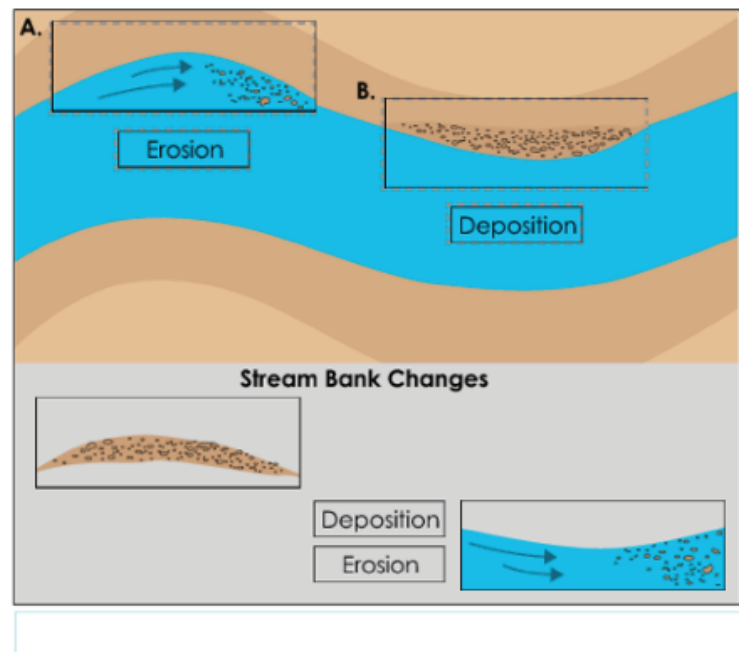
Question 2

Sample Responses

Sample Response: 2 points

The diagram shows a portion of a stream from above. Predict how the banks of the stream will change over time.

- Move an image into the blank box to show what bank A will look like over time. Move a label into the box underneath the bank that describes the process occurring.
 - Move an image into the blank box to show what bank B will look like over time. Move a label into the box underneath the bank that describes the process occurring.
- Use only one object in each blank box.



Notes on Scoring

This response correctly identifies both the correct process label and associated image as well as the correct stream bank locations where each process would occur. The response correctly shows the image of the sediment eroding away and carried downstream in bank A and the image of the still sediment deposited in the bend in bank B. The erosion label is correctly placed at location A and the deposition label at location B.

Sample Response: 1 point

The diagram shows a portion of a stream from above. Predict how the banks of the stream will change over time.

A. Move an image into the blank box to show what bank A will look like over time. Move a label into the box underneath the bank that describes the process occurring.

B. Move an image into the blank box to show what bank B will look like over time. Move a label into the box underneath the bank that describes the process occurring.

- Use only one object in each blank box.

The diagram shows a stream from above. Bank A is on the left, and Bank B is on the right. Bank A is labeled 'Deposition' and Bank B is labeled 'Erosion'. Below the stream, there is a section titled 'Stream Bank Changes' with two blank boxes for images and two labels: 'Deposition' and 'Erosion'. The 'Deposition' label is above the 'Erosion' label. The 'Deposition' label is also above the 'Erosion' label in the 'Stream Bank Changes' section.

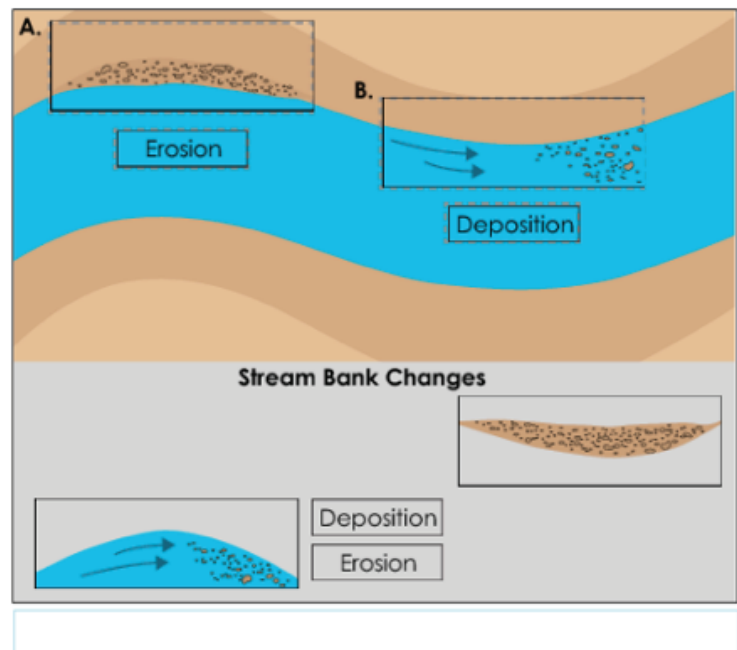
Notes on Scoring

This response would receive one point for showing partial understanding of the content by correctly matching the deposition and erosion labels with their respective images. This response fails to demonstrate how the stream flow direction typically results in erosion upstream where the force of moving water carries sediments downstream where those sediments are deposited. Deposition occurs when the moving water slows down and is unable to carry the sediment. The stream bank locations of the deposition and erosion processes are not correctly identified; therefore, this response does not receive full credit.

Sample Response: 0 points

The diagram shows a portion of a stream from above. Predict how the banks of the stream will change over time.

- Move an image into the blank box to show what bank A will look like over time. Move a label into the box underneath the bank that describes the process occurring.
 - Move an image into the blank box to show what bank B will look like over time. Move a label into the box underneath the bank that describes the process occurring.
- Use only one object in each blank box.



Notes on Scoring

This response is incorrect because although the erosion and deposition labels are placed in the correct bank locations, the labels are incorrectly matched to the image of the process and therefore receives no credit.

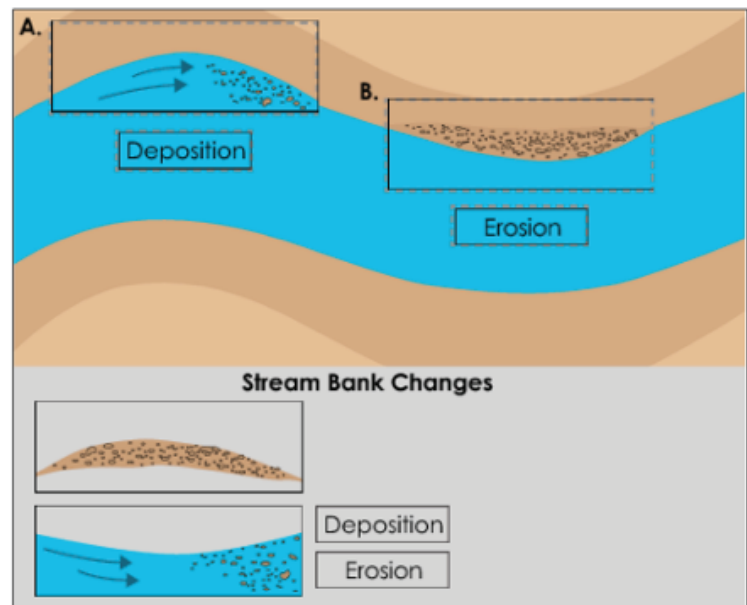
Sample Response: 0 points

The diagram shows a portion of a stream from above. Predict how the banks of the stream will change over time.

A. Move an image into the blank box to show what bank A will look like over time. Move a label into the box underneath the bank that describes the process occurring.

B. Move an image into the blank box to show what bank B will look like over time. Move a label into the box underneath the bank that describes the process occurring.

- Use only one object in each blank box.



Notes on Scoring

In this response, although the process images are placed in the correct bank locations, the labels are incorrectly matched with each process and therefore receives no credit.

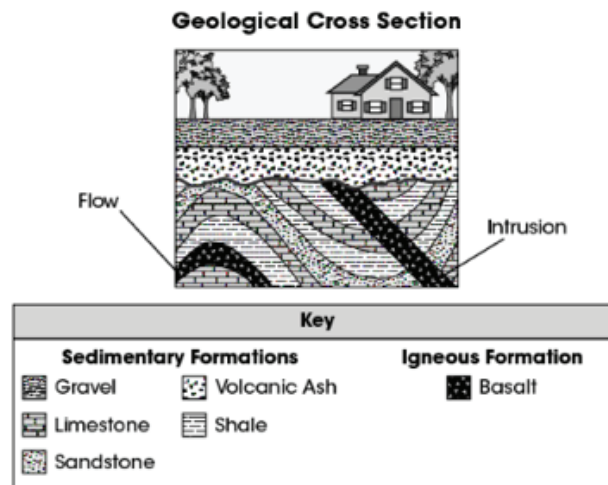
Grade 8 Science Practice Test

Question 3

Question and Scoring Guidelines

Question 3

A geologist is investigating the history of an area that has experienced various geological events, including sedimentation, erosion, tectonic deformation, and volcanic eruptions. The diagram shows the cross section produced from her study.



Using the cross section, explain how the geologist knows the relative age of the intrusion compared with that of the gravel.

Then, explain how the geologist knows that the flow is older than the intrusion.

Type your answer in the space provided.

A screenshot of a rich text editor toolbar. It includes buttons for bold (B), italic (I), underline (U), and strikethrough (ABC), followed by alignment (left, center, right, justified), bulleted list, numbered list, and link/unlink icons. Below the toolbar is a large empty text area.

Points Possible: 2

See **Alignment** for more detail.

Scoring Guidelines

2 points	<p>The response provides a complete interpretation and/or correct solution. It demonstrates a thorough understanding of the concept or task. It indicates logical reasoning and conclusions. It is accurate, relevant and complete. The response correctly</p> <ul style="list-style-type: none">• Explains how the geologist knows the relative age of the intrusion as compared with the gravel <p>AND</p> <ul style="list-style-type: none">• Explains how the geologist knows that the flow is older than the intrusion.
1 point	<p>The response provides evidence of a partial interpretation and/or solution process. It demonstrates an incomplete understanding of the concept or task. It contains minor flaws in reasoning. It neglects to address some aspect of the concept or task. The response correctly</p> <ul style="list-style-type: none">• Explains how the geologist knows the relative age of the intrusion as compared with the gravel <p>OR</p> <ul style="list-style-type: none">• Explains how the geologist knows that the flow is older than the intrusion.
0 points	<p>The response does not meet the criteria required to earn one point. The response indicates inadequate or no understanding of the task and/or the idea or concept needed to answer the item. The response may provide an incorrect solution/response.</p>

Alignment

Content Strand

Earth and Space Science

Content Statement

Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.

Earth is approximately 4.6 billion years old. Earth history is based on observations of the geologic record and the understanding that processes observed at present day are similar to those that occurred in the past (uniformitarianism). There are different

methods to determine relative and absolute age of some rock layers in the geologic record. Within a sequence of undisturbed sedimentary rocks, the oldest rocks are at the bottom (superposition).

Content Elaboration

The different methods used to determine the age of the Earth are an important factor in this concept. In elementary grades, fossils are used to compare what once lived to what lives now, but the concept of Earth's age and the age of the fossils were not included (the concept of billions or millions of years was not age-appropriate). In grade 8, the concept of index fossils is a way to build toward understanding relative dating. Superposition, crosscutting relationships and index fossils play an important role in determining relative age.

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 interpretation of a geological cross section to explain the relative age of geologic formations. The student will be required to use conceptual knowledge of superposition, crosscutting relationships and index fossils to explain how relative age is determined. The intrusion is older than the gravel because the gravel was deposited after the erosion took place and the intrusion was cut by the erosion. The flow is older than the intrusion because the flow is folded, which means that it had to be there when the rest of the sediments were folded. This happened before the intrusion because the intrusion is not folded.

This is a 2-point item. To earn the full-credit 2 points, the response must correctly explain both how the geologist knows the relative age of the intrusion as compared with the gravel as well as correctly explain how the geologist knows that the flow is older than the intrusion.

Grade 8 Science Practice Test

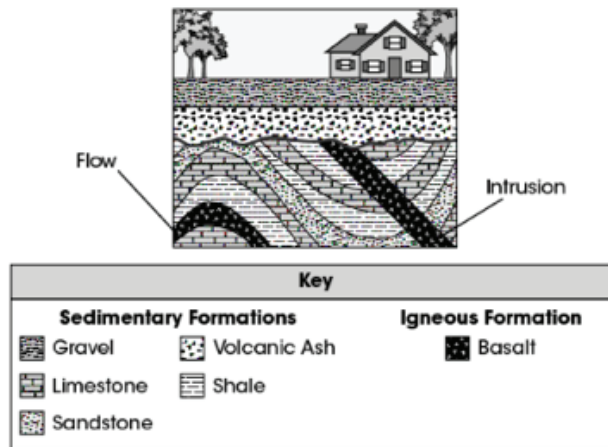
Question 3

Sample Responses

Sample Response: 2 points

A geologist is investigating the history of an area that has experienced various geological events, including sedimentation, erosion, tectonic deformation, and volcanic eruptions. The diagram shows the cross section produced from her study.

Geological Cross Section



Using the cross section, explain how the geologist knows the relative age of the intrusion compared with that of the gravel. Then, explain how the geologist knows that the flow is older than the intrusion.

Type your answer in the space provided.

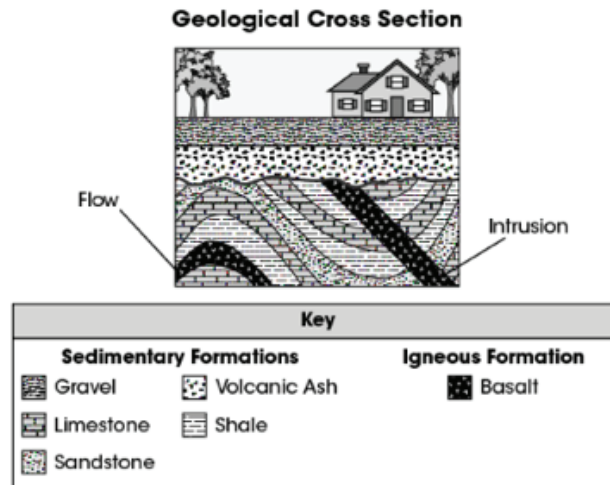
The intrusion starts several layers below the ground, so it is older relative to the gravel. The flow is older than the intrusion because the flow occurs beneath several layers of sedimentary rock that the intrusion seems to have just cut through.

Notes on Scoring

This response correctly interprets the cross section to determine that “The intrusion starts several layers below the gravel, so it is older relative to the gravel.” This response shows understanding of the law of superposition. This response also correctly states that “the flow occurs beneath several layers of sedimentary rock that the intrusion seems to have just cut through.” This statement shows an understanding that the flow is older than the intrusion because the sediments were deposited on top of the flow that was later cut across by an intrusion.

Sample Response: 2 points

A geologist is investigating the history of an area that has experienced various geological events, including sedimentation, erosion, tectonic deformation, and volcanic eruptions. The diagram shows the cross section produced from her study.



Using the cross section, explain how the geologist knows the relative age of the intrusion compared with that of the gravel.

Then, explain how the geologist knows that the flow is older than the intrusion.

Type your answer in the space provided.

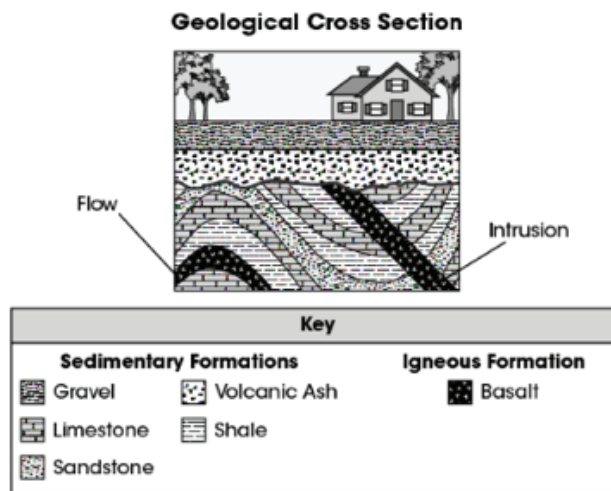
The cross section shows age between the intrusion and gravel because the gravel is above the intrusion and the top layer means that it is younger than the intrusion. The flow is older than the intrusion because the flow is a path that is curved and possible curved by tectoniv deformation and the intrusion is a straight line of Basalt and has not been deformed by tectonic deformation

Notes on Scoring

This response correctly interprets the cross section to determine that “the gravel is above the intrusion and the top layer means that it is younger.” This response also correctly states that “the flow is a path that is curved and possible curved by tectoniv deformation and the intrusion is a straight line of Basalt and has not been deformed by tectonic deformation.” This response demonstrates an understanding that the flow is older than the intrusion because the flow is folded or curved, which means that it had to be there when the rest of the sediments were folded. Therefore, this occurred before the basalt intrusion due to the fact that the intrusion is not folded.

Sample Response: 1 point

A geologist is investigating the history of an area that has experienced various geological events, including sedimentation, erosion, tectonic deformation, and volcanic eruptions. The diagram shows the cross section produced from her study.



Using the cross section, explain how the geologist knows the relative age of the intrusion compared with that of the gravel. Then, explain how the geologist knows that the flow is older than the intrusion.

Type your answer in the space provided.

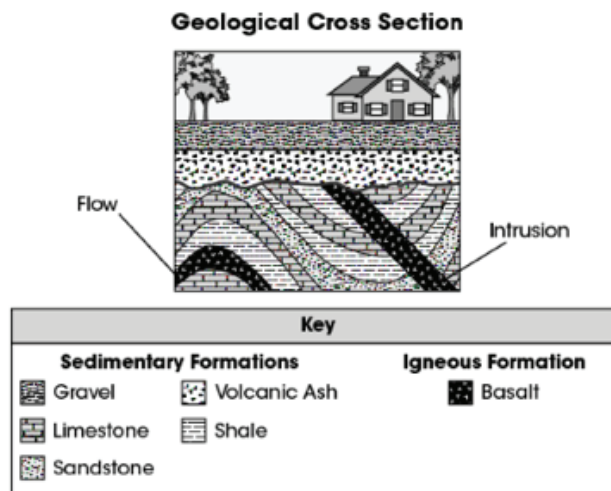
The geologist knows the age of the intrusion because it is lower than the gravel. Whatever is on the top is the newest rock. The geologist knows the flow is older because it is farther down in the ground.

Notes on Scoring

This response receives one point for correctly interpreting the cross section to explain how the geologist knows the relative age of the intrusion as compared with the gravel by stating "it is lower than the gravel. Whatever on top is the newest rock." This response states that "[the flow] is farther down in the ground," which is a vague statement, since both the flow and the intrusion are at the bottom most sections of the graphic; furthermore, this statement does not explain how the geologist knows that the flow is older than the intrusion.

Sample Response: 1 point

A geologist is investigating the history of an area that has experienced various geological events, including sedimentation, erosion, tectonic deformation, and volcanic eruptions. The diagram shows the cross section produced from her study.



Using the cross section, explain how the geologist knows the relative age of the intrusion compared with that of the gravel.

Then, explain how the geologist knows that the flow is older than the intrusion.

Type your answer in the space provided.

The geologist can tell the relative age of the intrusion by carbon dating the rocks surrounding. The geologist knows that the flow is older then the intrusion because the flow is beneth the younger rocks the intrusion cuts straight through the younger rocks.

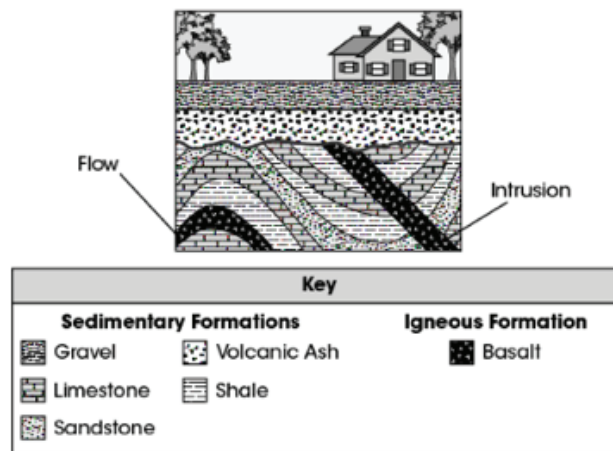
Notes on Scoring

This response receives one point for correctly interpreting the cross section to explain how the geologist knows that the flow is older than the intrusion. This response states that “the flow is beneth the younger rocks the intrusion cuts straight through the younger rocks.” This statement shows an understanding that the flow is older than the intrusion because the sediments were deposited on top of the flow that was later cut across by an intrusion. The response for how the geologist knows the relative age of the intrusion as compared with the gravel incorrectly states that “The geologist can tell the relative age of the intrusion by carbon dating the rocks surrounding.”

