Ohio | Department of Education

Ohio's State Tests

ITEM RELEASE

SPRING 2017

GRADE 8
SCIENCE

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Grade 8 Science
Spring 2017 Item Release
Content Summary and Answer Key

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1	Graphic Response	Earth and Space Science	Earth's crust consists of major and minor tectonic plates that move relative to each other.	---	1 point
2	Graphic Response	Earth and Space Science	Earth's crust consists of major and minor tectonic plates that move relative to each other.	---	1 point
3	Short Response	Physical Science	Forces have magnitude and direction.	---	2 points
4	Simulation	Physical Science	Forces have magnitude and direction.	---	---
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7	Multiple Choice	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.	A	1 point
8	Graphic Response	Earth and Space Science	Earth's crust consists of major and minor tectonic plates that move relative to each other.	---	1 point
9	Multiple Choice	Earth and Space Science	A combination of constructive and destructive geologic processes formed Earth's surface.	C	1 point

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Question No.	Item Type	Content Strand	Content Statement	Answer Key	Points
10	Multiple Choice	Physical Science	Forces between objects act when the objects are in direct contact or when they are not touching.	B	1 point
11	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
12	Graphic Response	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.	---	1 point
13	Graphic Response	Earth and Space Science	Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.	---	1 point
14	Multiple Choice	Life Science	Reproduction is necessary for the continuation of every species.	A	1 point
15	Graphic Response	Life Science	The characteristics of an organism are a result of inherited traits received from parent(s).	---	1 point
16	Multiple Choice	Life Science	Reproduction is necessary for the continuation of every species.	A	1 point
17	Graphic Response	Physical Science	Forces have magnitude and direction.	---	1 point
18	Graphic Response	Life Science	Reproduction is necessary for the continuation of every species.	---	1 point
19	Multiple Choice	Earth and Space Science	Earth's crust consists of major and minor tectonic plates that move relative to each other.	D	1 point

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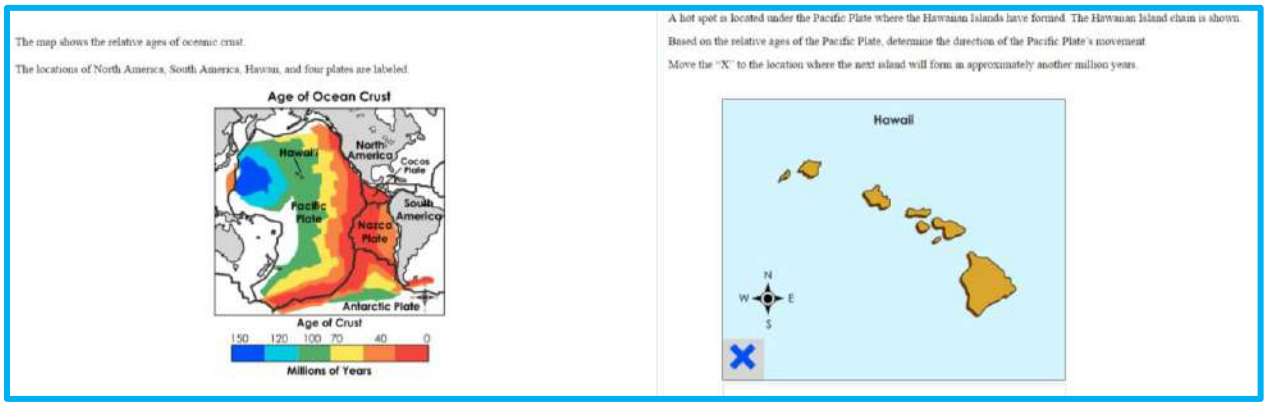
Question 1

Question and Scoring Guidelines

Question 1



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- The "X" placed southeast of the biggest island (1 point).

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

Each type of boundary results in specific motion and causes events such as earthquakes or volcanic activity or features (such as mountains or trenches) that are indicative of the type of boundary.

Volcanic activity, earthquakes, tsunamis, geysers, hot springs, faults, oceanic vents, island arcs, hot spots and rift valleys should all be included in the identification of plates and plate boundaries. Plate boundary identification (converging, diverging, transform) must be based on the resulting features or events. The focus must be on the cause of plate movement, the type and direction of plate movement and the result of the plate movement, not on memorizing plate names.

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 the relative age of oceanic crust to determine the direction of plate movement and to apply knowledge of how islands form at a hot spot to predict the location of the next island in the Hawaiian Island chain. A hot spot causes a chain of volcanic activity as a tectonic plate moves above it. The Pacific Plate is moving to the northwest, as indicated by the increasing age of the oceanic crust from southeast to northwest. As the Pacific Plate moves to the northwest, a new portion of the plate is over a hot spot located under the Pacific Ocean. The next island in the Hawaiian chain will form to the southeast of the largest island.

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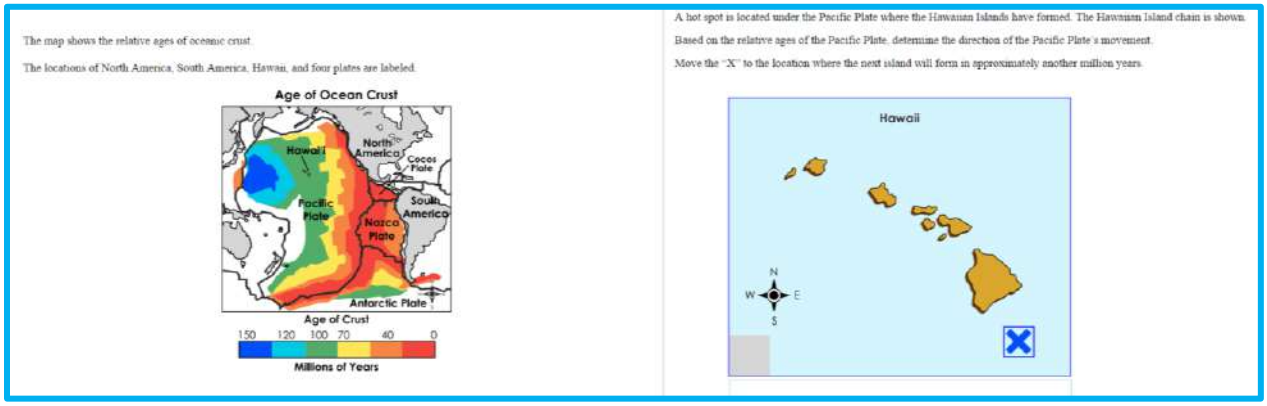
Question 1