Sample Response: 0 points

A geologist is investigating the history of an area that has experienced various geological events, including sedimentation, erosion, tectonic deformation, and volcanic eruptions. The diagram shows the cross section produced from her study.

Geological Cross Section



Using the cross section, explain how the geologist knows the relative age of the intrusion compared with that of the gravel. Then, explain how the geologist knows that the flow is older than the intrusion.

Type your answer in the space provided.

B I U T_x ∑ ≡ ∏ ∫ ∮ ∘ ∙ ∘ ∙ ✂ ☰ ☷ ↶ ↷ ↵ Ω

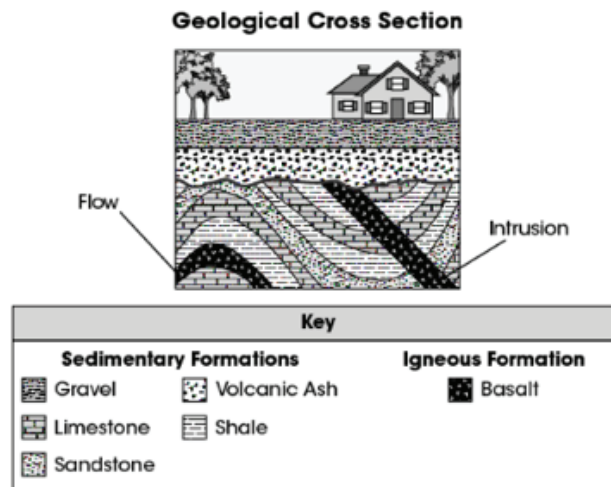
The geologist knows the intrusion compared to the gravel because the intrusion has a certain location which makes it possible for them to see how long it has been there. The geologist knows that the flow is older than the intrusion because of the direction it is going.

Notes on Scoring

This response is incorrect and does not explain how the geologist knows the relative age of the intrusion as compared with the gravel or explain how the geologist knows that the flow is older than the intrusion in terms of the law of superposition.

Sample Response: 0 points

A geologist is investigating the history of an area that has experienced various geological events, including sedimentation, erosion, tectonic deformation, and volcanic eruptions. The diagram shows the cross section produced from her study.



Using the cross section, explain how the geologist knows the relative age of the intrusion compared with that of the gravel.

Then, explain how the geologist knows that the flow is older than the intrusion.

Type your answer in the space provided.

The geologist knows the intrusions relative age because it has not formed in with the sedimentary formations yet. He knows that the flow is older because it has fit formed into the same shape as the sedimentary formation has.

Notes on Scoring

This response is incorrect and does not explain how the geologist knows the relative age of the intrusion as compared with the gravel or explain how the geologist knows that the flow is older than the intrusion in terms of the law of superposition.

Grade 8 Science Practice Test

Question 4

Question and Scoring Guidelines

Question 4

Several fish species became extinct millions of years ago. The graphs below show the distribution of fossils of these fishes as they occur in several undisturbed layers of sedimentary rock observable in a cliff face.

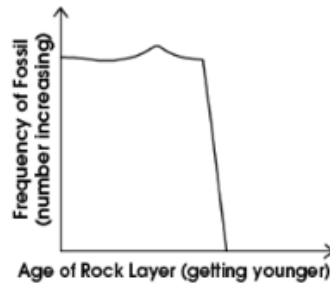


Figure 1. Fossil distribution is evidence of a sudden environmental change

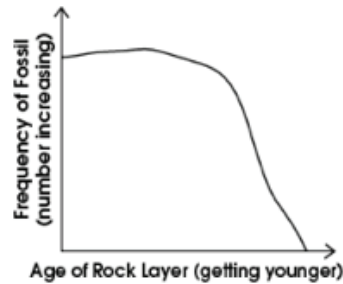


Figure 2. Fossil distribution is evidence of a gradual environmental change

Explain why the distribution of the fossils in figure 1 supports the hypothesis that the extinction of these species was a result of a sudden environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Explain why the distribution of the fossils in figure 2 supports the hypothesis that the extinction of these species was a result of a gradual environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Type your answer in the space provided.

B **I** **U** **I_x**

Points Possible: 4

See **Alignment** for more detail.

Scoring Guidelines

4 points

The focus of this item is on demonstrating an understanding of the fossil record as evidence of environmental change and an understanding of the types of environmental changes that cause gradual and sudden extinction.

The response:

- Provides an appropriate explanation of how the distribution of the fossils in figure 1 supports a hypothesis of sudden environmental change (describe graph figure 1)
- Describes a plausible environmental change that could have led to the rapid extinction of these fish species
- Provides an appropriate explanation of how the distribution of the fossils in figure 2 supports a hypothesis of gradual environmental change (describe graph figure 2)
- Describes a plausible environmental change that could have led to the gradual extinction of these fish species

3 points

The response shows partial evidence of understanding the fossil record as evidence of environmental change and/or a partial understanding of the types of environmental changes that cause gradual and sudden extinction by providing only three of the four bullets listed above.

Possible errors may include:

- An inaccurate explanation of why the distribution of fossils in figure 1 suggests extinction as a result of a sudden environmental change (failure to describe the graph in figure 1)
- An inappropriate type of environmental change as the cause of a sudden extinction
- An inaccurate explanation of why the distribution of fossils in figure 2 suggests extinction as a result of a gradual environmental change (failure to describe the graph in figure 2)
- An inappropriate type of environmental change as the cause of a gradual extinction

2 points	The response provides two of the four bullets listed above.
1 point	The response provides one of the four bullets listed above.
0 points	The response indicates inadequate or no understanding of the fossil record as evidence of environmental change or understanding of the types of environmental changes that cause gradual extinction. For example, the response may provide an inappropriate or incorrect explanation of why the distribution of fossils in the diagram suggests extinction as a result of a gradual environmental change and an inappropriate type of environmental change as the cause of a gradual extinction. The response does not meet the criteria required to earn one point. It may only repeat information given in the test item. The response may provide supportive information that is totally irrelevant to the item, or possibly, no other information is shown. The student may have written on a different topic or written, "I don't know."

Alignment

Content Strand

Earth and Space Science

Content Statement

Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.

Earth is approximately 4.6 billion years old. Earth history is based on observations of the geologic record and the understanding that processes observed at present day are similar to those that occurred in the past (uniformitarianism). There are different methods to determine relative and absolute age of some rock layers in the geologic record. Within a sequence of undisturbed sedimentary rocks, the oldest rocks are at the bottom (superposition). The geologic record can help identify past environmental and climate conditions.

Note: Environmental and climate conditions also can be documented through the cryosphere as seen through ice cores.

Content Elaboration

Uniformitarianism can be an important key in understanding how scientists have interpreted the environmental conditions that existed throughout Earth's history. Fossil evidence also can indicate specific environments and climate conditions that help interpret the geologic record.

Analyzing and interpreting the data to draw conclusions about geologic history is an important part of this content statement.

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 analyzing fossil data to explain how the fossil distribution supports a hypothesis of an extinction of fish species as a result of environmental change. This item requires the student to explain how Figure 1 supports the hypothesis that the extinction of the fossils was the result of a sudden environmental change and how Figure 2 supports the hypothesis of extinction due to gradual environmental change. This item then requires the description of a scenario for both a sudden and gradual environmental change that could cause this extinction, using conceptual knowledge of superposition and the use of geologic record in identifying past environmental conditions.

The law of superposition states that sedimentary layers are deposited in a time sequence, with the oldest on the bottom and the youngest on the top. Both graphs show the number of fish fossils decreasing with each younger rock layer in the geologic column. Figure 1 shows a sharp decline in fossils supporting the hypothesis of a sudden extinction due to a sudden environmental change such as a meteorite impact or volcanic eruption. Figure 2 shows a gradual decline in fossils indicating a gradual extinction possibly due to changes in climate, food sources or predators.

Grade 8 Science Practice Test

Question 4

Sample Responses

Sample Response: 4 points

Several fish species became extinct millions of years ago. The graphs below show the distribution of fossils of these fishes as they occur in several undisturbed layers of sedimentary rock observable in a cliff face.

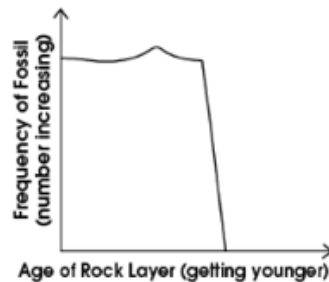


Figure 1. Fossil distribution is evidence of a sudden environmental change

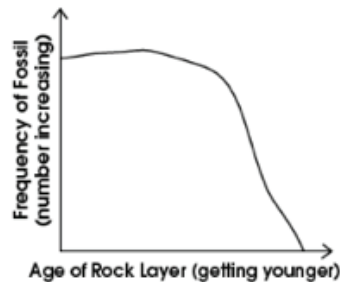


Figure 2. Fossil distribution is evidence of a gradual environmental change

Explain why the distribution of the fossils in figure 1 supports the hypothesis that the extinction of these species was a result of a sudden environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Explain why the distribution of the fossils in figure 2 supports the hypothesis that the extinction of these species was a result of a gradual environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Type your answer in the space provided.

Figure 1 graph shows a sudden environmental change, because all of the sudden there is a sharp turn in the line saying all of the sudden something happened to turn all these animals extinct. This could be caused by a meteor or sudden climate change.

The graph in figure 2 shows a steady decline, because the line gradually starts going down, not instantaneously. This could be caused by 1 species dieing out, then another, and then the rest die out because there was no food. It could also be caused by a slow climate change.

Notes on Scoring

This response provides an appropriate explanation of how the distribution of the fossils in Figure 1 supports a hypothesis of a sudden environmental change by stating, "all of the sudden there is a sharp turn in the line saying all of the sudden something happed to turn all these animals extinct." This response correctly describes the slope of graph in Figure 1 that supports the hypothesis.

This response provides a plausible environmental change that could have led to this sudden extinction by stating "could be caused by a meteor." A meteor is a valid example of an environmental change that would lead to a rapid extinction event.

This response provides an appropriate explanation of how the distribution of the fossils in Figure 2 supports a hypothesis of a gradual environmental change by stating, "the line gradually starts going down, not instintanusly." This response correctly describes the slope of graph in Figure 2 that supports the hypothesis.

This response provides a plausible environmental change that could have led to a gradual extinction by stating, "1 species dieing out, then another, and then the rest die out because there was no food." This response describes how changes in the food web could cause a gradual extinction of the fish fossil species.

Sample Response: 4 points

Several fish species became extinct millions of years ago. The graphs below show the distribution of fossils of these fishes as they occur in several undisturbed layers of sedimentary rock observable in a cliff face.

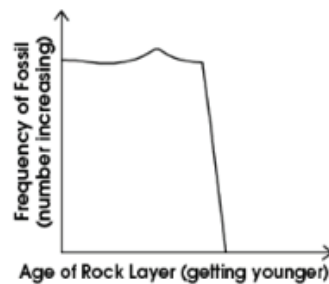


Figure 1. Fossil distribution is evidence of a sudden environmental change

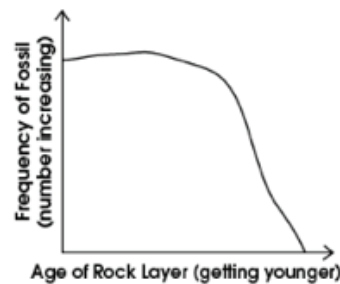


Figure 2. Fossil distribution is evidence of a gradual environmental change

Explain why the distribution of the fossils in figure 1 supports the hypothesis that the extinction of these species was a result of a sudden environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Explain why the distribution of the fossils in figure 2 supports the hypothesis that the extinction of these species was a result of a gradual environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Type your answer in the space provided.

B *I* U *ℱ*

Figure 1 shows a sudden environmental change. I know this because the graph suddenly drops without warning. An environmental change that could cause this is such things as a volcano eruption that decreased or made a species extinct.

In figure 2, there is a gradual drop the graph so that means there was a gradual environmental change, such as a growing population of a predator

Notes on Scoring

This response provides an appropriate explanation of how the distribution of the fossils in Figure 1 supports a hypothesis of a sudden environmental change by stating, "the graph suddenly drops." This response correctly describes the slope of graph in Figure 1 that supports the hypothesis.

This response provides a plausible environmental change that could have led to this sudden extinction by stating, "such things as a volcano eruption." A volcanic eruption is a valid example of an environmental change that would lead to a rapid extinction event.

This response provides an appropriate explanation of how the distribution of the fossils in Figure 2 supports a hypothesis of a gradual environmental change by stating, "there is a gradual drop in the graph." This response correctly describes the slope of graph in Figure 2 that supports the hypothesis.

This response provides a plausible environmental change that could have led to a gradual extinction by stating that it may have been the result of "a growing population of a predator." This response correctly identifies that an increase in predators could cause a gradual extinction of the fish fossil species.

Sample Response: 3 points

Several fish species became extinct millions of years ago. The graphs below show the distribution of fossils of these fishes as they occur in several undisturbed layers of sedimentary rock observable in a cliff face.

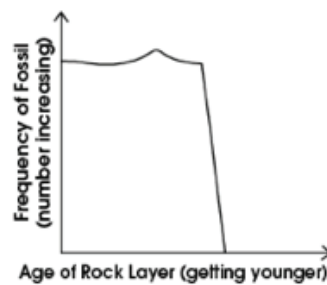


Figure 1. Fossil distribution is evidence of a sudden environmental change

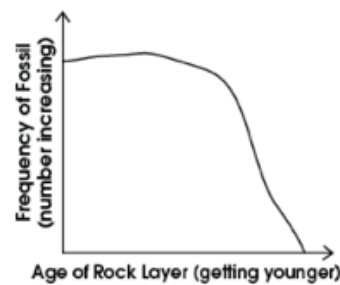


Figure 2. Fossil distribution is evidence of a gradual environmental change

Explain why the distribution of the fossils in figure 1 supports the hypothesis that the extinction of these species was a result of a sudden environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Explain why the distribution of the fossils in figure 2 supports the hypothesis that the extinction of these species was a result of a gradual environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Type your answer in the space provided.

The fossil chart in figure 1 supports the fact that the extinction of these species was a result of a sudden environmental change. It does this by showing you that the younger the rock gets the less fossils you find. Once change that could have caused an environmental change like this was an asteroid that hit Earth's surface.

The graph in figure two supports the theory that the extinction of these species was the result of a gradual environmental change. It goes this by making the decline line slope down slowly rather than drop down straight off. An environmental change that may have caused this was a change in the living condition or climate that made it hard for animals to survive.

Notes on Scoring

This response provides an appropriate explanation of how the distribution of the fossils in Figure 2 supports a hypothesis of a gradual environmental change by stating, “does this by making the decline line slope down slowly”; then by comparison, “rather than drop down straight off,” the student describes Figure 1. This response correctly describes the slope of both graphs.

This response provides a plausible environmental change that could have led to this sudden extinction by using the example, “an astroid that hit Earths surface.” An asteroid collision is a valid example of an environmental change that would lead to a rapid extinction event.

This response does not provide an example of a plausible environmental change that could have led to a gradual extinction.

Sample Response: 3 points

Several fish species became extinct millions of years ago. The graphs below show the distribution of fossils of these fishes as they occur in several undisturbed layers of sedimentary rock observable in a cliff face.

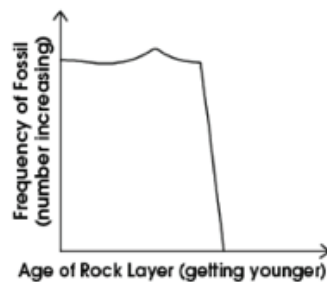


Figure 1. Fossil distribution is evidence of a sudden environmental change

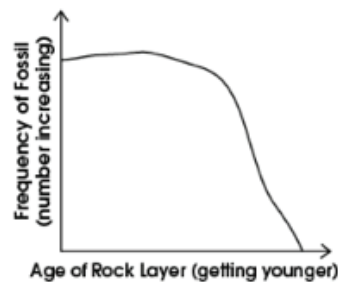


Figure 2. Fossil distribution is evidence of a gradual environmental change

Explain why the distribution of the fossils in figure 1 supports the hypothesis that the extinction of these species was a result of a sudden environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Explain why the distribution of the fossils in figure 2 supports the hypothesis that the extinction of these species was a result of a gradual environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Type your answer in the space provided.

B I U I_x **¶** **☒** **☐** **↶** **↷** **↺** **Ω**

IT COULD BE A RESULT OF A SUDDEN ENVIRONMENTAL CHANGE BECAUSE, THE FOSILS ARE GOING AT A NORMAL PACE, BUT THEN IT SUDDENLY JUST DROPS OFF, THERE COULD HAVE BEEN A KIND OF OIL SPILL, THE 2ND ONE COULD BE FROM A GRADUAL CHANGE BECAUSE THE LINE IS JUST SLOWLY GOING DOWN, AS OPPOSED TO ALMOST JUST DROPPING OFF. A NEW KIND OF ANIMAL THAT EATS FISH COULD HAVE COME UP SO THE FISH WOULD SLOWLY START GOING AWAY.

Notes on Scoring

This response provides an appropriate explanation of how the distribution of the fossils in Figure 1 supports a hypothesis of a sudden environmental change by stating, "FOSILS ARE GOING AT A NORMAL PACE, BUT THEN IT SUDDENLY JUST DROPS OFF." This response correctly describes the slope of graph in Figure 1 that supports the hypothesis.

The sudden environmental change provided in the response, "A KIND OF OIL SPILL" would not receive credit as it is not plausible. The example given in this response is of a human-induced change during a time period long before humans were present on Earth.

This response provides an appropriate explanation of how the distribution of the fossils in Figure 2 supports a hypothesis of a gradual environmental change by stating, "THE LINE IS JUST SLOWLY GOING DOWN." This response correctly describes the slope of graph in Figure 2 that supports the hypothesis.

This response provides a plausible environmental change that could have led to a gradual extinction by stating that it may have been the result of, "A NEW KIND OF ANIMAL THAT EATS FISH COULD HAVE COME UP SO THE FISH WOULD SLOWLY START GOING AWAY." This response correctly identifies that the introduction of a new predator could cause a gradual extinction of the fish fossil species.

Sample Response: 2 points

Several fish species became extinct millions of years ago. The graphs below show the distribution of fossils of these fishes as they occur in several undisturbed layers of sedimentary rock observable in a cliff face.

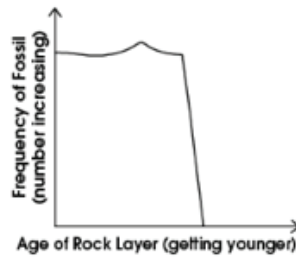


Figure 1. Fossil distribution is evidence of a sudden environmental change

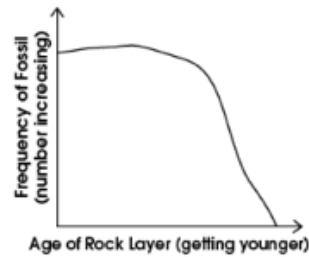


Figure 2. Fossil distribution is evidence of a gradual environmental change

Explain why the distribution of the fossils in figure 1 supports the hypothesis that the extinction of these species was a result of a sudden environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Explain why the distribution of the fossils in figure 2 supports the hypothesis that the extinction of these species was a result of a gradual environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Type your answer in the space provided.