Sample Responses

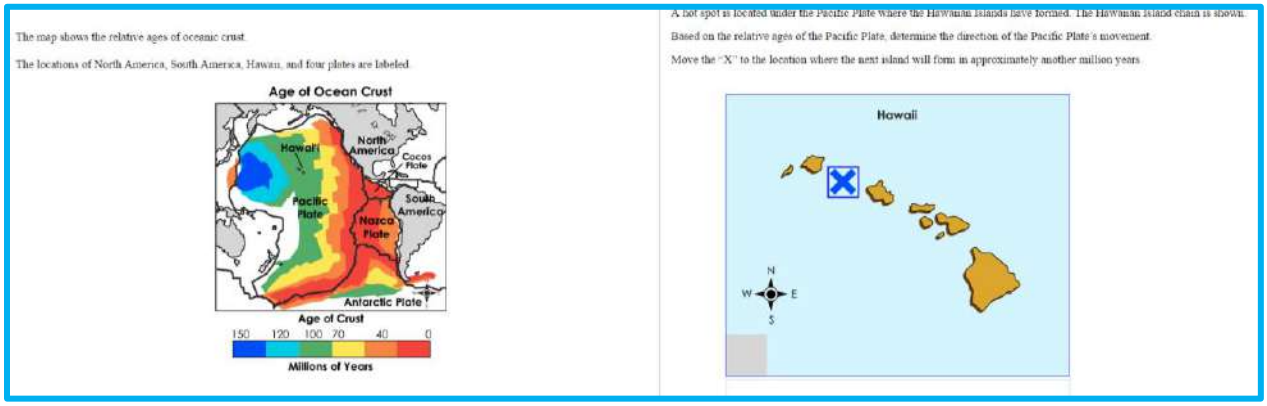
Sample Response: 1 point



Notes on Scoring

This response earns full credit (1 point) because it correctly locates the "X", indicating that the next island will form to the southeast of the largest island.

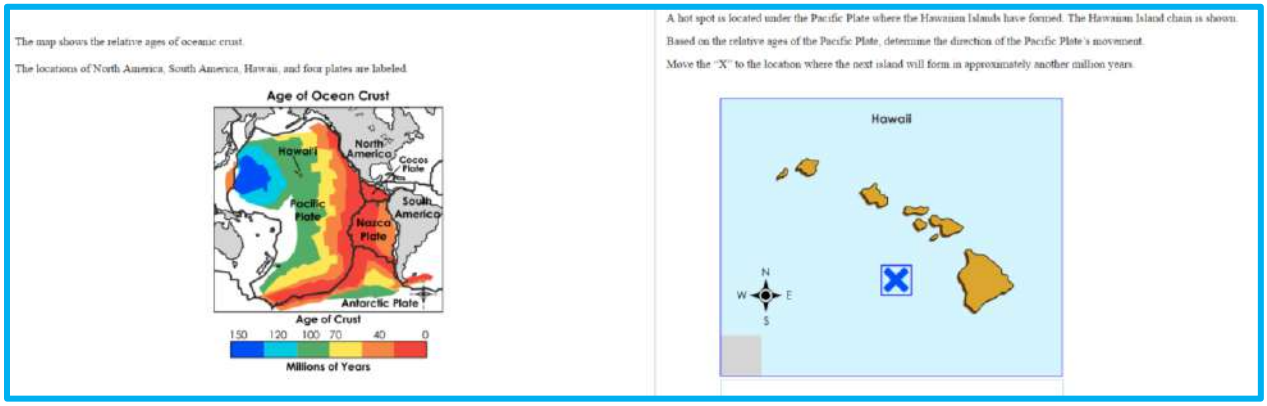
Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because it does not correctly locate the "X", indicating where the next island will form. The next island will form over a hot spot and will be at one end of the existing chain, in this case to the southeast of the largest island.

Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because it does not correctly locate the "X", indicating where the next island will form. The next island will form over a hot spot and will be at one end of the existing chain, in this case to the southeast of the largest island.

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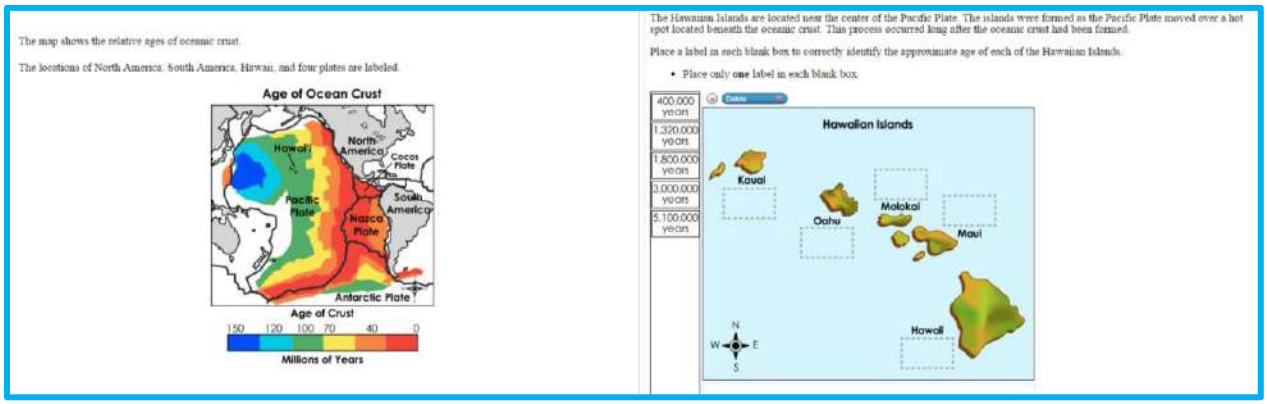
Question 2

Question and Scoring Guidelines

Question 2



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines7

For this item, a full-credit response includes:

- The "5,100,000 years" label in Kauai box;
  AND
- The "3,000,000 years" label in the Oahu box;
  AND
- The "1,800,000 years" label in the Molokai box;
  AND
- The "1,320,000 years" label in the Maui box;
  AND
- The "400,000 years" label in the Hawaii box (1 point).

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

Each type of boundary results in specific motion and causes events such as earthquakes or volcanic activity or features (such as mountains or trenches) that are indicative of the type of boundary.

Volcanic activity, earthquakes, tsunamis, geysers, hot springs, faults, oceanic vents, island arcs, hot spots and rift valleys should all be included in the identification of plates and plate boundaries. Plate boundary identification (converging, diverging, transform) must be based on the resulting features or events. The focus must be on the cause of plate movement, the type and direction of plate movement and the result of the plate movement, not on memorizing plate names.

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 the age of rocks to determine the direction of plate movement and to apply knowledge of how islands form at a hot spot to identify the relative ages of islands above a hot spot. A hot spot causes a chain of volcanic activity as a tectonic plate moves above it. The Pacific Plate is moving to the northwest, as indicated by the increasing age of rocks from southeast to northwest. As the Pacific Plate moves to the northwest, a new portion of the plate is over a hot spot located under the Pacific Ocean. The oldest island is located to the northwest and the youngest island is located to the southeast.

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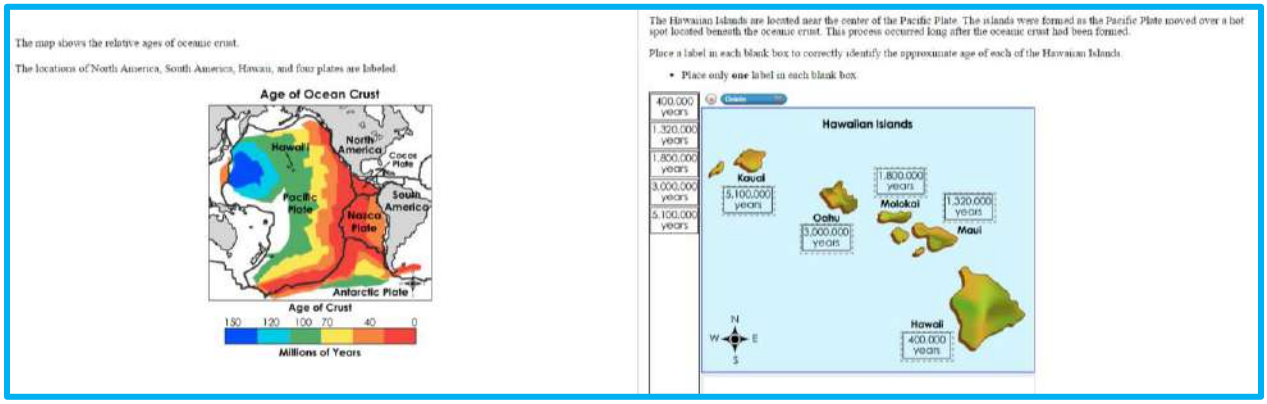
Question 2

Sample Responses

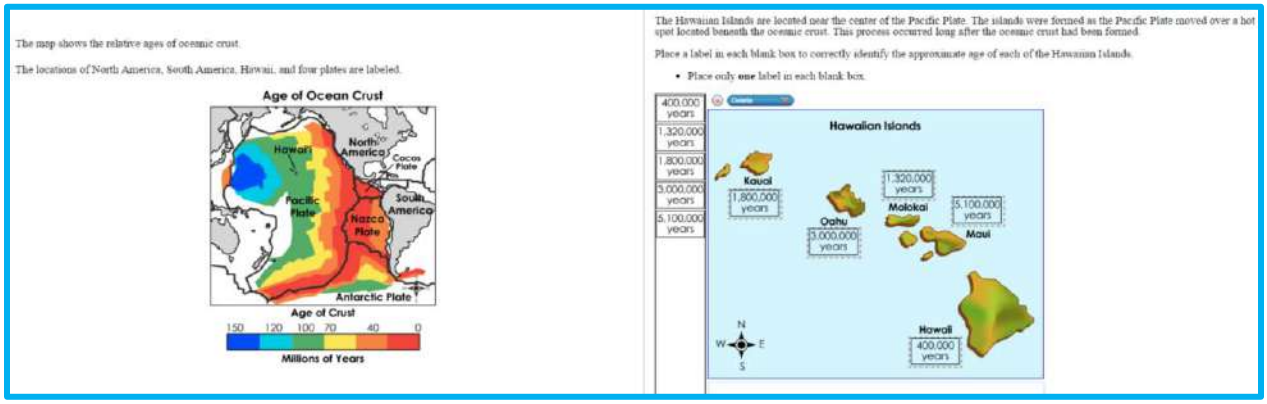
Sample Response: 1 point



Notes on Scoring

This response earns full credit (1 point) because it correctly shows that the islands decrease in age from northwest to southeast.

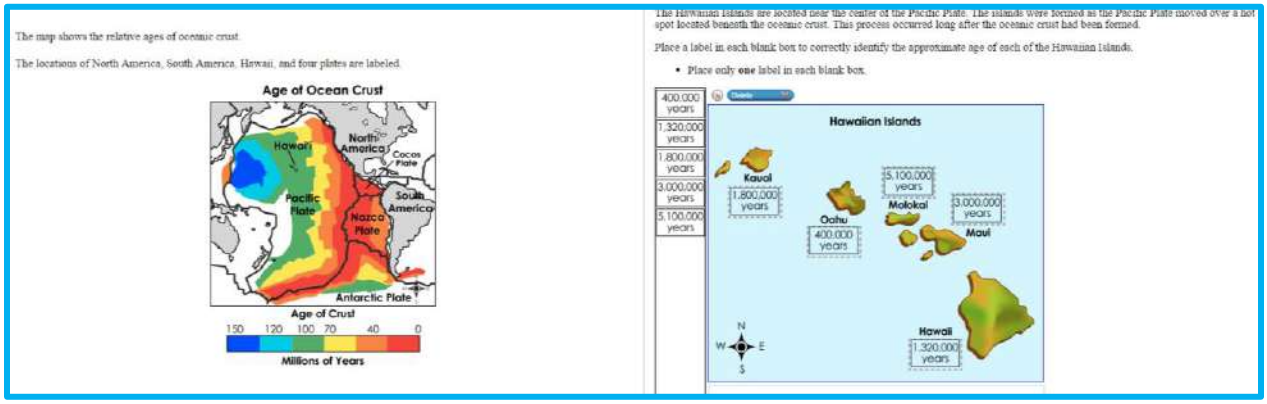
Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because it does not correctly show that the islands decrease in age from northwest to southeast. Islands form in a chain decreasing in age as a plate moves over a hot spot. This response incorrectly shows that the oldest islands are near the middle of the chain.

Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because it does not correctly show that the islands decrease in age from northwest to southeast. Islands form in a chain decreasing in age as a plate moves over a hot spot. This response partially indicates a trend of decreasing age from northwest to southeast, but it incorrectly labels Kauai and Oahu as younger than the other islands rather than older.