B I U I_x [bulleted list icon] [numbered list icon] [indent icon] [outdent icon] [undo icon] [redo icon] [link icon] [unlink icon] [Ω]

figure 1 supports the hypothesis because there is a extreme drop on the end a environment change is possibly a drought of some kind
figure 2 supports the hypothesis because the chart sho a small Decrease over time| an environmental change could be a drought over time killing the species very slowly

Notes on Scoring

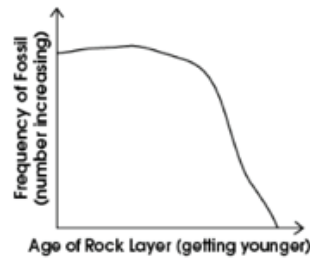
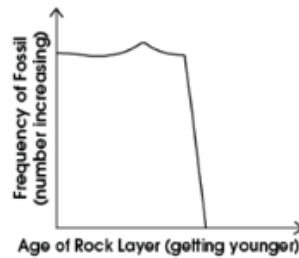
This response provides an appropriate explanation of how the distribution of the fossils in Figure 1 supports a hypothesis of a sudden environmental change by stating, "there is a extreme drop." This response correctly describes the slope of graph in Figure 1 that supports the hypothesis.

This response provides an appropriate explanation of how the distribution of the fossils in Figure 2 supports a hypothesis of a gradual environmental change by stating, "the chart sho a small Decrease over time." This response correctly describes the slope of graph in Figure 2 that supports the hypothesis.

This response fails to provide plausible environmental changes that could have led to either a sudden or a gradual extinction.

Sample Response: 2 points

Several fish species became extinct millions of years ago. The graphs below show the distribution of fossils of these fishes as they occur in several undisturbed layers of sedimentary rock observable in a cliff face.



Explain why the distribution of the fossils in figure 1 supports the hypothesis that the extinction of these species was a result of a sudden environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Explain why the distribution of the fossils in figure 2 supports the hypothesis that the extinction of these species was a result of a gradual environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Type your answer in the space provided.

B I U I_x [List of icons: bold, italic, underline, strikethrough, bulleted list, numbered list, indent, outdent, link, unlink, undo, redo, help, and a symbol for inserting a link or image]

It would result in a sudden environmental change in figure 1 because the slope of the line is at a steep incline. An example could be a land slide that made a bunch of rocks fall, and possibly killing many fish.
In figure 2, it is an example of a gradual change because the slope of it is gradual, it's not as steep. An environmental change that could make this occur would be an earthquake because it will kill some fish, but not a lot.

Notes on Scoring

This response provides an appropriate explanation of how the distribution of the fossils in Figure 1 supports a hypothesis of a sudden environmental change by stating, "the slope of the line is at a steep incline." This response correctly describes the slope of graph in Figure 1 that supports the hypothesis.

This response provides an appropriate explanation of how the distribution of the fossils in Figure 2 supports a hypothesis of a gradual environmental change by stating, "the slope of it is gradual." This response correctly describes the slope of graph in Figure 2 that supports the hypothesis.

This response fails to provide plausible environmental changes that could have led to either a sudden or a gradual extinction.

Sample Response: 1 point

Several fish species became extinct millions of years ago. The graphs below show the distribution of fossils of these fishes as they occur in several undisturbed layers of sedimentary rock observable in a cliff face.

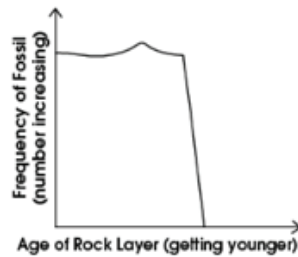


Figure 1. Fossil distribution is evidence of a sudden environmental change

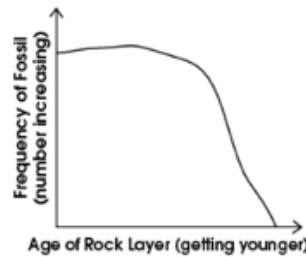


Figure 2. Fossil distribution is evidence of a gradual environmental change

Explain why the distribution of the fossils in figure 1 supports the hypothesis that the extinction of these species was a result of a sudden environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Explain why the distribution of the fossils in figure 2 supports the hypothesis that the extinction of these species was a result of a gradual environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Type your answer in the space provided.

The result of a sudden environmental change is it increased at one time then decreased a little then a lot as it got younger, so as it was older the more frequency and as it got younger the less frequency. The environmental change that could have caused this is it might have been a lake but got really hot and changed into a desert and dried up everything. Or it could have been a desert then it could have rained for several days. Figure 2 is a gradual environmental change because it stayed the same for a long time then slowly decreased a little by a little. A environmental change that could have done this is it might of been a forest then a lake then a desert. By it got flooded and turned into a lake then it got hot and turned into a desert because everything dried up.

Notes on Scoring

This response correctly provides an appropriate explanation of how the distribution of the fossils in Figure 2 supports a hypothesis of a gradual environmental change by stating, "it stayed the same for a long time then slowly decreased a little by a little." The response does not describe Figure 1 and fails to provide plausible environmental changes that could have led to either a sudden or a gradual extinction.

Sample Response: 1 point

Several fish species became extinct millions of years ago. The graphs below show the distribution of fossils of these fishes as they occur in several undisturbed layers of sedimentary rock observable in a cliff face.

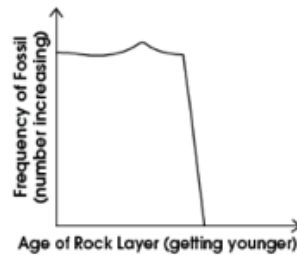


Figure 1. Fossil distribution is evidence of a sudden environmental change

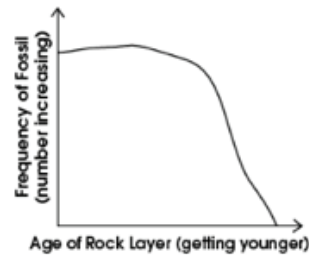


Figure 2. Fossil distribution is evidence of a gradual environmental change

Explain why the distribution of the fossils in figure 1 supports the hypothesis that the extinction of these species was a result of a sudden environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Explain why the distribution of the fossils in figure 2 supports the hypothesis that the extinction of these species was a result of a gradual environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Type your answer in the space provided.

The fossils in figure 1 were a result of a sudden environmental change. That could of been caused by Earth quakes or it could of been beaten up by the weather change. It was a sudden change because the fossils are all jagged and pointy not smooth like the rock in figure 2. The fossils in figure 2, supports the hypothesis of the extinction of species was a gradual environmental change. So it took a much longer time for figure 2. To form in the much smother shape because it took much longer for the extinction.

Notes on Scoring

This response correctly provides an appropriate explanation of how the distribution of the fossils in Figure 2 supports a hypothesis of a gradual environmental change by stating, "it took a much longer time for figure 2. To form in the much smother shape because it took much longer for the extinction." The response does not describe Figure 1 and fails to provide plausible environmental changes that could have led to either a sudden or a gradual extinction.

Sample Response: 0 points

Several fish species became extinct millions of years ago. The graphs below show the distribution of fossils of these fishes as they occur in several undisturbed layers of sedimentary rock observable in a cliff face.

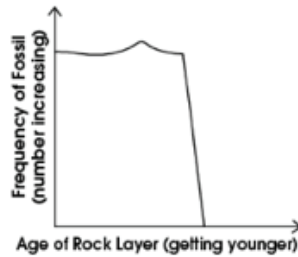


Figure 1. Fossil distribution is evidence of a sudden environmental change

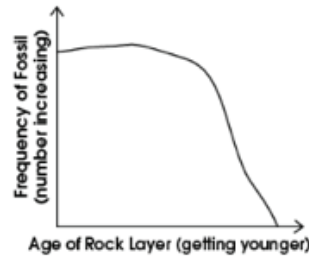


Figure 2. Fossil distribution is evidence of a gradual environmental change

Explain why the distribution of the fossils in figure 1 supports the hypothesis that the extinction of these species was a result of a sudden environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Explain why the distribution of the fossils in figure 2 supports the hypothesis that the extinction of these species was a result of a gradual environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Type your answer in the space provided.

B **I** **U** **I_x**

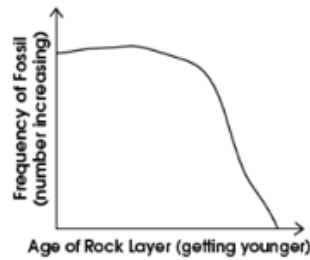
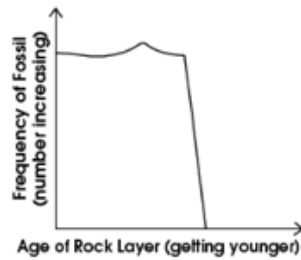
The distrubution of the fossils ^in graph 1 shows that something happen and killed them off fast.
In graph 2 whatever happened was in a slow process

Notes on Scoring

This response fails to explain why the graphs support either hypothesis or provide plausible environmental changes that could have led to either a sudden or a gradual extinction.

Sample Response: 0 points

Several fish species became extinct millions of years ago. The graphs below show the distribution of fossils of these fishes as they occur in several undisturbed layers of sedimentary rock observable in a cliff face.



Explain why the distribution of the fossils in figure 1 supports the hypothesis that the extinction of these species was a result of a sudden environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Explain why the distribution of the fossils in figure 2 supports the hypothesis that the extinction of these species was a result of a gradual environmental change.

Describe an environmental change that could have produced this kind of fossil distribution.

Type your answer in the space provided.

B I U [List of icons]

The water level could have gone down and most of the fish died.

Notes on Scoring

This response indicates a lack of understanding of how the fossil record is used as evidence of environmental change or how types of environmental changes cause extinction.

Grade 8 Science Practice Test

Question 5

Question and Scoring Guidelines

Question 5

What are the two sources of thermal energy in Earth's interior?

- Ⓐ solar heating and gravity
- Ⓑ combustion and solar heating
- Ⓒ gravity and radioactive decay
- Ⓓ radioactive decay and combustion

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. Earth's interior is not heated directly by the sun although the gravitational contraction of Earth's interior is a source of thermal energy.

Rationale for Option B: This is incorrect. Combustion needs oxygen; there is no free oxygen in Earth's interior and the sun does not directly heat Earth's interior.

Rationale for Option C: **Key** – As Earth formed, gas and dust particles condensed due to gravitational attraction and, over time, heavier materials contracted into the center of the Earth releasing thermal energy. Also, radioactive elements from Earth's formation decayed, releasing thermal energy. Gravity and radioactive decay continue to be sources of thermal energy in Earth's interior today.

Rationale for Option D: This is incorrect. Combustion needs oxygen and there is no free oxygen in Earth's interior.

Alignment

Content Strand

Earth and Space Science

Content Statement

The composition and properties of Earth's interior are identified by the behavior of seismic waves.

Content Elaboration

The formation of the planet generated heat from gravitational energy and the decay of radioactive elements, which are still present today. Heat released from Earth's core drives convection currents throughout the mantle and the crust.

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 a routine mathematical task. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures and basic principles.

Explanation of the Item

This item requires the student to recall the sources of thermal energy in the Earth's interior. As Earth formed, the heat in Earth's interior was much greater than it is today. The source of that heat came from gravitational contraction of Earth's interior and radioactive decay of radioactive elements in the interior of Earth.

As Earth formed, gas and dust particles condensed due to gravitational attraction and, over time, heavier materials contracted into the center of the Earth releasing thermal energy. Also, radioactive elements from Earth's formation decayed, releasing thermal energy. Gravity and radioactive decay continue to be sources of thermal energy in Earth's interior today.

Sample Response: 1 point

What are the two sources of thermal energy in Earth's interior?

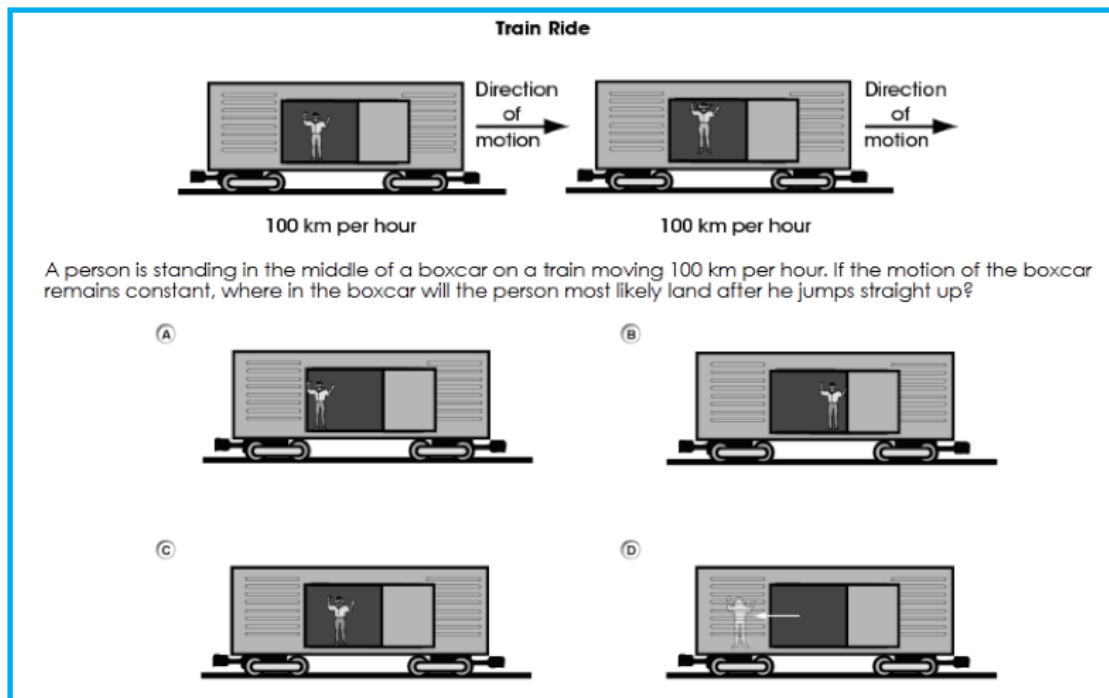
- ☐ (A) solar heating and gravity
- ☐ (B) combustion and solar heating
- ☒ (C) gravity and radioactive decay
- ☐ (D) radioactive decay and combustion

Grade 8 Science Practice Test

Question 6

Question and Scoring Guidelines

Question 6



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. The person is moving at the same speed and in the same direction as the train. Since there are no horizontal forces acting on the person, the person will keep moving with the same speed and in the same direction as the train, even while jumping. The person will land in the same position of the train from where the person jumped, not behind the jumping position. In order to land behind the jumping position, a net force acting in this direction would be required.

Rationale for Option B: This is incorrect. The person is moving at the same speed and in the same direction as the train. Since there are no horizontal forces acting on the person, the person will keep moving with the same speed and in the same direction as the train, even while jumping. The person will land in the same position of the train from where the person jumped, not in front of the jumping position. In order to land in front of the jumping position, a net force acting in this direction would be required.

Rationale for Option C: **Key** – The person is moving at the same speed and in the same direction as the train. Since there are no horizontal forces acting on the person, the person will keep moving with the same speed and in the same direction as the train, even while jumping. The person will land in the same position of the train from where the person jumped, not behind or in front of the jumping position. In order to land in a different position, a net horizontal force would be required.

Rationale for Option D: This is incorrect. The person is moving at the same speed and in the same direction as the train. Since there are no horizontal forces acting on the person, the person will keep moving with the same speed and in the same direction as the train, even while jumping. The person will land in the same position of the train from where the person jumped, not behind the jumping position. In order to land behind the jumping position, a net force acting in this direction would be required.

Alignment

Content Strand

Physical Science

Content Statement

Forces have magnitude and direction.

Content Elaboration

When the net force is zero, the object remains at rest or continues to move at a constant speed in a straight line.

If all forces are balanced by equal forces in the opposite direction, the object will maintain its current motion (both speed and direction). This means if the object is stationary, it will remain stationary. If the object is moving, it will continue moving in the same direction and at the same speed. Such qualitative, intuitive understandings and descriptions of inertia must be developed through inquiry activities.

Cognitive Demand

Interpreting and Communicating Science Concepts (C)

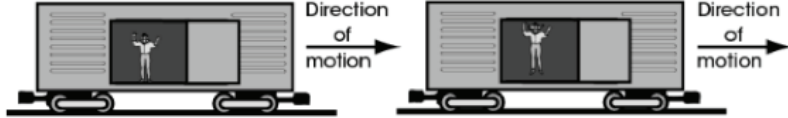
Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative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

Explanation of the Item

This item requires applying reasoning to a situation involving a person jumping in a boxcar of a moving train to determine where the person will land. The student must apply knowledge that a moving object will continue moving with the same speed and in the same direction in the absence of an outside net force to the situation. There are no horizontal forces acting on the person and the person is moving with the same speed and in the same direction as the train; therefore, the person will continue to move with the same speed and in the same direction as the train while jumping in the air and landing.



Sample Response: 1 point


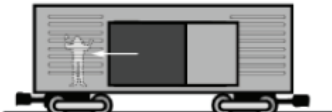
Train Ride



100 km per hour 100 km per hour

A person is standing in the middle of a boxcar on a train moving 100 km per hour. If the motion of the boxcar remains constant, where in the boxcar will the person most likely land after he jumps straight up?

(A)  (B) 

(C)  (D) 

Grade 8 Science Practice Test

Question 7

Question and Scoring Guidelines

Question 7

One bar magnet sits on a table, and a rubber band suspends another magnet above it. In the view on the left, the upper magnet is held in place and cannot move. In the view on the right, the upper magnet has been released.

How did the potential energy change when the upper magnet was released?

- (A) Magnetic, elastic and gravitational potential energy increased.
- (B) Magnetic, elastic and gravitational potential energy decreased.
- (C) Magnetic and elastic potential energy increased, and gravitational potential energy decreased.
- (D) Magnetic and gravitational potential energy decreased, and elastic potential energy increased.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. It is true the elastic potential energy will increase as the band is stretched; however, opposite poles attract and the magnetic potential energy decreases as attractive poles get closer together. Also, since gravitational force is only an attractive force between masses, gravitational potential energy becomes less as objects get closer to Earth.

Rationale for Option B: This is incorrect. It is true that gravitational potential energy and magnetic potential energy decrease; however, elastic potential energy increases as the rubber band is stretched.

Rationale for Option C: This is incorrect. It is true that the elastic potential energy increases and the gravitational potential energy decreases; however, opposite poles attract and the magnetic potential energy decreases as they get closer together.

Rationale for Option D: **Key** – Magnetic potential energy decreases. Since the magnets are oriented with the north pole of one magnet closest to the south pole of the second magnet, there is a net attractive force between the magnets as they are positioned in the picture. Since the magnetic force between the magnets is attractive, more energy must be put into the system to separate the attractive poles; therefore, the closer the attractive magnets are, the lower the magnetic potential energy. Likewise, since gravitational force is an attractive force between masses, more energy must be put into the system to separate the masses; therefore, the closer the masses are, the lower the gravitational potential energy. Also, elastic potential energy increases as the rubber band is stretched.

Alignment

Content Strand

Physical Science

Content Statement

There are different types of potential energy.

Content Elaboration

Gravitational potential energy changes in a system as the masses or relative positions of objects are changed.

Gravitational potential energy is associated with the mass of an object and its height above a reference point (e.g., above ground level, above floor level). A change in the height of an object is evidence that the gravitational potential energy has changed.

Elastic potential energy is associated with how much an elastic object has been stretched or compressed and how difficult such a compression or stretch is. A change in the amount of compression or stretch of an elastic object is evidence that the elastic potential energy has changed.

Magnetic potential energy is associated with the position of magnetic objects relative to each other.

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 a routine mathematical task. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures and basic principles.

Explanation of the Item

This multiple choice question requires the student to identify how the magnetic, elastic and gravitational potential energy change in a system involving two magnets and a rubber band.