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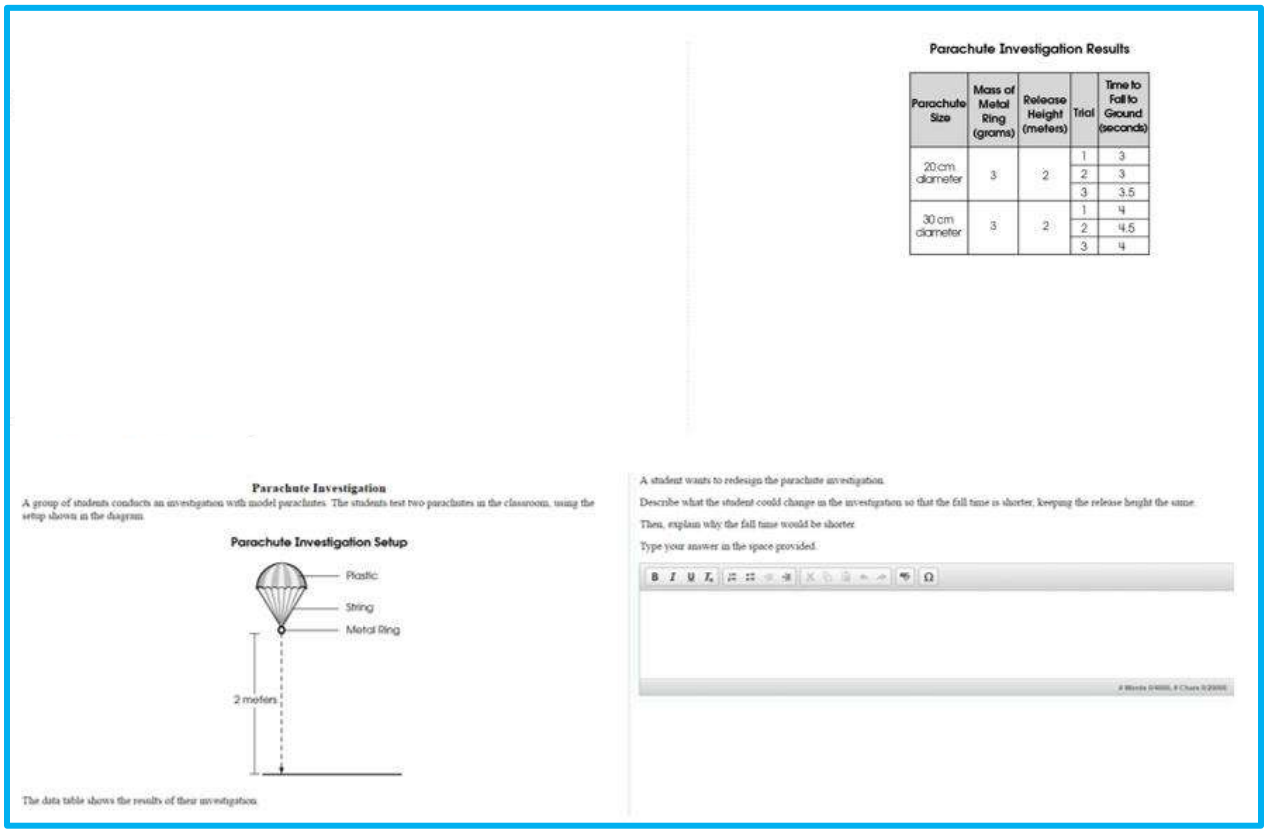
Question 3

Question and Scoring Guidelines

Question 3



Parachute Investigation Results

Parachute Size	Mass of Metal Ring (grams)	Release Height (meters)	Trial	Time to Fall to Ground (seconds)
20 cm diameter	3	2	1	3
			2	3
			3	3.5
30 cm diameter	3	2	1	4
			2	4.5
			3	4

Parachute Investigation

A group of students conducts an investigation with model parachutes. The students test two parachutes in the classroom, using the setup shown in the diagram.

Parachute Investigation Setup

The data table shows the results of their investigation.

A student wants to redesign the parachute investigation.

Describe what the student could change in the investigation so that the fall time is shorter, keeping the release height the same.

Then, explain why the fall time would be shorter.

Type your answer in the space provided.

Points Possible: 2

See **Alignment** for more detail.

Scoring Guidelines

Score Point	Description
2 points	The response correctly: • Describes how the student can make the fall time shorter; AND • Explains why the fall time is shorter.
1 point	The response correctly: • Describes how the student can make the fall time shorter; OR • Explains why the fall time is shorter.
0 points	The response fails to demonstrate any understanding of how to revise a parachute design to shorten its fall time. 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. It may only repeat information given in the test item. The response may provide an incorrect solution/response and the provided supportive information may be 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
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.

Drag is a force that opposes the motion of an object when an object moves through a fluid (e.g., gas, liquid).

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

Requires students to solve science-based engineering or technological problems through application of scientific inquiry. Within given scientific constraints, propose or critique solutions, analyze and interpret technological and engineering problems, use science principles to anticipate effects of technological or engineering design, find solutions using science and engineering or technology, consider consequences and alternatives and/or integrate and synthesize scientific information.

Explanation of the Item
This item requires the student to make a change to an experimental setup to decrease the fall time of a parachute and to explain why this change will decrease the fall time. A falling parachute has at least two forces acting on it: the force of gravity and drag. These forces act in opposite directions, with the force of gravity acting toward the ground and drag acting away from the ground (opposing motion). The sum of these forces determines the motion of the parachute. Changes to the experimental setup that decrease drag, such as decreasing the size of the parachute or increasing the mass of the system, will allow the parachute to fall faster, decreasing the fall time.

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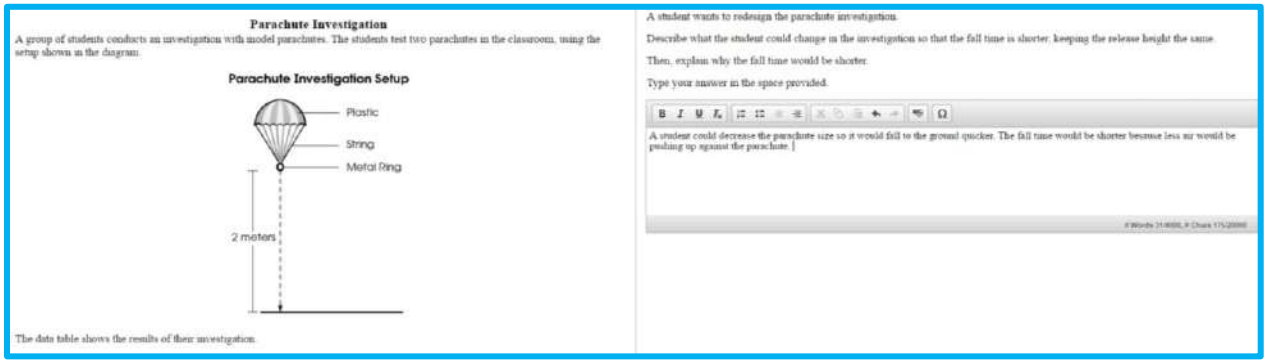
Question 3

Sample Responses

Sample Response: 2 points



Parachute Investigation

A group of students conducts an investigation with model parachutes. The students test two parachutes in the classroom, using the setup shown in the diagram.

Parachute Investigation Setup

The data table shows the results of their investigation.

A student wants to redesign the parachute investigation.

Describe what the student could change in the investigation so that the fall time is shorter, keeping the release height the same.

Then, explain why the fall time would be shorter.

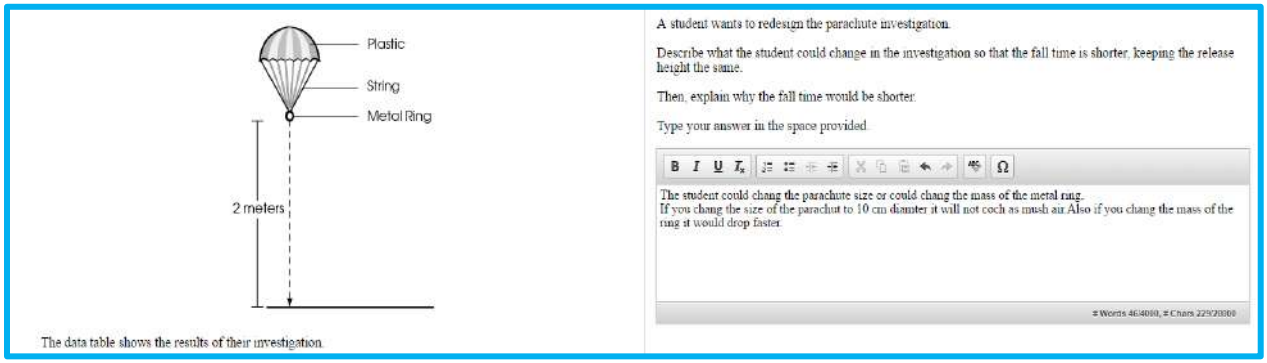
Type your answer in the space provided.

A student could decrease the parachute size so it would fall to the ground quicker. The fall time would be shorter because less air would be pushing up against the parachute.

Notes on Scoring

This response earns full credit (2 points) because it correctly identifies a change to the investigation that would decrease the fall time and explains why this change would decrease the fall time. The response states "…decrease the parachute size" "because less air would be pushing up against the parachute."

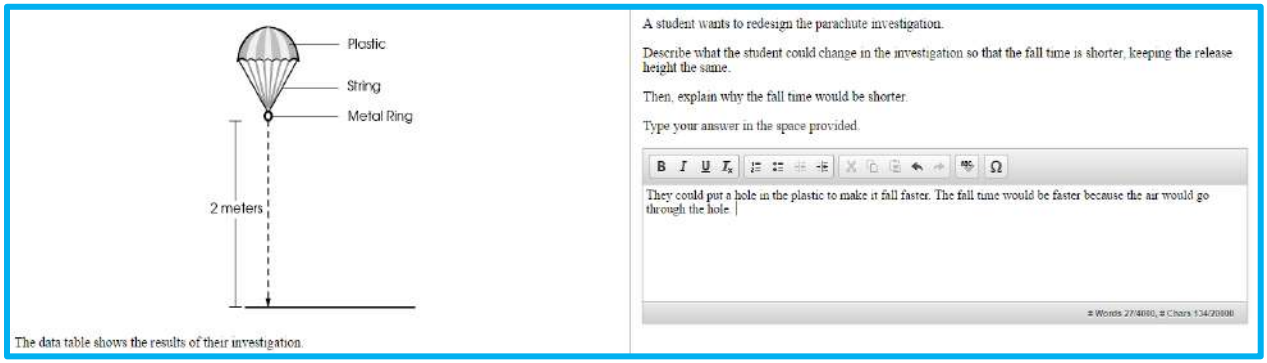
Sample Response: 2 points



Notes on Scoring

This response earns full credit (2 points) because it correctly identifies a change to the investigation that would decrease the fall time, "chang the size of the parachut to 10 cm diameter", and explains why this change would decrease the fall time: "it will not coch as mush air". Decreasing the parachute size would decrease drag, making the net force on the parachute greater. Although this response also identifies changing the mass without specifying whether mass should be increased or decreased and without explaining why it would affect fall time, this does not prevent the response from receiving full credit.

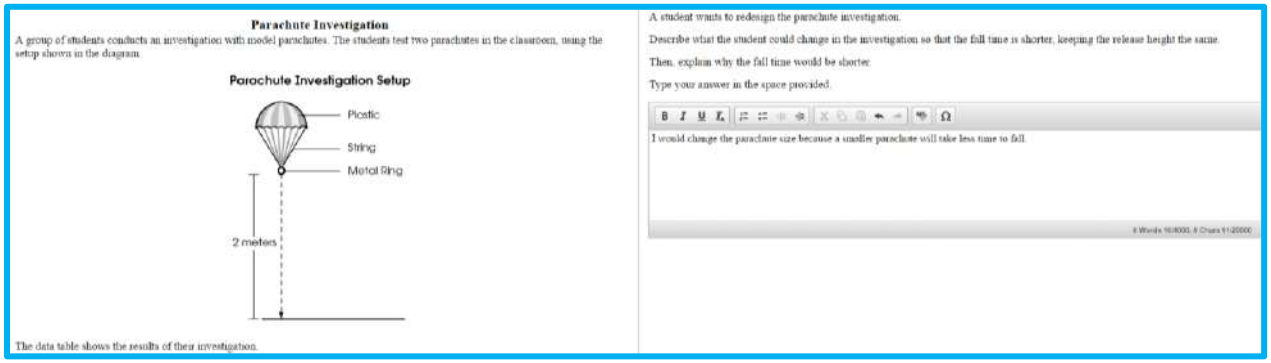
Sample Response: 2 points



Notes on Scoring

This response earns full credit (2 points) because it correctly identifies a change to the investigation that would decrease the fall time, "put a hole in the plastic to make it fall faster", and explains why this change would decrease the fall time: "the air would go through the hole". Putting a hole in the parachute would decrease drag, making the net force on the parachute larger.

Sample Response: 1 point



Parachute Investigation

A group of students conducts an investigation with model parachutes. The students test two parachutes in the classroom, using the setup shown in the diagram.

Parachute Investigation Setup

The data table shows the results of their investigation.

A student wants to redesign the parachute investigation.

Describe what the student could change in the investigation so that the fall time is shorter, keeping the release height the same.

Then, explain why the fall time would be shorter.