As the system is released, the upper magnet is closer to the ground. Since gravitational potential energy is attractive, the closer the two objects are (in this case the magnet and Earth), the lower the gravitational potential energy. In order to increase the gravitational potential energy, more energy must be transferred into the system to separate the masses that attract one another.

As the system is released, the rubber band is stretched more, increasing the elastic potential energy.

The magnets are positioned so the north pole of one magnet is closest to the south pole of the other magnet. This results in a net attractive force between the magnets. After the system is released, the magnets get closer together. Since the net force between the magnets positioned in this way is attractive, the closer the two objects are, the lower the magnetic potential energy. In order to increase the magnetic potential energy, more energy must be transferred into the system to separate the attractive poles.

If the magnets are positioned differently, where similar poles are closer together (north closer to north or south closer to south), there would be a net repulsive force between the magnets. With a repulsive force between the magnets, the magnetic potential energy would increase as the magnets got closer. This is because more energy must be transferred into the system to bring the repulsive poles closer together.

Sample Response: 1 point

One bar magnet sits on a table, and a rubber band suspends another magnet above it. In the view on the left, the upper magnet is held in place and cannot move. In the view on the right, the upper magnet has been released.

Before Release **After Release**

How did the potential energy change when the upper magnet was released?

- ☐ (A) Magnetic, elastic and gravitational potential energy increased.
- ☐ (B) Magnetic, elastic and gravitational potential energy decreased.
- ☐ (C) Magnetic and elastic potential energy increased, and gravitational potential energy decreased.
- ☒ (D) Magnetic and gravitational potential energy decreased, and elastic potential energy increased.

Grade 8 Science Practice Test

Question 8

Question and Scoring Guidelines

Question 8

An engineer is collecting data on four different satellites orbiting Earth. The engineer records the satellites' distances from Earth in kilometers (km) and their forces due to gravity in Newtons (N).

Estimate the values for the two missing quantities. Enter your estimates into the blank boxes in the table.

Satellite	Mass (kg)	Distance (km)	Force due to gravity (N)
1	700	4000	17000
2	700	36000	<input type="text"/>
3	1000	<input type="text"/>	11000
4	1000	7000	8100

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit (1 point) response includes

- Greater than 0 and less than 7000 in the Satellite 3 Distance box
- AND
- Greater than 0 and less than 17000 in the Satellite 2 Force due to gravity box.

Alignment

Content Strand

Physical Science

Content Statement

Forces between objects act when the objects are in direct contact or when they are not touching.

Content Elaboration

Gravitational fields exist around objects with mass. If a second object with mass is placed in the field, the two objects experience attractive gravitational forces toward each other. Gravitational force weakens rapidly with increasing distance.

Every object exerts a gravitational force on every other object with mass. These forces are hard to detect unless at least one of the objects is very massive (e.g., sun, planets). The gravitational force increases with the mass of the objects, decreases rapidly with increasing distance and points toward the center of objects. Weight is gravitational force and is often confused with mass. Weight is proportional to mass, but depends upon the gravitational field at a particular location. An object will have the same mass when it is on the moon as it does on Earth. However, the weight (force of gravity) will be different at these two locations.

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 table item requires the student to apply reasoning and scientific knowledge to estimate acceptable values for gravitational force and distance into a data table. It must be understood that gravitational force increases with mass and decreases with distance. Since it is not required to know precise mathematical relationships, a wide range of answers is accepted.

To determine the force due to gravity for Satellite 2, one can compare it to Satellite 1, since it has the same mass. Since Satellite 2 has a greater distance from Earth than Satellite 1 but the same mass, it will have a lower force of gravity than 17000 N, the force of gravity of Satellite 1. Since its mass is still attracted to Earth, it cannot have a mass of 0; therefore, any answer greater than 0 N and less than 17000 N is accepted. If Newton's Law of Universal Gravity is used (introduced in High School Physics), the best answer is 2100 N; however, students are not held accountable for the mathematical relationship between distance and force due to gravity at this level of precision. Simply understanding that the force decreases as the distance increases is acceptable for this grade level.

To determine the distance for Satellite 3, one can compare it to Satellite 4, since it has the same mass. Since Satellite 3 has a higher force due to gravity than Satellite 4 but the same mass, it will be at a distance less than 7000 km, the distance of Satellite 4. Any answer greater than 0 km and less than 7000 km is accepted. If Newton's Law of Universal Gravity is used (introduced in High School Physics) the best answer is 6000 N; however, students are not held accountable for the mathematical relationship between distance and force due to gravity at this level of precision. Simply understanding that the force increases as the distance decreases is acceptable for this grade level.

This item is worth one point. In order to receive credit, the student must estimate both values within the acceptable ranges.

Grade 8 Science Practice Test

Question 8

Sample Responses

Sample Response: 1 point

An engineer is collecting data on four different satellites orbiting Earth. The engineer records the satellites' distances from Earth in kilometers (km) and their forces due to gravity in Newtons (N).

Estimate the values for the two missing quantities. Enter your estimates into the blank boxes in the table.

Satellite	Mass (kg)	Distance (km)	Force due to gravity (N)
1	700	4000	17000
2	700	36000	2100
3	1000	6000	11000
4	1000	7000	8100

Notes on Scoring

This response earns one point because both estimated values are within the accepted ranges. The force due to gravity for Satellite 2 is predicted to be "2100 N," which is greater than 0 N and less than 17000 N. The distance for Satellite 3 is predicted to be "6000 N," which is greater than 0 km and less than 7000 km.

Sample Responses: 0 points

An engineer is collecting data on four different satellites orbiting Earth. The engineer records the satellites' distances from Earth in kilometers (km) and their forces due to gravity in Newtons (N).

Estimate the values for the two missing quantities. Enter your estimates into the blank boxes in the table.

Satellite	Mass (kg)	Distance (km)	Force due to gravity (N)
1	700	4000	17000
2	700	36000	<input type="text" value="25000"/>
3	1000	<input type="text" value="9000"/>	11000
4	1000	7000	8100

Notes on Scoring

This response earns zero points because neither estimated value is within the accepted range. The force due to gravity for Satellite 2 is predicted to be "25000 N," which is greater, not less than 17000 N. The distance for Satellite 3 is predicted to be "9000 N," which is greater, not less than 7000 km.

An engineer is collecting data on four different satellites orbiting Earth. The engineer records the satellites' distances from Earth in kilometers (km) and their forces due to gravity in Newtons (N).

Estimate the values for the two missing quantities. Enter your estimates into the blank boxes in the table.

Satellite	Mass (kg)	Distance (km)	Force due to gravity (N)
1	700	4000	17000
2	700	36000	<input type="text" value="24000"/>
3	1000	<input type="text" value="6000"/>	11000
4	1000	7000	8100

Notes on Scoring

This response earns zero points because both estimated values must be within the accepted ranges in order to earn credit. The distance for Satellite 3 is predicted to be "6000 N," which is greater than 0 km and less than 7000 km; however, the force due to gravity for Satellite 2 is predicted to be "24000 N," which is greater, not less than 17000 N.

Grade 8 Science Practice Test

Question 9

Question and Scoring Guidelines

Question 9

Which term is an example of force?

- ☐ (A) energy
- ☐ (B) mass
- ☐ (C) weight
- ☐ (D) work

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. Force is an attraction or repulsion between two objects. Energy can be transferred from one object to another through forces, but energy is not a force.

Rationale for Option B: This is incorrect. Mass can be thought of as the amount of matter in an object. Force is an attraction or repulsion between two objects.

Rationale for Option C: **Key** – Weight is another term for the gravitational force between two objects with mass.

Rationale for Option D: This is incorrect. Work is a method by which energy can be transferred by a force being exerted on two objects as they move over a distance. Force is an attraction or repulsion between two objects.

Alignment

Content Strand

Physical Science

Content Statement

Forces between objects act when the objects are in direct contact or when they are not touching.

Content Elaboration

Every object exerts a gravitational force on every other object with mass. These forces are hard to detect unless at least one of the objects is very massive (e.g., sun, planets). The gravitational force increases with the mass of the objects, decreases rapidly with increasing distance and points toward the center of objects. Weight is gravitational force and is often confused with mass. Weight is proportional to mass, but depends upon the gravitational field at a particular location. An object will have the same mass when it is on the moon as it does on Earth; however, the weight (force of gravity) will be different at these two locations.

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 a routine mathematical task. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures and basic principles.

Explanation of the Item

This multiple choice item requires students to identify that weight is an example of force. Force is an attraction or repulsion between two objects. Weight is a measure of the gravitational attraction between two objects.

Sample Response: 1 point

Which term is an example of force?

- ☐ (A) energy
- ☐ (B) mass
- ☒ (C) weight
- ☐ (D) work

Grade 8 Science Practice Test

Question 10

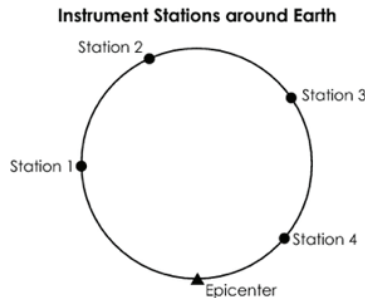
Question and Scoring Guidelines

Question 10

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

Part A

Instruments located around Earth record seismic wave activity during an earthquake. The epicenter of the earthquake and locations of four instrument stations around Earth are shown.



Which stations will record fewer waves than the others?

- (A) Stations 1 and 4
- (B) Stations 2 and 3
- (C) Stations 3 and 4
- (D) Stations 1 and 2

Part B

Select the **two** statements that explain why fewer waves were recorded at some stations.

- ☐ Part of Earth's interior bent some of the waves.
- ☐ Different materials in Earth reflect some of the waves.
- ☐ Some waves are blocked by water on the Earth's surface.
- ☐ Weather events near the stations can prevent waves from being recorded.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Part A

Rationale for Option A: This is incorrect. Station 1 and station 4 are closest to the epicenter of the earthquake and therefore are in locations that will pick up all of the waves. When seismic waves pass through different types of materials their speed is altered; consequently, their path through the materials may be bent. This is called “refraction.”

Rationale for Option B: **Key** – Stations 2 and 3 are farthest away from the epicenter of the earthquake and therefore are in positions where some, if not all, of the waves will not reach. Some waves will be reflected away from and some will be refracted away from the stations due to the composition of Earth's interior.

When seismic waves hit a surface between very different materials they may bounce off; this is called “reflection.” In the Earth, seismic waves reflect at the boundaries between the major earth layers.

Rationale for Option C: This is incorrect. Station 4 is in a location that will pick up all of the waves.

Rationale for Option D: This is incorrect. Station 1 is in a location that will pick up all of the waves.

Part B

First Rationale: **Key** – Some of the stations will either receive only one type of wave or none of the waves due to the waves being reflected or refracted away from their positions.

Second Rationale: **Key** – Some of the stations will either receive only one type of wave or none of the waves due to the waves being reflected or refracted away from their positions.

Third Rationale: This is incorrect. Seismic waves travel through Earth’s crust and are recorded from their terminal point on the solid crust. Some waves are able to travel through water but do not need to in order to reach the recording stations.

Fourth Rationale: This is incorrect. Weather events occur above Earth’s crust and cannot prevent waves from reaching recording stations.

Alignment

Content Strand

Earth and Space Science

Content Statement

The composition and properties of Earth’s interior are identified by the behavior of seismic waves.

The refraction and reflection of seismic waves as they move through one type of material to another is used to differentiate the layers of Earth’s interior. Earth has an inner and outer core, an upper and lower mantle, and a crust.

Content Elaboration

It is important to provide the background knowledge regarding how scientists know about the structure and composition of the interior of Earth (without being able to see it). Seismic data, graphics, charts, digital displays and cross sections must be used to study Earth’s interior. Actual data from the refraction and reflection of seismic waves can be used to demonstrate how scientists have determined the different layers of Earth’s interior. New discoveries and technological advances relating to understanding Earth’s interior also play an important role in this content.

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 interpreting a real world earthquake scenario and seismic wave activity. The student is required to identify the two stations that will record the fewest seismic waves and explain why this occurs. When an Earthquake occurs seismic waves are emitted from the epicenter. From the epicenter there are several paths the waves can take through the earth before emerging again at the surface. The speed of seismic waves depends on variations in strength and density of the material that they pass through. When seismic waves hit a surface between very different materials they may bounce off; this is called “reflection.” In the Earth, seismic waves reflect at the boundaries between the major earth layers. When seismic waves pass through different types of materials their speed is altered and consequently their path through the materials may be bent, which is called “refraction.”

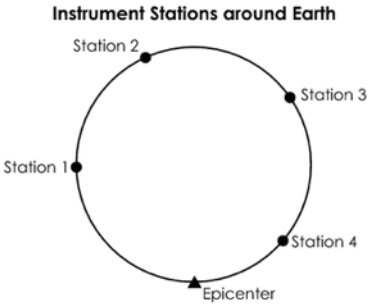
Sample Response: 1 point

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

Part A

Instruments located around Earth record seismic wave activity during an earthquake. The epicenter of the earthquake and locations of four instrument stations around Earth are shown.

Instrument Stations around Earth



Which stations will record fewer waves than the others?

(A) Stations 1 and 4
(B) Stations 2 and 3
(C) Stations 3 and 4
(D) Stations 1 and 2

Part B

Select the **two** statements that explain why fewer waves were recorded at some stations.

☒ Part of Earth's interior bent some of the waves.
☒ Different materials in Earth reflect some of the waves.
☐ Some waves are blocked by water on the Earth's surface.
☐ Weather events near the stations can prevent waves from being recorded.

Grade 8 Science Practice Test

Question 11

Simulation for Question 12

Question 11 (Simulation for Question 12)

A farmer grows flowering bushes. The bushes have red, white, or red and white flowers.

Select two parents to cross and then click Start. The number of offspring with each flower color will be shown.



Parent 1 Red Flowers ▼

Parent 2 Red Flowers ▼

Start

 Clear All Rows

Parent 1	Parent 2	Red Flowers	White Flowers	Red and White Flowers



Grade 8 Science Practice Test

Question 12

Question and Scoring Guidelines

Question 12

Use the simulation to perform an investigation to determine the flower color genotype for each flowering bush parent.

Place the alleles in the blank boxes to show the genotype for each parent.

- Place only **one** allele in each box.
- You may use each allele more than once.
- You do **not** need to use all the alleles.

R

r

W

w

Delete

Parent	Genotype
Red Flowers	<div><div></div><div></div></div>
White Flowers	<div><div></div><div></div></div>
Red and White Flowers	<div><div></div><div></div></div>

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes

- Only “R” “R” in the Red Flowers boxes
- AND
- Only “W” “W” in the White Flowers boxes
- AND
- Only “R” “W” in the Red and White Flowers boxes (1 point).

Note: The two alleles placed in each cell of the table can be placed in the same dashed box and in any order and credit will still be awarded.

Alignment

Content Strand

Life Science

Content Statement

The characteristics of an organism are a result of inherited traits received from parent(s).

Content Elaboration

The traits of one or two parents are passed on to the next generation through reproduction. Traits are determined by instructions encoded in deoxyribonucleic acid (DNA), which forms genes. Genes have different forms called alleles. The concepts of dominant and recessive genes are appropriate at this grade level. Co-dominant traits such as roan color in horses and cows may be useful to provide further validation of the theory and to help dispel some misconceptions.

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 determining the flower color genotype for each flowering plant parent. The item also requires application of the concept that the traits of one or two parents are passed on to the next generation through reproduction and that these traits are determined by instructions encoded in deoxyribonucleic acid (DNA), which forms genes. Genes have different forms called alleles. It should be understood that a genotype is the representation of alleles shown as either uppercase (dominant) or lowercase (recessive) letters.

In this item, students will interpret the results of the simulation and determine that when both co-dominant alleles are present, both allele traits are expressed in the organism. The co-dominance pattern differs from a simple dominance pattern; the dominant (uppercase) allele will always be expressed and the recessive (lowercase) trait will only be expressed if both alleles are recessive. Using the simulation to cross parents of different flower color variations and interpreting the patterns of traits in the offspring, the student can determine the genotype for each flowering plant parent.

Grade 8 Science Practice Test

Question 12

Sample Responses

Sample Responses: 1 point

Use the simulation to perform an investigation to determine the flower color genotype for each flowering bush parent.

Place the alleles in the blank boxes to show the genotype for each parent.

- Place only **one** allele in each box.
- You may use each allele more than once.
- You do **not** need to use all the alleles.

R

r

W

w

Delete

Parent	Genotype
Red Flowers	<div>R</div> <div>R</div>
White Flowers	<div>W</div> <div>W</div>
Red and White Flowers	<div>R</div> <div>W</div>

Use the simulation to perform an investigation to determine the flower color genotype for each flowering bush parent.

Place the alleles in the blank boxes to show the genotype for each parent.

- Place only **one** allele in each box.
- You may use each allele more than once.
- You do **not** need to use all the alleles.

R

r

W

w

Delete

Parent	Genotype
Red Flowers	<div>R</div> <div>R</div>
White Flowers	<div>W</div> <div>W</div>
Red and White Flowers	<div>W</div> <div>R</div>

Notes on Scoring

These responses correctly identify that all the alleles are dominant through the use of all uppercase letters in the genotypes. The response correctly shows that the red flowers must have two dominant alleles, "R," to express the red color. The response correctly shows that the white flowers must have two dominant alleles, "W," to express the white color. The response correctly shows that the plant with both red- and white-colored flowers must have one of each of the dominant alleles "R" and "W" to express both of these colors. The genotype for red and white flowers can be written as either "RW" or "WR."

Sample Response: 0 points

Use the simulation to perform an investigation to determine the flower color genotype for each flowering bush parent.

Place the alleles in the blank boxes to show the genotype for each parent.

- Place only **one** allele in each box.
- You may use each allele more than once.
- You do **not** need to use all the alleles.

R

r

W

w

Delete

Genotype of Body Cells

Parent	Genotype
Red Flowers	<div>W</div> <div>W</div>
White Flowers	<div>R</div> <div>R</div>
Red and White Flowers	<div>R</div> <div>W</div>

Notes on Scoring

This response correctly identifies that all the alleles are dominant through the use of all uppercase letters in the genotypes and correctly shows that the plant with both red and white flowers must have one of each of the dominant alleles “R” and “W” to express both of these colors; however, the response incorrectly shows that the red flowers are represented by two dominant “W” alleles and the white flowers represented by two dominant “R” alleles. This shows a lack of understanding as to which trait the alleles represent.

Sample Response: 0 points

Use the simulation to perform an investigation to determine the flower color genotype for each flowering bush parent.

Place the alleles in the blank boxes to show the genotype for each parent.

- Place only **one** allele in each box.
- You may use each allele more than once.
- You do **not** need to use all the alleles.

R

r

W

w

Delete

Genotype of Body Cells

Parent	Genotype
Red Flowers	<div>R</div> <div>r</div>
White Flowers	<div>W</div> <div>w</div>
Red and White Flowers	<div>R</div> <div>W</div>

Notes on Scoring

This response incorrectly identifies the alleles of the red flowers as having one dominant allele ("R") and one recessive allele ("r") and the white flowers of having one dominant allele ("W") and one recessive allele ("w"). This shows a lack of understanding of the concept of simple dominance pattern verses co-dominance patterns. This response does correctly show that the plant with both red and white flowers must have one of each of the dominant alleles "R" and "W" to express both of these colors.

Grade 8 Science Practice Test

Question 13

Question and Scoring Guidelines

Question 13

- A. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of mitosis for a bush with red and white flowers.
- B. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of meiosis for a bush with red and white flowers.
- You may use some of the cells more than once.
 - You may **not** need to use all the objects.

Red-white Flowering Plant	
A. Mitosis	B. Meiosis

Points Possible: 2

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes

- Placing of 2 cells total, each containing a red and a white chromosome in the “A” region labeled Mitosis (1 point)

AND

- Placing of 4 cells total, 2 containing a single red chromosome and 2 containing a single white chromosome in the “B” region labeled Meiosis (1 point).

Alignment

Content Strand

Life Science

Content Statement

Reproduction is necessary for the continuation of every species.