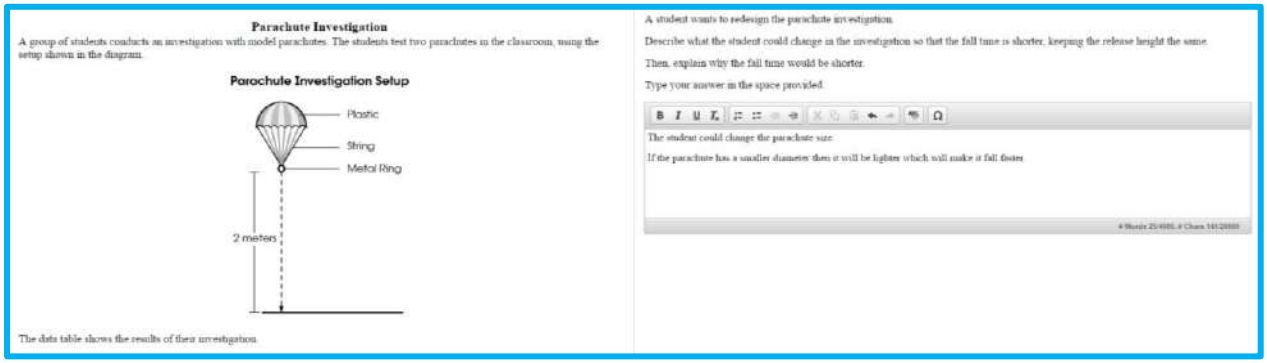
Type your answer in the space provided.

I would change the parachute size because a smaller parachute will take less time to fall.

Notes on Scoring

This response earns partial credit (1 point) because it correctly identifies a change to the investigation that would decrease the fall time, "change the parachute size", but does not explain why this change would decrease the fall time. A smaller parachute would experience less drag, making the net force on the parachute greater.

Sample Response: 1 point



Parachute Investigation

A group of students conducts an investigation with model parachutes. The students test two parachutes in the classroom, using the setup shown in the diagram.

Parachute Investigation Setup

The data table shows the results of their investigation.

A student wants to redesign the parachute investigation.

Describe what the student could change in the investigation so that the fall time is shorter, keeping the release height the same.

Then, explain why the fall time would be shorter.

Type your answer in the space provided.

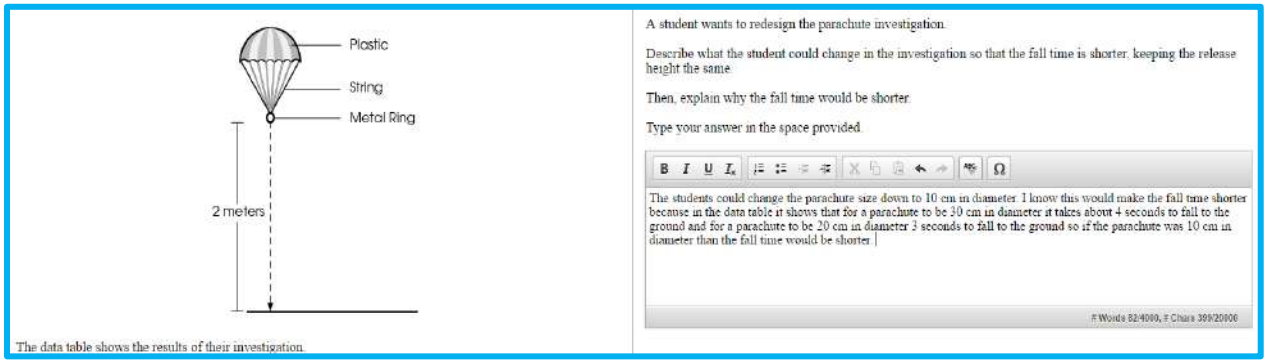
The student could change the parachute size.

If the parachute has a smaller diameter then it will be lighter which will make it fall faster.

Notes on Scoring

This response earns partial credit (1 point) because it correctly identifies a change to the investigation that would decrease the fall time, "If the parachute has a smaller diameter", but gives an incorrect explanation of why this change would decrease the fall time: "will be lighter".

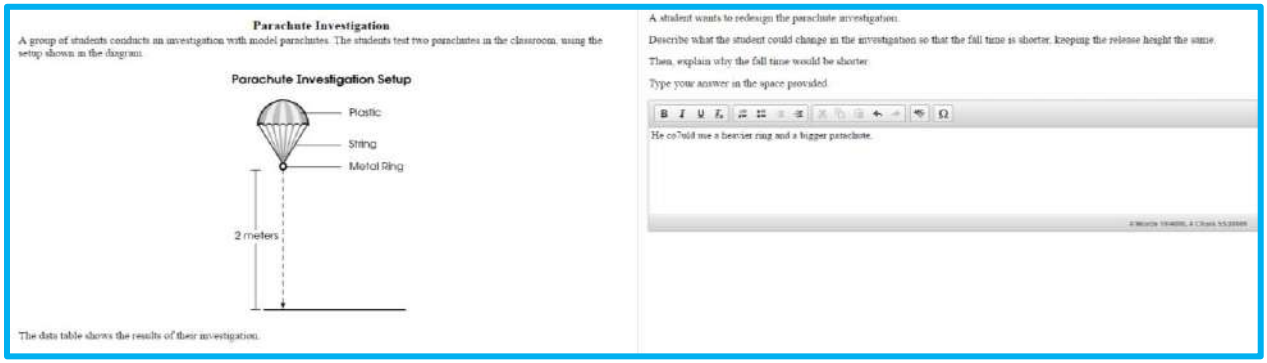
Sample Response: 1 point



Notes on Scoring

This response earns partial credit (1 point) because it correctly identifies a change to the investigation that would decrease the fall time, "change the parachute size down", but does not explain why this change would decrease the fall time. A smaller parachute would experience less drag, making the net force on the parachute greater. Although this response provides supporting evidence from the data that the change would decrease fall time, it does not explain why this would be the case.

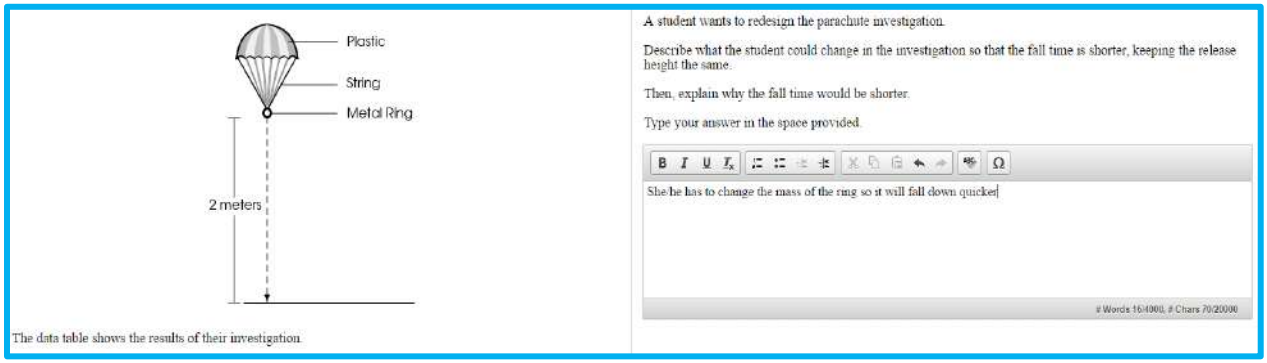
Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because it does not correctly identify a change to the investigation that would decrease the fall time and does not explain why this change would decrease the fall time. The response lists two changes that would have opposite effects on the fall rate. A heavier ring would decrease the fall time, but a bigger parachute would increase the fall time. The response also does not contain an explanation of why these changes would affect the fall rate.

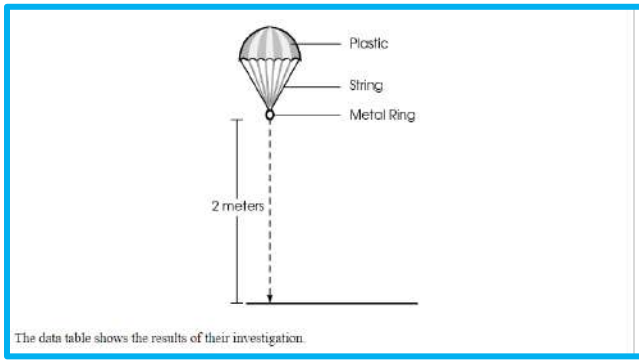
Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because it does not correctly identify a change to the investigation that would decrease the fall time and does not explain why this change would decrease the fall time. The response does not indicate whether the mass should be increased or decreased and does not contain an explanation of why changing the mass would affect the fall rate.

Sample Response: 0 points



The data table shows the results of their investigation.

A student wants to redesign the parachute investigation.

Describe what the student could change in the investigation so that the fall time is shorter, keeping the release height the same.

Then, explain why the fall time would be shorter.

Type your answer in the space provided.

The fall time would be shorter because it gets colder and people would want to stay inside, so that is why it is shorter in the fall.

Words 27/4000, # Chars 133/20000

Notes on Scoring

This response earns no credit (0 points) because it does not correctly identify a change to the investigation that would decrease the fall time and does not explain why this change would decrease the fall time. This response confuses the use of fall (a noun), a season of the year, with fall (a verb), which means to descend toward the Earth.

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Question 4

Simulation for Questions 5 and 6

Question 4 (Simulation for Questions 5 and 6)

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

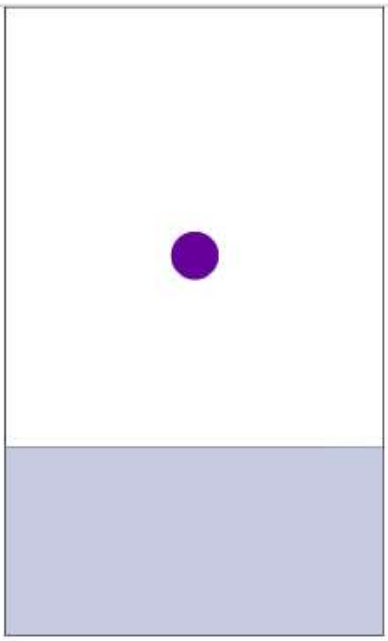
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 10 g

Height of Ball 1.0 m

Liquid Water

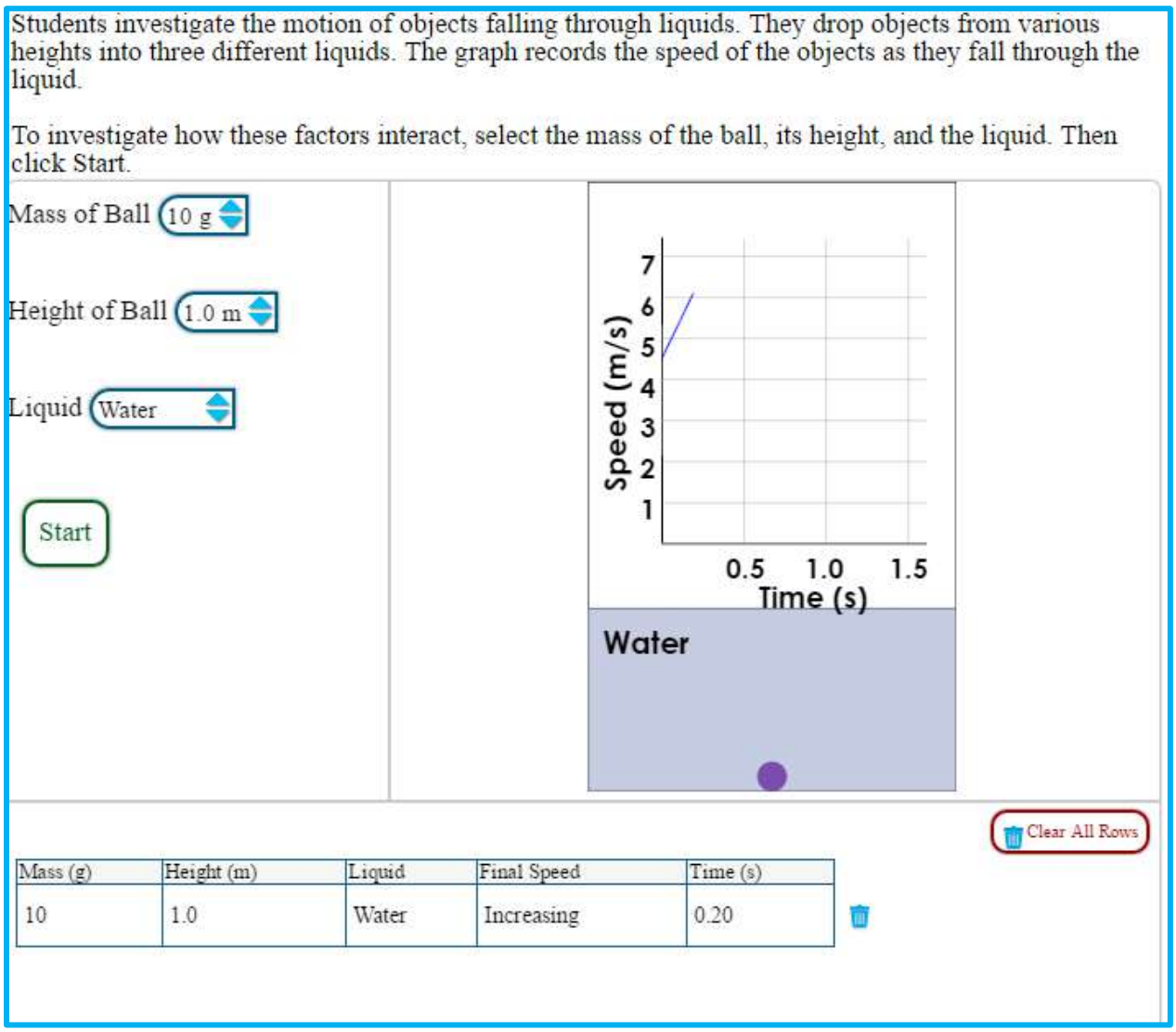
Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)