Content Elaboration

Most organisms reproduce either sexually or asexually. Some organisms are capable of both. In asexual reproduction, all genes come from a single parent, which usually means the offspring are genetically identical to their parent, allowing genetic continuity. The end products of mitotic and meiotic cell divisions are compared as they relate to asexual and sexual reproduction.

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 comparing the processes of mitosis and meiosis in a flowering plant by correctly identifying the number of cells produced and amount of genetic information in the resulting cells in each process. This requires the student to interpret the diagrams to communicate that in the process of mitosis the cell copies its genetic material and undergoes one cell division to produce two genetically identical cells.

In the process of mitosis, the parent cell copies its genetic material and undergoes one cell division to produce two genetically identical cells.

Meiosis begins with one cell containing two copies of each chromosome, one from the organism's mother and one from its father. The cell divides twice, producing four cells containing one copy of each chromosome. Each of the resulting chromosomes in the cells is a unique mixture of maternal and paternal DNA.

Grade 8 Science Practice Test

Question 13







Sample Responses

Sample Responses: 2 points

- A. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of mitosis for a bush with red and white flowers.
- B. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of meiosis for a bush with red and white flowers.

- You may use some of the cells more than once.
- You may **not** need to use all the objects.







Red-white Flowering Plant

A. Mitosis	B. Meiosis
	
	
	
	

- A. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of mitosis for a bush with red and white flowers.
- B. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of meiosis for a bush with red and white flowers.

- You may use some of the cells more than once.
- You may **not** need to use all the objects.

Red-white Flowering Plant

A. Mitosis	B. Meiosis
	
	
	
	

Notes on Scoring

These responses correctly show that cells undergoing mitosis divide once and result in a total of 2 cells. Each of these cells contain identical genetic material shown in the diagram as a red and white chromosome. These responses correctly show that meiosis results in a total of 4 cells, 2 containing a single red chromosome and 2 containing a single white chromosome. These responses show a correct understanding of the different results of the mitosis and meiosis processes.

Sample Response: 1 point

A. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of mitosis for a bush with red and white flowers.

B. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of meiosis for a bush with red and white flowers.

- You may use some of the cells more than once.
- You may **not** need to use all the objects.

Red-white Flowering Plant	
A. Mitosis	B. Meiosis

Notes on Scoring

This response correctly shows that mitosis results in a total of 2 cells; however, it incorrectly shows that one of the cells has 2 red-colored chromosomes and one of the cells has 2 white chromosomes. At the end of mitosis, the cells should be identical, with each containing a single red and a single white chromosome. This response correctly shows that meiosis results in a total of 4 cells, each with half of the genetic material.

Sample Response: 1 point

A. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of mitosis for a bush with red and white flowers.

B. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of meiosis for a bush with red and white flowers.

- You may use some of the cells more than once.
- You may **not** need to use all the objects.

Red-white Flowering Plant	
A. Mitosis	B. Meiosis

Notes on Scoring

This response correctly shows that meiosis results in a total of 4 cells; however, it incorrectly shows each cell with two of each chromosome type. In meiosis, the four resulting cells have one-half of the genetic material of the parent cell. This response correctly shows that cells undergoing mitosis divide once and result in a total of 2 cells containing identical genetic material.

Sample Response: 0 points

A. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of mitosis for a bush with red and white flowers.

B. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of meiosis for a bush with red and white flowers.

- You may use some of the cells more than once.
- You may **not** need to use all the objects.

Red-white Flowering Plant	
A. Mitosis	B. Meiosis

Notes on Scoring

This response is incorrect for both the mitosis and meiosis columns. This response incorrectly shows 4 cells produced in mitosis, each with one type of chromosome. This response incorrectly shows only 2 cells produced in meiosis, with each cell containing both a single red and white chromosome.




Sample Response: 0 points

A. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of mitosis for a bush with red and white flowers.

B. In the table, place the correct number of cells containing the appropriate genetic information that would result from the process of meiosis for a bush with red and white flowers.

- You may use some of the cells more than once.
- You may **not** need to use all the objects.

Red-white Flowering Plant

A. Mitosis	B. Meiosis
 	

Notes on Scoring

This response is incorrect for both the mitosis and meiosis columns. This response incorrectly shows 2 cells produced in mitosis, each with two of the same chromosomes. This response incorrectly shows only 1 cell produced in meiosis.

Grade 8 Science Practice Test

Question 14

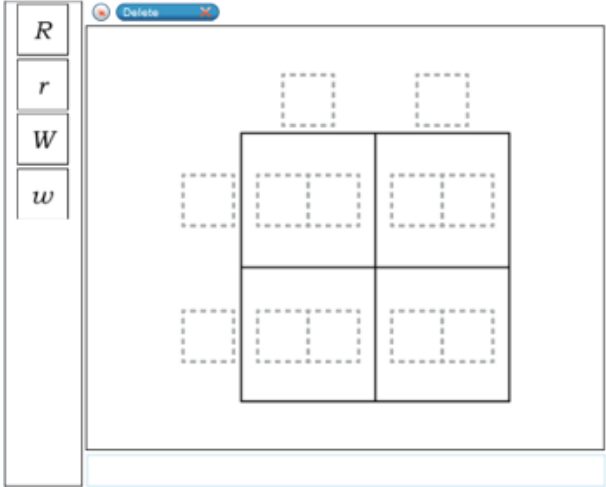
Question and Scoring Guidelines

Question 14

Use the simulation to cross a red flowering bush and a red and white flowering bush.

Place the alleles into the blank boxes to fill in the Punnett square for this cross.

- Place only **one** allele in each box.
- You may use each allele more than once.
- There may be more than one correct answer.
- You do **not** need to use all the alleles.



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes

- “R” in three out of four of the boxes on the outside of the Punnett square (i.e., the “parent” boxes) and “W” in the remaining box on the outside of the Punnett square
- AND
- Each cell of the Punnett square contains two alleles filled in according to the placement of the alleles in the four boxes on the outside of the Punnett square
- AND
- Only one allele palette object in each of the boxes on the outside of the Punnett square AND only two allele palette objects in each cell of the Punnett square (1 point).

Note: The two alleles placed in one of the cells of the Punnett square can be placed in the same dashed box and credit will still be awarded. The order the two correct alleles are placed in one of the cells of the Punnett square does not affect the scoring of the item.

Alignment

Content Strand

Life Science

Content Statement

The characteristics of an organism are a result of inherited traits received from parent(s).

Content Elaboration

The traits of one or two parents are passed on to the next generation through reproduction. Traits are determined by instructions encoded in deoxyribonucleic acid (DNA), which forms genes. Genes have different forms called alleles. The concepts of dominant and recessive genes are appropriate at this grade level. Co-dominant traits such as roan color in horses and cows may be useful to provide further validation of the theory and to help dispel some misconceptions.

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 application of conceptual knowledge of genotypes and phenotypes to identify the genotypes of the parents given their phenotype. The student then needs to correctly set up and complete a Punnett square crossing a red flowering plant with a red and white flowering plant and interpret the results. Genes have different forms called alleles. It should be understood that a genotype is the representation of alleles shown as either uppercase (dominant) or lowercase (recessive) letters. In this item, students need to recognize that when both co-dominant alleles ("RW") are present, both traits are expressed in the organism. The co-dominance pattern differs from a simple dominance pattern; the dominant (uppercase) allele will always be expressed and the recessive (lowercase) trait will only be expressed if both alleles are recessive.

Using the simulation to cross parents of different flower color variations and interpreting the patterns of traits in the offspring, the student can determine the genotype for each flowering plant parent. For this cross, the phenotypes of the parents are given as a red flowering bush and a red and white flowering bush. For the red and white flower parent, since both traits are expressed, the genotype is "RW" and should be placed on either the top or left side outside of the Punnett square. The phenotype of the other parent is a red flowering bush. Following the co-dominance pattern, the genotype of this parent is "RR" and should be placed on either the top or left side; outside of the Punnett square.

Grade 8 Science Practice Test

Question 14

Sample Responses

Sample Responses: 1 point

Use the simulation to cross a red flowering bush and a red and white flowering bush.

Place the alleles into the blank boxes to fill in the Punnett square for this cross.

- Place only **one** allele in each box.
- You may use each allele more than once.
- There may be more than one correct answer.
- You do **not** need to use all the alleles.

	R	R
R	R R	R R
W	R W	R W

Use the simulation to cross a red flowering bush and a red and white flowering bush.

Place the alleles into the blank boxes to fill in the Punnett square for this cross.

- Place only **one** allele in each box.
- You may use each allele more than once.
- There may be more than one correct answer.
- You do **not** need to use all the alleles.

	R	W
R	R R	R W
R	R R	R W

Notes on Scoring

These responses correctly identify the parent genotypes as “RR” (red-flowered) and “RW” (red- and white-flowered). Each parental genotype can be placed either on the top or the left side of the Punnett square without affecting the results of the Punnett square cross. Both responses show a correctly completed Punnett square with half of the resulting offspring inheriting two “RR” (red) alleles, one from each parent. The other half of offspring are correctly shown as inheriting one “R” (red) allele from one parent and one “W” (white) allele from the other parent.

Sample Response: 0 points

Use the simulation to cross a red flowering bush and a red and white flowering bush.

Place the alleles into the blank boxes to fill in the Punnett square for this cross.

- Place only **one** allele in each box.
- You may use each allele more than once.
- There may be more than one correct answer.
- You do **not** need to use all the alleles.

	R	R
W	R W	R W
W	R W	R W

Notes on Scoring

This response correctly identifies the genotype of the red-flowered parent ("RR") but incorrectly identifies the parental genotype of the red- and white-flowered parent as "WW" instead of "RW". This response does not indicate that a parental plant exhibiting both red and white color traits must have one of each allele for these traits. Due to the use of an incorrect genotype for one of the parents, the resulting Punnett square incorrectly shows all offspring as "RW" (red and white flowering plant).

Sample Response: 0 points

Use the simulation to cross a red flowering bush and a red and white flowering bush.

Place the alleles into the blank boxes to fill in the Punnett square for this cross.

- Place only **one** allele in each box.
- You may use each allele more than once.
- There may be more than one correct answer.
- You do **not** need to use all the alleles.

	R	r
W	R W	r W
w	R w	r w

Notes on Scoring

This response incorrectly identifies the genotypes of both parents. The response incorrectly identifies the genotype of the red flower plant parent as having one dominant allele ("R") and one recessive allele ("r") instead of two dominant alleles for the red color trait "RR." The response incorrectly identifies the parental genotype of the red and white flowered plant as "WW" instead of "RW." This response does not indicate that a parental plant exhibiting both red and white color traits must have one of each allele for these traits. Due to the use of incorrect genotypes of both parents, the resulting Punnett square is completed incorrectly.

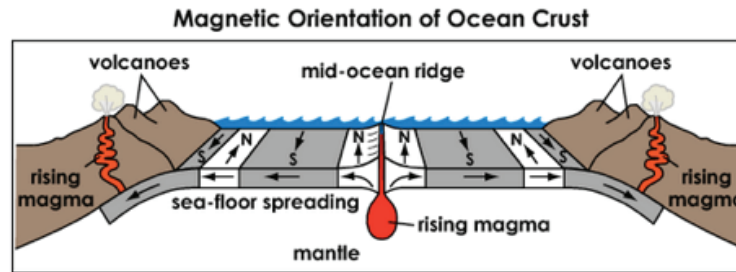
Grade 8 Science Practice Test

Question 15

Question and Scoring Guidelines

Question 15

As magma rises from the mid-ocean ridge, it cools and solidifies. As this magma solidifies, some of the minerals align with Earth's magnetic field. Every few million years, Earth's magnetic field reverses. This reversal is recorded in the magma that solidified after leaving the mid-ocean ridge. In the picture, these magnetic reversals are indicated by dark and light bands.



Courtesy of Kenneth R. Lang, *The Cambridge Guide to the Solar System*,
Second Edition 2011.

How can scientists tell when the reversals of the magnetic field occurred?

- (A) by measuring the thickness of the different bands of the oceanic crust
- (B) by measuring the distance between the mid-ocean ridge and the ocean floor band
- (C) by measuring the amounts of minerals that aligned to Earth's magnetic field in the different bands
- (D) by measuring the strength of Earth's magnetic field recorded in the solidified magma of the oceanic crust

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. Magnetic field reversal is not related to crust thickness.

Rationale for Option B: **Key** – By measuring the distance of the band boundary from the mid-ocean ridge and using the rate of sea floor spreading, the times of the magnetic reversals can be determined.

Rationale for Option C: This is incorrect. The amounts of minerals that aligned to Earth's magnetic field will not impart any information as to the timing of the reversals.

Rationale for Option D: This is incorrect. It is the direction, not the strength of the magnetic field that is the relevant property.

Alignment

Content Strand

Earth and Space Science

Content Statement

Earth's crust consists of major and minor tectonic plates that move relative to each other.

Content Elaboration

Historical data and observations such as fossil distribution, paleomagnetism, continental drift and sea-floor spreading contributed to the theory of plate tectonics. The rigid tectonic plates move with the molten rock and magma beneath them in the upper mantle.

The historical data related to the present plate tectonic theory must include continental "puzzle-like-fit" noticed as early as Magellan and by other mapmakers and explorers, paleontological data, paleoclimate data, paleomagnetic data, continental drift (Wegener), convection theory (Holmes) and sea floor spreading (Hess, Deitz). Contemporary data must be introduced, including seismic data, GPS/GIS data (documenting plate movement and rates of movement), robotic studies of the sea floor and further exploration of Earth's interior.

Cognitive Demand

Interpreting and Communicating Science Concepts (C)

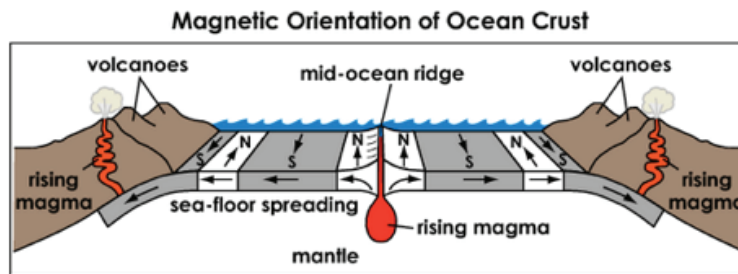
Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative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

Explanation of the Item

This item requires the student to interpret a diagram showing bands of oceanic crust with different magnetic orientations near a mid-ocean ridge to determine how to estimate when the magnetic field reversals occurred. As the sea floor is formed, magma rises from the mid-ocean ridge, forming new rock, and pushes the older rock away from the center, forming symmetrical bands on either side of the ridge. Every few million years, the magnetic field reverses in these bands. By measuring the distance of the band boundary from the mid-ocean ridge and using the rate of sea floor spreading, scientists can determine when the reversals of the magnetic field occurred.

Sample Response: 1 point

As magma rises from the mid-ocean ridge, it cools and solidifies. As this magma solidifies, some of the minerals align with Earth's magnetic field. Every few million years, Earth's magnetic field reverses. This reversal is recorded in the magma that solidified after leaving the mid-ocean ridge. In the picture, these magnetic reversals are indicated by dark and light bands.



Courtesy of Kenneth R. Lang, *The Cambridge Guide to the Solar System*,
Second Edition 2011.

How can scientists tell when the reversals of the magnetic field occurred?

- ☐ Ⓐ by measuring the thickness of the different bands of the oceanic crust
- ☒ Ⓑ by measuring the distance between the mid-ocean ridge and the ocean floor band
- ☐ Ⓒ by measuring the amounts of minerals that aligned to Earth's magnetic field in the different bands
- ☐ Ⓓ by measuring the strength of Earth's magnetic field recorded in the solidified magma of the oceanic crust

Grade 8 Science Practice Test

Question 16

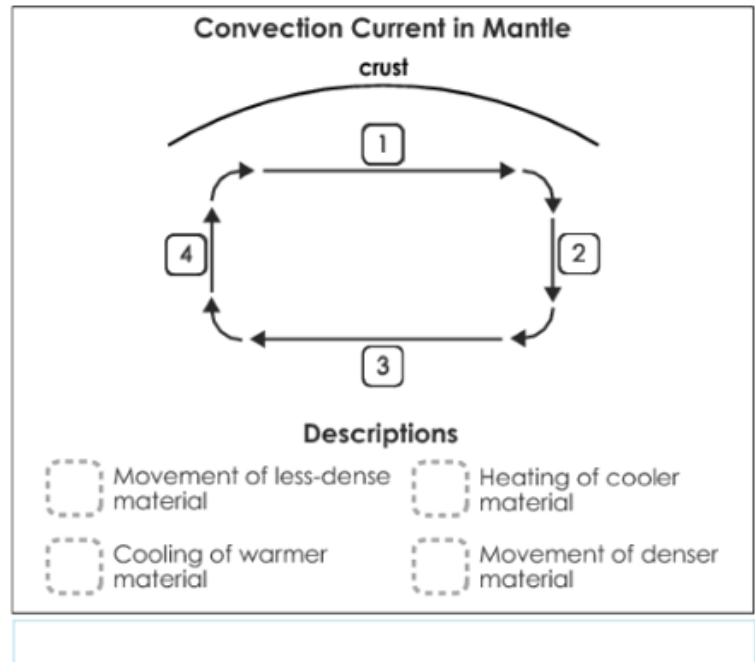
Question and Scoring Guidelines

Question 16

The diagram represents a convection current in Earth's mantle.

Descriptions of the events at each of the positions are shown.

Move each number from the diagram to the blank box that describes the event occurring at that position in the convection current.



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes

- "4" in the top left box

AND

- "1" in the bottom left box

AND

- "3" in the top right box

AND

- "2" in the bottom right box (1 point).

Alignment

Content Strand

Earth and Space Science

Content Statement

The composition and properties of Earth's interior are identified by the behavior of seismic waves.

Content Elaboration

Earth and other planets in the solar system formed as heavier elements coalesced in their centers. Planetary differentiation is a process in which more dense materials of a planet sink to the center, while less dense materials stay on the surface. A major period of planetary differentiation occurred approximately 4.6 billion years ago (College Board Standards for College Success, 2009).

The formation of the planet generated heat from gravitational energy and the decay of radioactive elements, which are still present today. Heat released from Earth's core drives convection currents throughout the mantle and the crust.

In addition to the composition of Earth's interior, the history of the formation of Earth and the relationship of energy transfer, transformation and convection currents within the mantle and crust are essential in understanding sources of energy.

Cognitive Demand

Recalling Accurate Science (R)

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

Explanation of the Item

This item requires recalling the role of heat and convection currents in energy and matter transfer within the mantle in relation to the position on the diagram.

This item requires recalling how heat generated from gravitational energy and the decay of radioactive elements drives convection currents throughout the mantle. The student must also recall the process of planetary differentiation in which more dense materials of a planet sink to the interior of Earth, while less dense materials rise closer to the surface.

Grade 8 Science Practice Test

Question 16

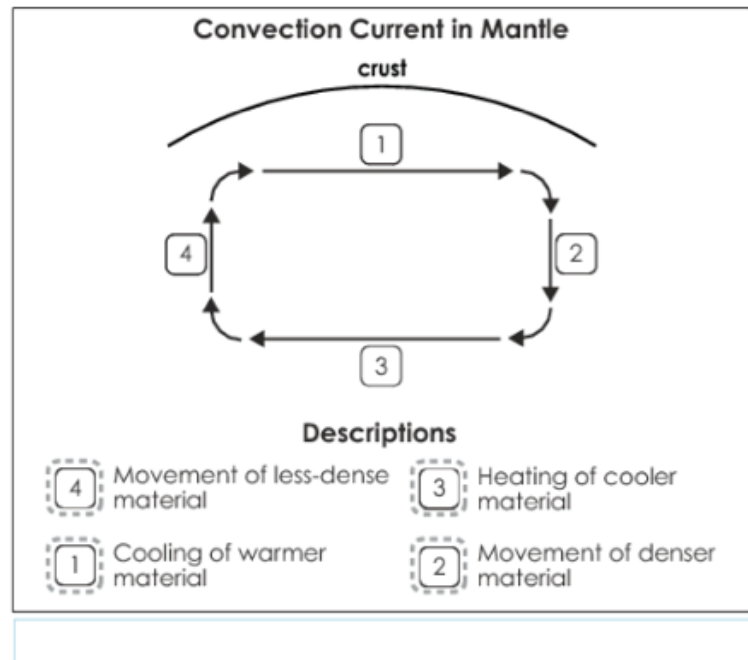
Sample Responses

Sample Response: 1 point

The diagram represents a convection current in Earth's mantle.

Descriptions of the events at each of the positions are shown.

Move each number from the diagram to the blank box that describes the event occurring at that position in the convection current.



Notes on Scoring

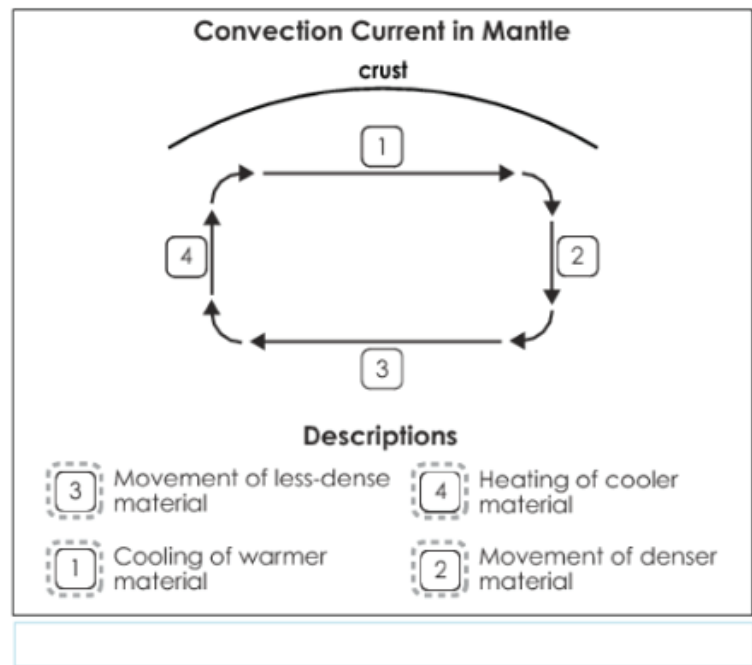
This response correctly matches the descriptions with their positions on the diagram. Position 1 is correctly described as material cooling as it moves closer to the crust. Position 2 is correctly described as denser material sinking over time and moving further down in the mantle. Position 3 is correctly described as heating of cooler material as it is further down in the mantle closer to the hot core of the earth. Position 4 is correctly described as movement of less dense material slowly rising in the mantle until it again reaches position 1 and the cycle continues.

Sample Response: 0 points

The diagram represents a convection current in Earth's mantle.

Descriptions of the events at each of the positions are shown.

Move each number from the diagram to the blank box that describes the event occurring at that position in the convection current.



Notes on Scoring

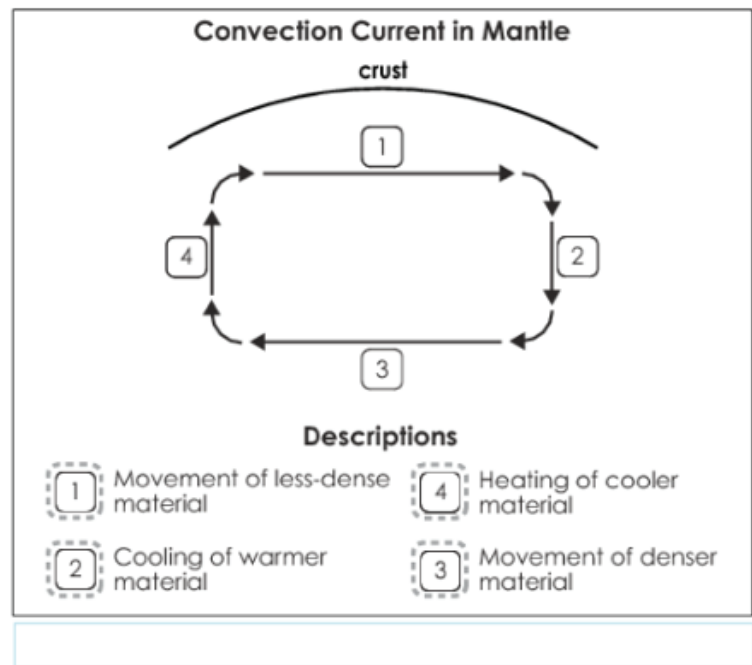
This response incorrectly matches the descriptions with the diagram position labels 3 and 4.

Sample Response: 0 points

The diagram represents a convection current in Earth's mantle.

Descriptions of the events at each of the positions are shown.

Move each number from the diagram to the blank box that describes the event occurring at that position in the convection current.



Notes on Scoring

This response incorrectly matches the descriptions with diagram position labels.

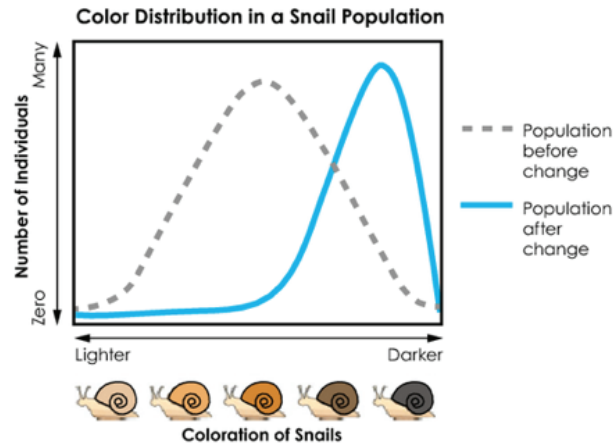
Grade 8 Science Practice Test

Question 17

Question and Scoring Guidelines

Question 17

An environmental change occurs, causing a change in the color of snails present in an ecosystem. The graph shows the color distribution in a snail population at two different times.



Select the **four** possible explanations for the results shown in the graph.

- ☐ The lighter-colored snails are all extinct.
- ☐ Snails with darker coloration left the ecosystem.
- ☐ Predators could more easily catch lighter-colored snails.
- ☐ The lighter-colored snails had few offspring to pass the trait along.
- ☐ The darker coloration was an existing trait in the original population.
- ☐ Snails with the lighter coloration moved into another ecosystem to survive.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

First Rationale: This is incorrect. The number of lighter-colored snails has decreased but there are still some lighter-colored snails in the ecosystem.

Second Rationale: This is incorrect. There are a higher number of darker-colored snails in the changed ecosystem than the original population.

Third Rationale: **Key** – The results of the graph support that light-colored snails are less suited to their environment. It is possible that the environmental change made the lighter-colored snails easier to see, making them more likely to be preyed upon by predators; thus, reducing the number of lighter-colored snails.

Fourth Rationale: **Key** – Lighter-colored snails did not survive to reproduce to pass the trait for lighter color on to their offspring.

Fifth Rationale: **Key** – Based on the graph of the original population, darker coloration was an existing trait in the snail population.

Sixth Rationale: **Key** – Lighter-colored snails may have migrated out of the ecosystem due to the environmental change in order to survive

Alignment

Content Strand

Life Science

Content Statement

Diversity of species occurs through gradual processes over many generations. Fossil records provide evidence that changes have occurred in number and types of species.

Content Elaboration

Diversity can result from sexual reproduction. The sorting and combination of genes results in different genetic combinations that allow offspring to be similar to, yet different from, their parents and each other. (This statement must be connected to the grade 8 Life Science content statement on reproduction and Mendelian Genetics.) These variations may allow for survival of individuals when the environment changes. Diversity in a species increases the likelihood that some individuals will have characteristics suitable to survive under changed conditions.

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.

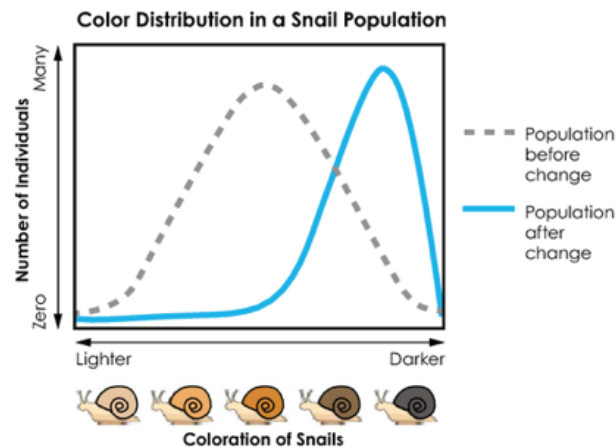
Explanation of the Item

This item requires interpreting graphical data of color distribution in a snail population and explaining the results of the data. This requires the student to interpret how changes in environmental conditions can affect how beneficial the color trait will be for the survival and reproductive success of a snail population. The graph shows that trait for color is present in various shades from lighter to darker. In the original

population the number of individual snails in the population that are very light or very dark is small, while the number of snails with medium coloration is highest. This indicates that snails with medium coloration in the original population are best suited to their environment and are most likely to survive and pass this coloration trait on to their offspring. After an environmental change occurs, there are fewer snails of light or medium coloration and a higher number of snails with darker coloration. This indicates that the darker coloration is best suited to this new environment and that darker snails are more likely to survive and pass this coloration trait on to their offspring.

Sample Response: 1 point

An environmental change occurs, causing a change in the color of snails present in an ecosystem. The graph shows the color distribution in a snail population at two different times.



Select the **four** possible explanations for the results shown in the graph.

- ☐ The lighter-colored snails are all extinct.
- ☐ Snails with darker coloration left the ecosystem.
- ☒ Predators could more easily catch lighter-colored snails.
- ☒ The lighter-colored snails had few offspring to pass the trait along.
- ☒ The darker coloration was an existing trait in the original population.
- ☒ Snails with the lighter coloration moved into another ecosystem to survive.

Grade 8 Science Practice Test

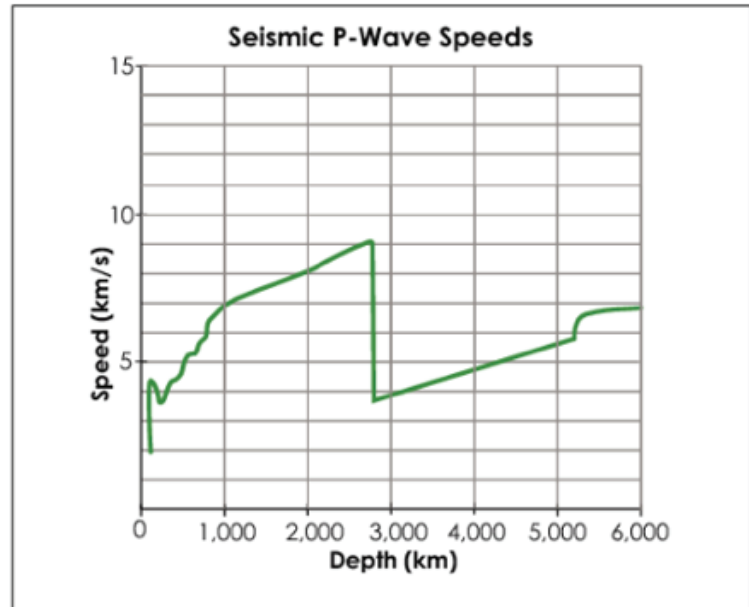
Question 18

Question and Scoring Guidelines

Question 18

The graph shows the behavior of primary waves during an earthquake.

Click on each region of the graph where seismic waves entered different layers of Earth's interior.



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes

- The region at 2,800 km selected
- AND
- the region at 5,300 km selected (1 point).

Alignment

Content Strand

Earth and Space Science

Content Statement

The composition and properties of Earth's interior are identified by the behavior of seismic waves.

Content Elaboration

The refraction and reflection of seismic waves as they move through one type of material to another is used to differentiate the layers of Earth's interior. Earth has an inner and outer core, an upper and lower mantle, and a crust.

Seismic data, graphics, charts, digital displays and cross sections must be used to study Earth's interior. Actual data from the refraction and reflection of seismic waves can be used to demonstrate how scientists have determined the different layers of Earth's interior. New discoveries and technological advances relating to understanding Earth's interior also play an important role in this content.

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 interpreting data of the speed of seismic waves at increasing depths inside Earth during an earthquake. The students will use their knowledge of the composition of the layers of Earth to interpret seismic wave data at different depths. As the waves travel through the crust to the mantle, the speed increases. P-waves are compressional waves that travel through different materials at different speeds. They travel slowest in air, faster in water and fastest in solids. As the P-waves move through the Earth's interior (crust, mantle, inner and outer core), their speed changes.

The speed of seismic waves depends on variations in strength and density of the material that they pass through. The speed increases from the crust to the mantle. The speed of the waves decreases sharply as they travel from the mantle to the hotter more liquid outer core. The speed of the waves spikes slightly at 5,300 km as the waves travel from the outer to the inner core.

Grade 8 Science Practice Test

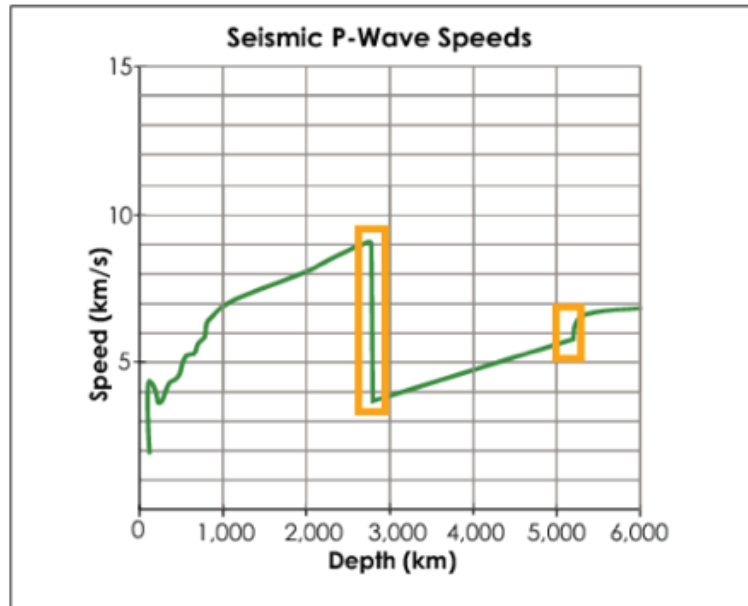
Question 18

Sample Responses

Sample Response: 1 point

The graph shows the behavior of primary waves during an earthquake.

Click on each region of the graph where seismic waves entered different layers of Earth's interior.



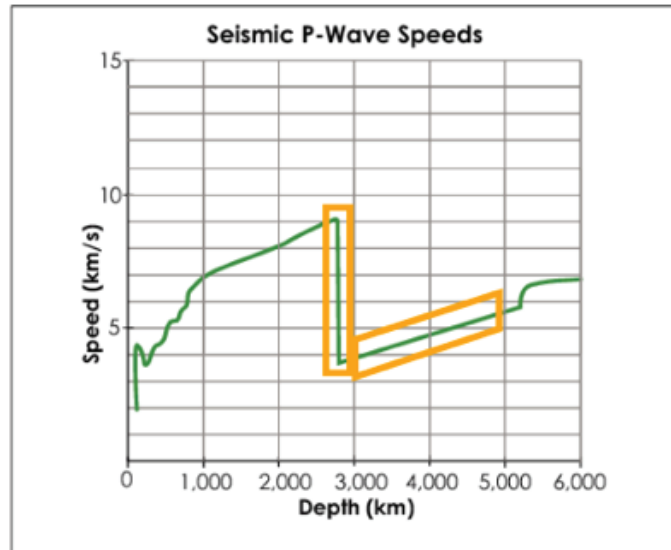
Notes on Scoring

This response correctly identifies the depth regions on the graph at 2,800 km and 5,300 km as regions in which seismic waves entered the different layers of Earth. The first region (2,800 km) shows the speed of the waves decreasing sharply as they travel from the mantle to the hotter, more liquid outer core. The speed gradually increases as the waves travel through the outer core as the temperatures increase with depth. The speed of the waves spikes slightly at 5,300 km as the waves travel from the outer to the inner core.

Sample Responses: 0 points

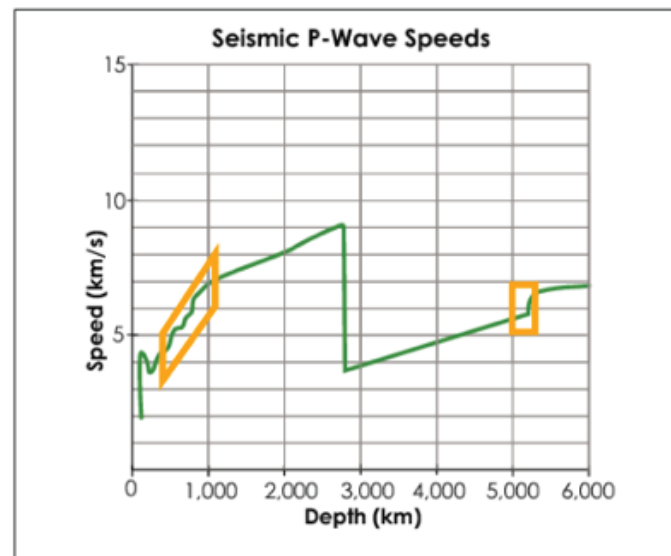
The graph shows the behavior of primary waves during an earthquake.

Click on each region of the graph where seismic waves entered different layers of Earth's interior.



The graph shows the behavior of primary waves during an earthquake.

Click on each region of the graph where seismic waves entered different layers of Earth's interior.



Notes on Scoring

These incorrect responses identify only one of the correct regions where the waves entered different layers of Earth. Correctly identifying both regions is required to earn credit.

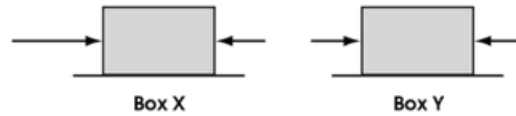
Grade 8 Science Practice Test

Question 19

Question and Scoring Guidelines

Question 19

Horizontal forces act on two boxes, initially at rest, as shown. The magnitude and direction of the horizontal forces are also shown.



What happens to Box X and Box Y as a result of the forces?

- (A) Box X starts moving, speeding up, and Box Y remains at rest.
- (B) Box X starts moving at constant speed, and Box Y remains at rest.
- (C) Box X starts moving at constant speed, and Box Y starts moving, speeding up.
- (D) Box X starts moving, speeding up, and Box Y starts moving at a constant speed.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: **Key** – There are unbalanced forces acting on Box X, meaning it will change its speed. In addition, since Box Y is at rest and there are balanced forces acting on it, it will remain at rest.

Rationale for Option B: This is incorrect. It is true Box Y will remain at rest since it starts at rest and there are balanced forces acting on it. However, since Box X has an unbalanced force acting on it, its motion must change.

Rationale for Option C: This is incorrect. There are unbalanced forces acting on Box X so it must change its motion. Also, since Box Y starts at rest and is acted on by balanced forces, it will remain at rest.

Rationale for Option D: This is incorrect. It is true Box X will start moving (speeding up) since it starts at rest and has an unbalanced force acting on it; however, since Box Y starts at rest and there are balanced forces acting on it, it will remain at rest.

Alignment

Content Strand

Physical Science

Content Statement

Forces have magnitude and direction.

Content Elaboration

When the net force is greater than zero, the object's speed and/or direction will change.

When the net force is zero, the object remains at rest or continues to move at a constant speed in a straight line.

A force is described by its strength (magnitude) and in what direction it is acting. Many forces can act on a single object simultaneously. The forces acting on an object can be represented by arrows drawn on an isolated picture of the object (a force diagram). The direction of each arrow shows the direction of push or pull. When many forces act on an object, their combined effect is what influences the motion of that object. The sum of all the forces acting on an object depends not only on how strong the forces are, but also in what directions they act. Forces can cancel to a net force of zero if they are equal in strength and act in opposite directions. Such forces are said to be balanced. If all forces are balanced by equal forces in the opposite direction, the object will maintain its current motion (both speed and direction). This means that if the object is stationary, it will remain stationary. If the object is moving, it will continue moving in the same direction and at the same speed. Such qualitative, intuitive understandings and descriptions of inertia must be developed through inquiry activities.

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

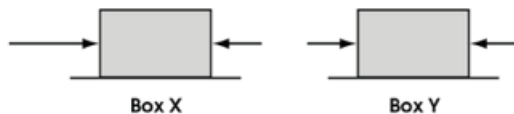
This multiple choice item requires the student to interpret force diagrams and apply scientific reasoning to determine what happens to the motion of two boxes initially at rest.

For Box X, there is a net force acting to the right since the arrow going to the right is longer than the arrow to the left. A net force greater than zero causes a change in an object's speed. Since the box is initially at rest, it will speed up in the same direction as the force, to the right.

For Box Y, there is a net force of zero. The two forces cancel each other since they are pointing in opposite directions and are the same length, indicating they have the same strength; therefore, the forces are balanced. When a net force of zero acts upon an object, the object does not change its motion. Since Box Y starts at rest, it will remain at rest.

Sample Response: 1 point

Horizontal forces act on two boxes, initially at rest, as shown. The magnitude and direction of the horizontal forces are also shown.



What happens to Box X and Box Y as a result of the forces?

- ☒ A Box X starts moving, speeding up, and Box Y remains at rest.
- ☐ B Box X starts moving at constant speed, and Box Y remains at rest.
- ☐ C Box X starts moving at constant speed, and Box Y starts moving, speeding up.
- ☐ D Box X starts moving, speeding up, and Box Y starts moving at a constant speed.

Grade 8 Science Practice Test

Question 20

Question and Scoring Guidelines

Question 20

The table describes several methods scientists can use to date rock layers and fossils.

Dating Methods

Dating Method	Description
Method 1	<ul style="list-style-type: none">• Uses carbon from organic matter• Can determine ages from rocks or directly from fossils• Used on samples up to about 100,000 years old
Method 2	<ul style="list-style-type: none">• Used on samples more than 100,000 years old• Determines ages of igneous rocks
Method 3	<ul style="list-style-type: none">• Uses the number and patterns of tree rings to find the age of the tree• Used on samples less than 11,000 years old
Method 4	<ul style="list-style-type: none">• Determines the last date a sediment sample was exposed to sunlight

A geologist wants to date several samples. Descriptions are provided for each sample. Because sampling can be expensive and time consuming, the geologist only wants to use the dating methods that are likely to provide a reliable date.

Select the boxes to show all methods that can be used to date each sample.

	Method 1	Method 2	Method 3	Method 4
A deeply buried sample of limestone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A piece of wood from a Native American cliff dwelling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A shallowly buried sample of shale that contains oyster and snail fossils	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A dinosaur bone found in a sandstone layer that sits between two layers of basalt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item a full-credit response includes

- “Method 4” selected for “A deeply buried sample of limestone”
- AND
- “Method 1” AND “Method 3” selected for “A piece of wood from a Native American cliff dwelling”
- AND

- “Method 1” AND “Method 4” selected for “A shallowly buried sample of shale that contains oyster and snail fossils”

AND

- “Method 2” AND “Method 4” selected for “A dinosaur bone found in a sandstone layer that sits between two layers of basalt”

AND

- No other boxes selected (1 point).

Alignment

Content Strand

Earth and Space Science

Content Statement

Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.

There are different methods to determine relative and absolute age of some rock layers in the geologic record. Within a sequence of undisturbed sedimentary rocks, the oldest rocks are at the bottom (superposition). The geologic record can help identify past environmental and climate conditions.

Content Elaboration

The different methods used to determine the age of the Earth are an important factor in this concept. In elementary grades, fossils are used to compare what once lived to what lives now, but the concept of Earth's age and the age of the fossils were not included (the concept of billions or millions of years was not age-appropriate). In grade 8, the concept of index fossils is a way to build toward understanding relative dating. Superposition, crosscutting relationships and index fossils play an important role in determining relative age. Radiometric dating plays an important role in absolute age. The inclusion of new advances and studies (mainly due to developing technological advances) is important in learning about the geologic record.

Cognitive Demand

Demonstrating Science Knowledge (D)

Requires students 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/Identifying Accurate Science.

Explanation of the Item

This item requires the student to analyze information about several rock and fossil samples to determine the appropriate dating technologies that can be used to most reliably date each sample. In analyzing the samples, the student needs to determine if the sample contains the materials necessary for each method as well as if the sample fits within the time period that method can reliably date.

Method 1 uses carbon from organic matter to date the sample; therefore, the sample must contain remains of a living organism that contains carbon such as wood, bone or shells. Method 1 can also only be used on samples up to 100,000 years old, so samples older than this time period cannot be reliably tested using this method.

Method 2 can only be used to determine the ages of igneous rocks such as basalt. Therefore this method cannot be used to date sedimentary rock such as limestone, sandstone or shale. The sample must also be less than 11,000 years old to be dated with this method.

Method 3 can only be used on samples containing remains of wood from trees. The number and pattern of tree rings can then be analyzed to determine the age of the wood in the sample.

Method 4 can be used only for samples composed of sediment, such as different types of sedimentary rock, in order to determine the last date the sediment was exposed to sunlight.

Grade 8 Science Practice Test

Question 20

Sample Responses

Sample Response: 1 point

The table describes several methods scientists can use to date rock layers and fossils.

Dating Methods

Dating Method	Description
Method 1	<ul style="list-style-type: none">• Uses carbon from organic matter• Can determine ages from rocks or directly from fossils• Used on samples up to about 100,000 years old
Method 2	<ul style="list-style-type: none">• Used on samples more than 100,000 years old• Determines ages of igneous rocks
Method 3	<ul style="list-style-type: none">• Uses the number and patterns of tree rings to find the age of the tree• Used on samples less than 11,000 years old
Method 4	<ul style="list-style-type: none">• Determines the last date a sediment sample was exposed to sunlight

A geologist wants to date several samples. Descriptions are provided for each sample. Because sampling can be expensive and time consuming, the geologist only wants to use the dating methods that are likely to provide a reliable date.

Select the boxes to show all methods that can be used to date each sample.

	Method 1	Method 2	Method 3	Method 4
A deeply buried sample of limestone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
A piece of wood from a Native American cliff dwelling	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
A shallowly buried sample of shale that contains oyster and snail fossils	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
A dinosaur bone found in a sandstone layer that sits between two layers of basalt	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Notes on Scoring

For this item, a full-credit response includes only dating methods that are likely to provide a reliable date selected for each sample with no other incorrect boxes selected in that row.

For a deeply buried limestone sample, the only correct dating method is dating method 4; this method involves determining the last date a sediment sample was exposed to sunlight. Limestone is composed of sediments so this method would be reliable in this case.

For the piece of wood from a Native American cliff dwelling, the correct dating methods are method 1 and method 3. Method 1 is reliable for this sample because wood is organic matter that contains carbon. Method 3 is also a reliable dating method for this wood sample because it contains tree rings that can be analyzed to determine the age of the tree the wood sample came from.

For the shallowly buried sample of shale that contains oyster and snail fossils, the only correct dating methods are method 1 and method 4. Method 1 is a reliable dating method for this sample because the oyster and snail fossils in the sample are organic matter that contain carbon. Dating method 4 is also correct because shale is composed of sediment.

For the sample of a dinosaur bone found in a sandstone layer that sits between two layers of basalt, the only correct dating methods are method 2 and method 4. Method 2 is correct since this sample contains basalt, which is an igneous rock. Dating method 4 is also correct because sandstone is composed of sediment.

Sample Response: 0 points

The table describes several methods scientists can use to date rock layers and fossils.

Dating Methods

Dating Method	Description
Method 1	<ul style="list-style-type: none">• Uses carbon from organic matter• Can determine ages from rocks or directly from fossils• Used on samples up to about 100,000 years old
Method 2	<ul style="list-style-type: none">• Used on samples more than 100,000 years old• Determines ages of igneous rocks
Method 3	<ul style="list-style-type: none">• Uses the number and patterns of tree rings to find the age of the tree• Used on samples less than 11,000 years old
Method 4	<ul style="list-style-type: none">• Determines the last date a sediment sample was exposed to sunlight

A geologist wants to date several samples. Descriptions are provided for each sample. Because sampling can be expensive and time consuming, the geologist only wants to use the dating methods that are likely to provide a reliable date.

Select the boxes to show all methods that can be used to date each sample.

	Method 1	Method 2	Method 3	Method 4
A deeply buried sample of limestone	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A piece of wood from a Native American cliff dwelling	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A shallowly buried sample of shale that contains oyster and snail fossils	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
A dinosaur bone found in a sandstone layer that sits between two layers of basalt	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Notes on Scoring

Method 1 is selected for all the samples but is only appropriate for the samples containing organic matter such as wood or oyster and snail fossils that are samples up to 100,000 years old. This method would not be reliable for dinosaur bones, which are known to be millions of years old.

Method 2 is incorrectly selected for the limestone sample, which is not an igneous rock.

Sample Response: 0 points

The table describes several methods scientists can use to date rock layers and fossils.

Dating Methods

Dating Method	Description
Method 1	<ul style="list-style-type: none">• Uses carbon from organic matter• Can determine ages from rocks or directly from fossils• Used on samples up to about 100,000 years old
Method 2	<ul style="list-style-type: none">• Used on samples more than 100,000 years old• Determines ages of igneous rocks
Method 3	<ul style="list-style-type: none">• Uses the number and patterns of tree rings to find the age of the tree• Used on samples less than 11,000 years old
Method 4	<ul style="list-style-type: none">• Determines the last date a sediment sample was exposed to sunlight

A geologist wants to date several samples. Descriptions are provided for each sample. Because sampling can be expensive and time consuming, the geologist only wants to use the dating methods that are likely to provide a reliable date.

Select the boxes to show all methods that can be used to date each sample.

	Method 1	Method 2	Method 3	Method 4
A deeply buried sample of limestone	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
A piece of wood from a Native American cliff dwelling	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
A shallowly buried sample of shale that contains oyster and snail fossils	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
A dinosaur bone found in a sandstone layer that sits between two layers of basalt	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Notes on Scoring

Method 1 is incorrectly selected for the limestone sample as it does not contain organic matter.

Method 2 is incorrectly selected for limestone as it is not an igneous rock.

Method 4 is incorrectly selected for the wood sample as it does not contain sediment.

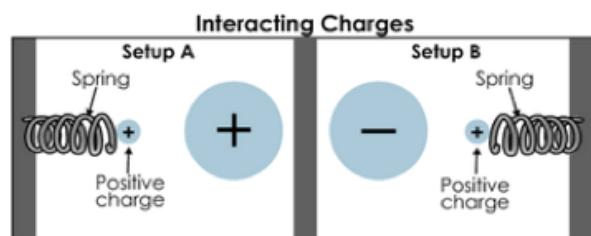
Grade 8 Science Practice Test

Question 21

Question and Scoring Guidelines

Question 21

Two positively charged particles are attached to springs. A metal sphere is placed near each charged particle, as shown in the diagram.



Positive charge is slowly added to Sphere A. An equal amount of negative charge is slowly added to Sphere B. Assume the two systems are isolated from each other.

How does the elastic potential energy change for each of the springs?

- (A) The elastic potential energy of both springs will increase.
- (B) The elastic potential energy of both springs will decrease.
- (C) The elastic potential energy of the spring in set-up A will decrease and the elastic potential energy of the spring in setup B will increase.
- (D) The elastic potential energy of the spring in set-up A will increase and the elastic potential energy of the spring in setup B will decrease.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: **Key** – The elastic potential energy of a spring can be increased by either stretching or compressing the spring. Adding positive charge to Sphere A increases the repulsive force between the sphere and the particle, compressing the spring more and increasing the elastic potential energy of the spring. Adding negative charge to Sphere B increases the attractive force between the sphere and the particle, stretching the spring more and increasing the elastic potential energy of the spring.

Rationale for Option B: This is incorrect. The elastic potential energy of a spring can be increased by either stretching or compressing the spring. Adding positive charge to Sphere A increases the repulsive force between the sphere and the particle, compressing the spring more and increasing the elastic potential energy of the spring. Adding negative charge to Sphere B increases the attractive force between the sphere and the particle, stretching the spring more and increasing the elastic potential energy of the spring.

Rationale for Option C: This is incorrect. The elastic potential energy of a spring can be increased by either stretching or compressing the spring. Adding positive charge to Sphere A increases the repulsive force between the sphere and the particle, compressing the spring more and increasing the elastic potential energy of the spring. Adding negative charge to Sphere B increases the attractive force between the sphere and the particle, stretching the spring more and increasing the elastic potential energy of the spring.

Rationale for Option D: This is incorrect. The elastic potential energy of a spring can be increased by either stretching or compressing the spring. Adding positive charge to Sphere A increases the repulsive force between the sphere and the particle, compressing the spring more and increasing the elastic potential energy of the spring. Adding negative charge to Sphere B increases the attractive force between the sphere and the particle, stretching the spring more and increasing the elastic potential energy of the spring.

Alignment

Content Strand

Physical Science

Content Statement

There are different types of potential energy.

Content Elaboration

Elastic potential energy is associated with how much an elastic object has been stretched or compressed and how difficult such a compression or stretch is. A change in the amount of compression or stretch of an elastic object is evidence that the elastic potential energy has changed.

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

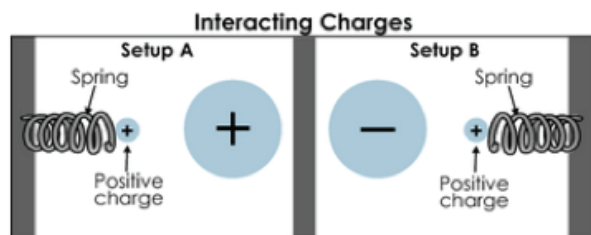
This multiple choice item requires the application of reasoning and scientific knowledge to determine the change in elastic potential energy of springs connected to a charge under the influence of other charges. Students must also recognize that springs can store elastic potential energy both when they are compressed and when they are stretched.

In Setup A, both the particles and the sphere are positive. These objects repel each other, compressing the spring. As positive charge is added to Sphere A, there is greater repulsion so the charges move farther apart, compressing the spring more and increasing the elastic potential energy.

In Setup B, the particle is positive and the spring is negative. These objects attract each other, stretching the spring. As negative charge is added to Sphere B, there is greater attraction, so the charges move closer together, stretching the spring more and increasing the elastic potential energy.

Sample Response: 1 point

Two positively charged particles are attached to springs. A metal sphere is placed near each charged particle, as shown in the diagram.



Positive charge is slowly added to Sphere A. An equal amount of negative charge is slowly added to Sphere B. Assume the two systems are isolated from each other.

How does the elastic potential energy change for each of the springs?

- ☒ The elastic potential energy of both springs will increase.
- ☐ The elastic potential energy of both springs will decrease.
- ☐ The elastic potential energy of the spring in set-up A will decrease and the elastic potential energy of the spring in setup B will increase.
- ☐ The elastic potential energy of the spring in set-up A will increase and the elastic potential energy of the spring in setup B will decrease.

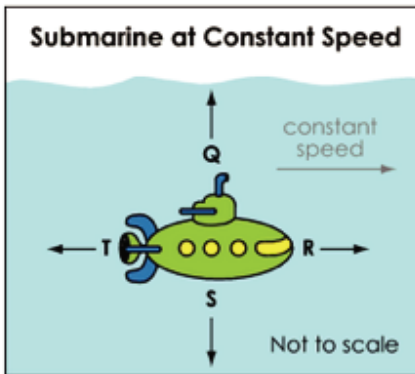
Grade 8 Science Practice Test

Question 22

Question and Scoring Guidelines

Question 22

A battery-powered toy submarine is moving through water at constant speed and at a constant depth below the surface. The diagram shows the submarine with arrows representing the directions but not the magnitudes of four forces acting on it.



Which conclusion can be made about the magnitudes of the forces acting on the submarine?

- Ⓐ Force Q is equal to Force S and Force R is equal to Force T.
- Ⓑ Force Q is less than Force S and Force R is equal to Force T.
- Ⓒ Force Q is equal to Force S and Force R is greater than Force T.
- Ⓓ Force Q is less than Force S and Force R is greater than Force T.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: **Key** – The fact that the submarine is moving at constant speed means that all forces acting on it must be balanced. Equal and opposite forces balance to zero. Force R, the forward thrust produced by the motor, must balance the drag force, T. Force S, the weight of the toy, must balance the force of the water pushing up on the submarine.

Rationale for Option B: This is incorrect. If Force Q were less than Force S, the resulting net force would push down on the toy, causing it to descend.

Rationale for Option C: This is incorrect. If Force R were greater than Force T, the resulting net force would push forward on the toy, causing its speed to increase.

Rationale for Option D: This is incorrect. If Force Q were less than Force S, the resulting net force would push downward on the toy, causing it to descend and if Force R is greater than Force T it would be speeding up.

Alignment

Content Strand

Physical Science

Content Statement

Forces have magnitude and direction.

Content Elaboration

When the net force is zero, the object remains at rest or continues to move at a constant speed in a straight line.

Many forces can act on a single object simultaneously. The forces acting on an object can be represented by arrows drawn on an isolated picture of the object (a force diagram). The direction of each arrow shows the direction of push or pull. When many forces act on an object, their combined effect is what influences the motion of that object. The sum of all the forces acting on an object depends not only on how strong the forces are, but also in what directions they act. Forces can cancel to a net force of zero if they are equal in strength and act in opposite directions. Such forces are said to be balanced. If all forces are balanced by equal forces in the opposite direction, the object will maintain its current motion (both speed and direction). This means if the object is stationary, it will remain stationary. If the object is moving, it will continue moving in the same direction and at the same speed.

Cognitive Demand

Interpreting and Communicating Science Concepts (C)

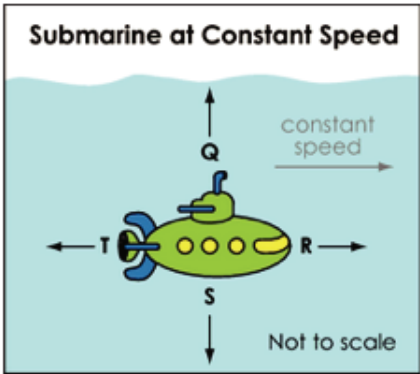
Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative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

Explanation of the Item

This item requires the student to apply reasoning to a situation involving a toy submarine that is moving at constant speed and that does not change direction. The student must determine the relative magnitude of four forces acting on the submarine, by applying knowledge that an object will maintain its current motion (both speed and direction) if all forces acting on the object are balanced by equal forces acting in the opposite direction. The submarine is moving at constant speed and stays at a constant depth, so its forward motion is maintained relative to the surface. Therefore, Forces Q and S (which are in opposite directions) must be equal in magnitude, and likewise for Forces R and T.

Sample Response: 1 point

A battery-powered toy submarine is moving through water at constant speed and at a constant depth below the surface. The diagram shows the submarine with arrows representing the directions but not the magnitudes of four forces acting on it.



The diagram, titled "Submarine at Constant Speed", shows a green submarine moving to the right at a "constant speed", as indicated by a horizontal arrow. Four forces are represented by arrows acting on the submarine: Force Q acts upwards from the top, Force S acts downwards from the bottom, Force T acts to the left from the rear, and Force R acts to the right from the front. The text "Not to scale" is present in the bottom right corner of the diagram.

Which conclusion can be made about the magnitudes of the forces acting on the submarine?

- ☒ A Force Q is equal to Force S and Force R is equal to Force T.
- ☐ B Force Q is less than Force S and Force R is equal to Force T.
- ☐ C Force Q is equal to Force S and Force R is greater than Force T.
- ☐ D Force Q is less than Force S and Force R is greater than Force T.

Grade 8 Science Practice Test

Question 23

Question and Scoring Guidelines

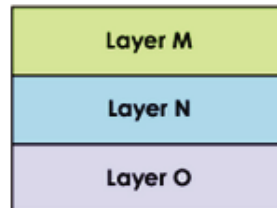
Question 23

Following is a description of the geologic history of a region.

- A large sea covered the region, allowing coral reefs to develop.
- Next, the sea retreated and the region became desert.
- Then, geological stresses caused surface rocks to crack and break.
- Finally, the deep cracks in the surface rocks allowed lava to erupt and extrude, which then quickly cooled.

The layers M, N, and O represent the positions of three rock layers found in the region. The layers have not been overturned.

Rock Layers



Select the boxes to match the geologic features or materials that will likely be found in the layers, based on the region's geologic history.

	Layer M	Layer N	Layer O
Fault	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Basalt (igneous)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Limestone (sedimentary)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sandstone (sedimentary)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item a full-credit response includes

- “Layer M” selected for “Basalt”;
AND
- “Layer N” selected for “Fault” AND “Sandstone”;
AND
- “Layer O” selected for “Limestone” AND “Fault”;
AND
- No other boxes selected (1 point).

Alignment

Content Strand

Earth and Space Science

Content Statement

Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.

Content Elaboration

Within a sequence of undisturbed sedimentary rocks, the oldest rocks are at the bottom (superposition). The geologic record can help identify past environmental and climate conditions.

Superposition, cross-cutting relationships and index fossils play an important role in determining relative age. Uniformitarianism can be an important key in understanding how scientists have interpreted the environmental conditions that existed throughout Earth's history. Fossil evidence also can indicate specific environments and climate conditions that help interpret the geologic record. Field studies or geologic research (can be virtual/digital) can help identify local formations and interpret the environment that existed at the time of the formation.

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 apply knowledge of superposition, cross-cutting relationships and fossil evidence to determine where certain features or materials will likely be found within the layers, based on a description of the region's geologic history.

Because the layers have not been overturned, the oldest rock layer must be at the bottom (Layer O). Thus, Layer O was likely formed at the earliest known point in the region's geologic history, when there was a marine environment. Students must apply knowledge of fossil evidence to identify the type of rock (sedimentary limestone) that is usually associated with ancient marine environments. Because the marine environment only existed at the earliest time in the region's geologic history, sedimentary limestone would likely be found only in Layer O.

Likewise, the youngest rock layer must be at the top (Layer M). Thus, Layer M likely formed at the most recent known point in the region's geologic history, when lava erupted through the surface and cooled. Students must recognize that basalt is an igneous rock that forms at or near the surface, and identify the basalt feature with only Layer M.

Layer N must have formed after Layer O and before Layer M. Therefore, Layer N was most likely deposited during the time when a desert environment existed in the region. Students must recognize that the sedimentary sandstone would most likely be found only in Layer N.

Students must also apply understanding of cross-cutting relationships to the rock layers. The geological stresses occurred after the formation of Layers O and N, but before the lava eruption. Therefore, the fault would likely be found in Layers O and N, but not in Layer M.

Grade 8 Science Practice Test

Question 23

Sample Responses

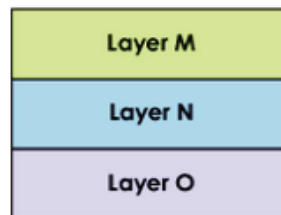
Sample Response: 1 point

Following is a description of the geologic history of a region.

- A large sea covered the region, allowing coral reefs to develop.
- Next, the sea retreated and the region became desert.
- Then, geological stresses caused surface rocks to crack and break.
- Finally, the deep cracks in the surface rocks allowed lava to erupt and extrude, which then quickly cooled.

The layers M, N, and O represent the positions of three rock layers found in the region. The layers have not been overturned.

Rock Layers



Select the boxes to match the geologic features or materials that will likely be found in the layers, based on the region's geologic history.

	Layer M	Layer N	Layer O
Fault	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Basalt (igneous)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Limestone (sedimentary)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Sandstone (sedimentary)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Notes on Scoring

This response earns one point because it demonstrates understanding of superposition, cross-cutting relationships and use of fossil evidence. The response correctly identifies that Layer O is the oldest layer and corresponds to a marine environment, that Layer M is the youngest layer and corresponds to the lava eruption, that Layer N was formed after Layer O but before Layer M and corresponds to a desert environment, and that the fault would appear in both Layers O and N.

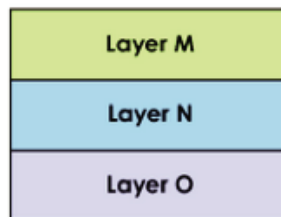
Sample Response: 0 points

Following is a description of the geologic history of a region.

- A large sea covered the region, allowing coral reefs to develop.
- Next, the sea retreated and the region became desert.
- Then, geological stresses caused surface rocks to crack and break.
- Finally, the deep cracks in the surface rocks allowed lava to erupt and extrude, which then quickly cooled.

The layers M, N, and O represent the positions of three rock layers found in the region. The layers have not been overturned.

Rock Layers



Select the boxes to match the geologic features or materials that will likely be found in the layers, based on the region's geologic history.

	Layer M	Layer N	Layer O
Fault	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Basalt (igneous)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Limestone (sedimentary)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Sandstone (sedimentary)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Notes on Scoring

This response earns zero points because it does not demonstrate complete understanding. The response does not correctly identify where the sandstone would likely be found in the layers. The response may indicate partial understanding of cross-cutting relationships and fossil evidence, but it does not demonstrate a complete understanding of superposition.

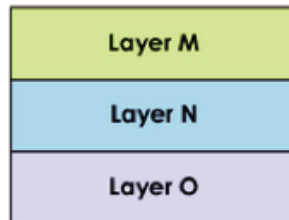
Sample Response: 0 points

Following is a description of the geologic history of a region.

- A large sea covered the region, allowing coral reefs to develop.
- Next, the sea retreated and the region became desert.
- Then, geological stresses caused surface rocks to crack and break.
- Finally, the deep cracks in the surface rocks allowed lava to erupt and extrude, which then quickly cooled.

The layers M, N, and O represent the positions of three rock layers found in the region. The layers have not been overturned.

Rock Layers



Select the boxes to match the geologic features or materials that will likely be found in the layers, based on the region's geologic history.

	Layer M	Layer N	Layer O
Fault	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Basalt (igneous)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Limestone (sedimentary)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sandstone (sedimentary)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Notes on Scoring

This response earns zero points because it does not demonstrate complete understanding. The response does not correctly identify where the basalt and limestone would likely be found in the layers. The response may indicate partial understanding of cross-cutting relationships, but it does not demonstrate a complete understanding of superposition, fossil evidence or igneous rock formation.

Grade 8 Science Practice Test


Question 24

Question and Scoring Guidelines





Question 24

The diagram shows a toy car on a track that is lying on the floor.

Toy Car on Track with Bumpers



Select the boxes to identify the net force for each stage of the car's motion.

	Zero Net Force				
At rest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Begins to move forward	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Moves at a constant speed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Slows down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item a full-credit response includes

- "Zero Net Force" selected for "At rest" AND "Moves at a constant speed";
AND
- The right facing arrow selected for "Begins to move forward";
AND
- The left facing arrow selected for "Slows down" (1 point).

Alignment

Content Strand

Physical Science

Content Statement

Forces have magnitude and direction.

Content Elaboration

Forces can be added. The net force on an object is the sum of all of the forces acting on the object. The net force acting on an object can change the object's direction and/or speed.

Many forces can act on a single object simultaneously. The forces acting on an object can be represented by arrows drawn on an isolated picture of the object (a force diagram). The direction of each arrow shows the direction of push or pull. When many forces act on an object, their combined effect is what influences the motion of that object. The sum of all the forces acting on an object depends not only on how strong the forces are, but also in what directions they act. Forces can cancel to a net force of zero if they are equal in strength and act in opposite directions. Such forces are said to be balanced. If all forces are balanced by equal forces in the opposite direction, the object will maintain its current motion (both speed and direction). This means if the object is stationary, it will remain stationary. If the object is moving, it will continue moving in the same direction and at the same speed. Such qualitative, intuitive understandings and descriptions of inertia must be developed through inquiry activities.

Cognitive Demand

Recalling Accurate Science (R)

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

Explanation of the Item

This item requires the student to determine the direction of the net force on a toy car in different scenarios. When the car is at rest or moving at a constant speed, its motion is not changing. Thus, for these two stages of the car's motion, all forces acting on the car must be balanced and the forces must be combining to a net force of zero. The car is initially at rest, so when it begins to move forward, its motion is changing. Since it is speeding up in the forward direction during this time, there must be a nonzero net force in the forward direction. When the car is slowing down, its motion is also changing. Since it is slowing down in the forward direction during this time, there must be a nonzero net force in the backward direction.

Grade 8 Science Practice Test

Question 24

Sample Responses





Sample Response: 1 point

The diagram shows a toy car on a track that is lying on the floor.

Toy Car on Track with Bumpers



Select the boxes to identify the net force for each stage of the car's motion.

	Zero Net Force				
At rest	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Begins to move forward	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Moves at a constant speed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Slows down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Notes on Scoring

This response receives one point because it demonstrates understanding of how net force influences the motion of an object. The response correctly identifies that when the car is at rest or moving at constant speed the net force must be zero. It correctly identifies that when the car begins to move forward, the net force must be nonzero and in the forward direction. It correctly identifies that when the car slows down in the forward direction, the net force must be nonzero and in the backward direction.





Sample Response: 0 points

The diagram shows a toy car on a track that is lying on the floor.

Toy Car on Track with Bumpers



Select the boxes to identify the net force for each stage of the car's motion.

	Zero Net Force				
At rest	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Begins to move forward	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Moves at a constant speed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Slows down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Notes on Scoring

This response earns zero points because it does not demonstrate complete understanding. The response does not correctly identify the direction of the net force when the car begins to move forward. The response may demonstrate partial understanding of net force when an object's motion is not changing, but it does not demonstrate complete understanding of the direction of net force when an object's motion is changing.





Sample Response: 0 points

The diagram shows a toy car on a track that is lying on the floor.

Toy Car on Track with Bumpers



Select the boxes to identify the net force for each stage of the car's motion.

	Zero Net Force				
At rest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Begins to move forward	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Moves at a constant speed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Slows down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Notes on Scoring

This response earns zero points because it demonstrates no understanding of how net force influences the motion of an object.

Grade 8 Science Practice Test

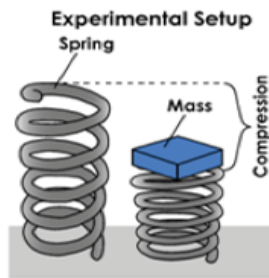
Question 25

Question and Scoring Guidelines

Question 25

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

A student investigates the change in potential energy of a spring, using the experimental setup shown.



The student conducts three tests, using a different mass on top of the spring for each one. She records the mass on the spring and spring compression data in the partially completed table.

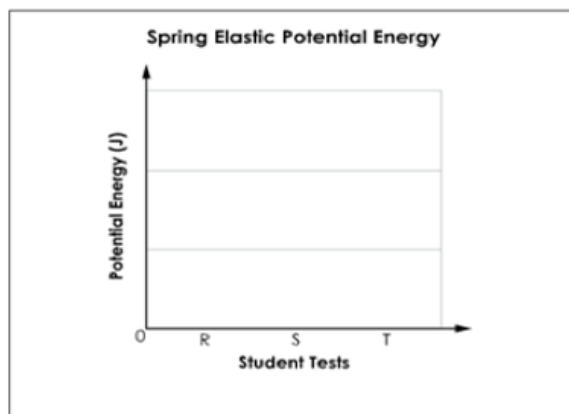
Part A

Click on the blank boxes to fill in the table with the spring's compression data for each test, based on the experimental setup.

Compression Data		
Student Test	Mass on Spring (grams)	Spring Compression (centimeters)
R	20	<input type="text"/>
S	40	<input type="text"/>
T	60	<input type="text"/>

Part B

Select points on the graph to show where the top of bars R, S, and T should be to compare the spring's elastic potential energy for each of the student's tests, based on the compression data in part A.



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item a full-credit response includes

- “0.7” selected for “R”;
AND
- “1.2” selected for “S”;
AND
- “1.6” selected for “T”;
AND
- The bar for “R” is the shortest;
AND
- The bar for “S” is taller than “R” but shorter than “T”;
AND
- The bar for “T” is the tallest (1 point).

Alignment

Content Strand

Physical Science

Content Statement

There are different types of potential energy.

Content Elaboration

Objects can have elastic potential energy due to their compression. Elastic potential energy is associated with how much an elastic object has been stretched or compressed and how difficult such a compression or stretch is. A change in the amount of compression or stretch of an elastic object is evidence that the elastic potential energy has changed.

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 use knowledge of elastic potential energy to relate the compression of a spring to its elastic potential energy. The student selects the compression of a spring based on the amount of mass compressing it. The student then constructs a column graph showing the relative amount of potential energy for three different compressions.

A spring that has mass placed on top of it will be compressed. The more mass resting on the spring, the greater the compression. Placing 60 grams on this spring will compress it the most. Placing 20 grams on this spring will compress it the least.

The compression of the spring transfers energy to the spring which is stored as elastic potential energy. The graph depicting the relative amounts of potential energy needs to show test T (60 grams) with the most potential energy and test R (20 grams) with the least potential energy.

Grade 8 Science Practice Test

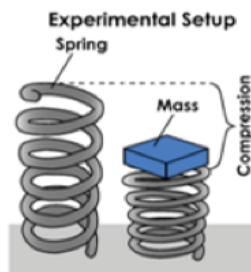
Question 25

Sample Responses

Sample Response: 1 point

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

A student investigates the change in potential energy of a spring, using the experimental setup shown.



The student conducts three tests, using a different mass on top of the spring for each one. She records the mass on the spring and spring compression data in the partially completed table.

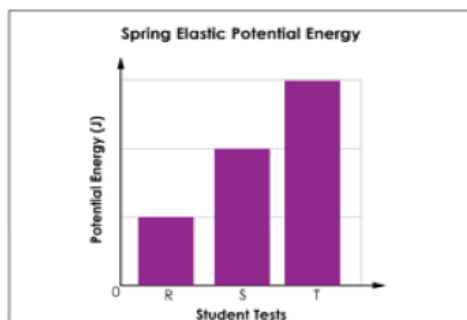
Part A

Click on the blank boxes to fill in the table with the spring's compression data for each test, based on the experimental setup.

Compression Data		
Student Test	Mass on Spring (grams)	Spring Compression (centimeters)
R	20	0.7
S	40	1.2
T	60	1.6

Part B

Select points on the graph to show where the top of bars R, S, and T should be to compare the spring's elastic potential energy for each of the student's tests, based on the compression data in part A.



Notes on Scoring

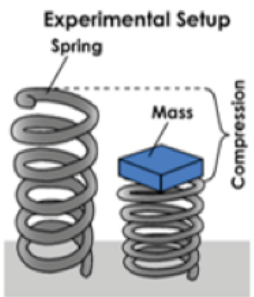
This response earns full credit (1 point) because the *Compression Data* chart was correctly completed to show that the more mass on the spring, the further the spring will be compressed. The response also contains a graph indicating that the more the spring is compressed, the more potential energy is present in the spring.

Sample Response: 1 point

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

A student investigates the change in potential energy of a spring, using the experimental setup shown.

Experimental Setup



The student conducts three tests, using a different mass on top of the spring for each one. She records the mass on the spring and spring compression data in the partially completed table.

Part A

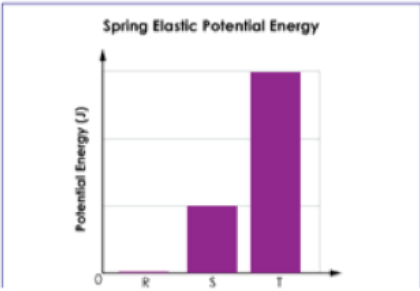
Click on the blank boxes to fill in the table with the spring's compression data for each test, based on the experimental setup.

Student Test	Mass on Spring (grams)	Spring Compression (centimeters)
R	20	0.7
S	40	1.2
T	60	1.6

Part B

Select points on the graph to show where the top of bars R, S, and T should be to compare the spring's elastic potential energy for each of the student's tests, based on the compression data in part A.

Spring Elastic Potential Energy



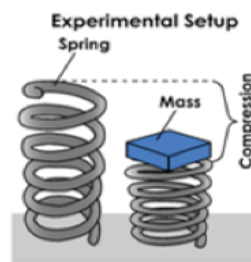
Notes on Scoring

This response earns full credit (1 point) because the *Compression Data* chart was correctly completed to show that the more mass on the spring, the further the spring will be compressed. The response also contains a graph indicating that the more the spring is compressed, the more potential energy is present in the spring. Although the bar for test R is near zero and the bars are not evenly spaced in the graph in part B, this graph indicates the relative amounts of potential energy. At this grade level, students are not expected to apply mathematical calculations to the compression of a spring.

Sample Response: 0 points

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

A student investigates the change in potential energy of a spring, using the experimental setup shown.



The student conducts three tests, using a different mass on top of the spring for each one. She records the mass on the spring and spring compression data in the partially completed table.

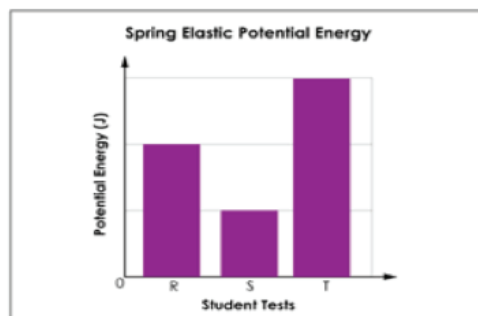
Part A

Click on the blank boxes to fill in the table with the spring's compression data for each test, based on the experimental setup.

Compression Data		
Student Test	Mass on Spring (grams)	Spring Compression (centimeters)
R	20	0.7 ▾
S	40	1.2 ▾
T	60	1.6 ▾

Part B

Select points on the graph to show where the top of bars R, S, and T should be to compare the spring's elastic potential energy for each of the student's tests, based on the compression data in part A.



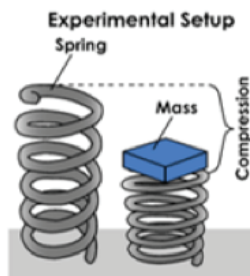
Notes on Scoring

This response earns no credit (0 points) because although the *Compression Data* chart shows the correct compressions, the graph in part B is incorrect. This graph shows that a compression of 1.2 centimeters has the least potential energy. This is incorrect. The more a spring is compressed, the greater its potential energy. Test R should show the least potential energy.

Sample Response: 0 points

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

A student investigates the change in potential energy of a spring, using the experimental setup shown.



The student conducts three tests, using a different mass on top of the spring for each one. She records the mass on the spring and spring compression data in the partially completed table.

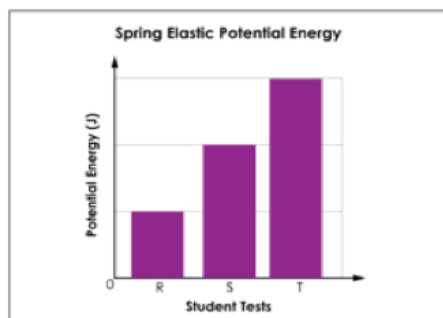
Part A

Click on the blank boxes to fill in the table with the spring's compression data for each test, based on the experimental setup.

Compression Data		
Student Test	Mass on Spring (grams)	Spring Compression (centimeters)
R	20	1.6 ▾
S	40	0.7 ▾
T	60	1.2 ▾

Part B

Select points on the graph to show where the top of bars R, S, and T should be to compare the spring's elastic potential energy for each of the student's tests, based on the compression data in part A.



Notes on Scoring

This response earns no credit (0 points) because the *Compression Data* chart is incorrect. The more mass on the spring, the more it will be compressed. Additionally, the graph in part B of this response does not match the data chosen in the chart. The item asked for a graph “based on the compression data in part A”.

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