When "**10 g**", "**1.0 m**" and "**Water**" are selected, the following appears:



When "**15 g**", "**1.0 m**" and "**Water**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

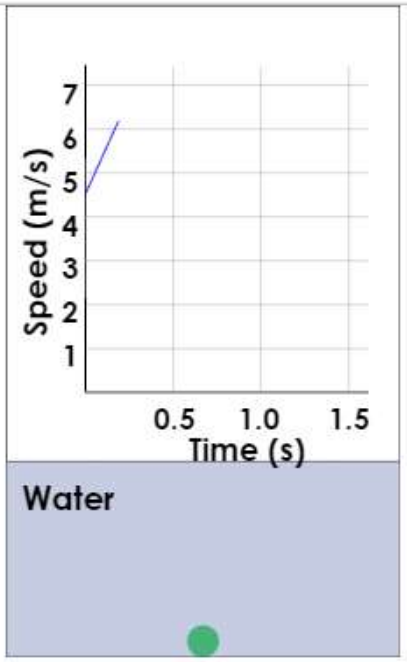
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 15 g

Height of Ball 1.0 m

Liquid Water

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
10	1.0	Water	Increasing	0.20
15	1.0	Water	Increasing	0.20

When "**25 g**", "**1.0 m**" and "**Water**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

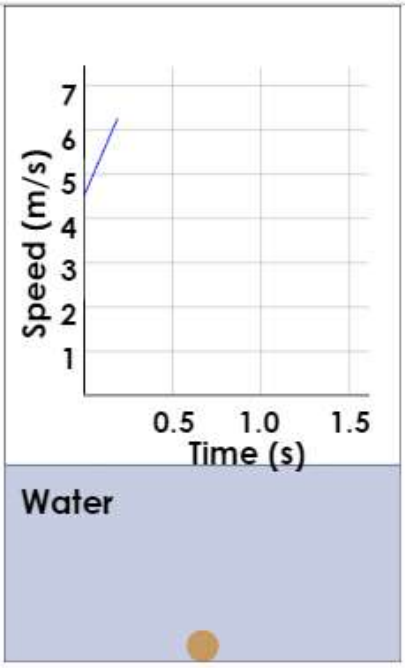
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 25 g

Height of Ball 1.0 m

Liquid Water

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
10	1.0	Water	Increasing	0.20
15	1.0	Water	Increasing	0.20
25	1.0	Water	Increasing	0.20

When "**10 g**", "**1.5 m**" and "**Water**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

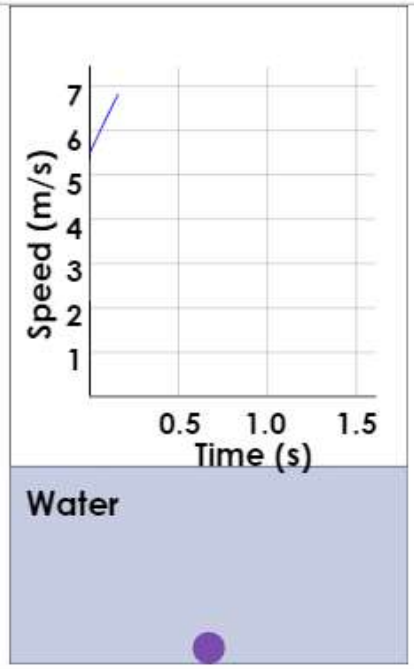
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 10 g

Height of Ball 1.5 m

Liquid Water

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
10	1.0	Water	Increasing	0.20
15	1.0	Water	Increasing	0.20
25	1.0	Water	Increasing	0.20
10	1.5	Water	Increasing	0.17

When "**15 g**", "**1.5 m**" and "**Water**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

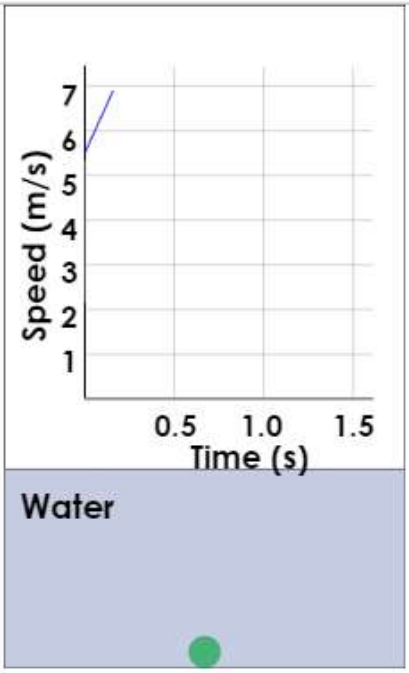
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 15 g

Height of Ball 1.5 m

Liquid Water

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
10	1.0	Water	Increasing	0.20
15	1.0	Water	Increasing	0.20
25	1.0	Water	Increasing	0.20
10	1.5	Water	Increasing	0.17
15	1.5	Water	Increasing	0.17

When "**25 g**", "**1.5 m**" and "**Water**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

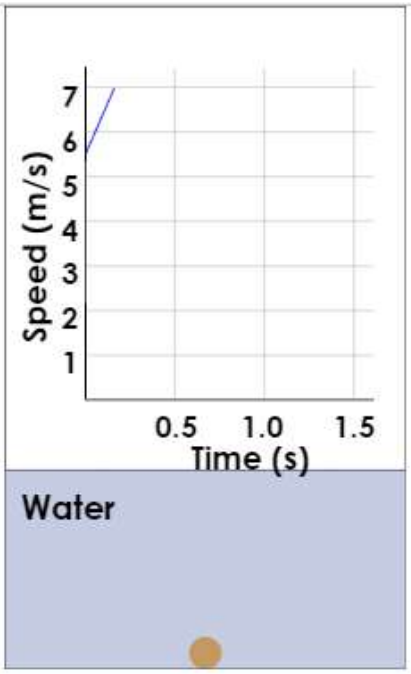
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 25 g

Height of Ball 1.5 m

Liquid Water

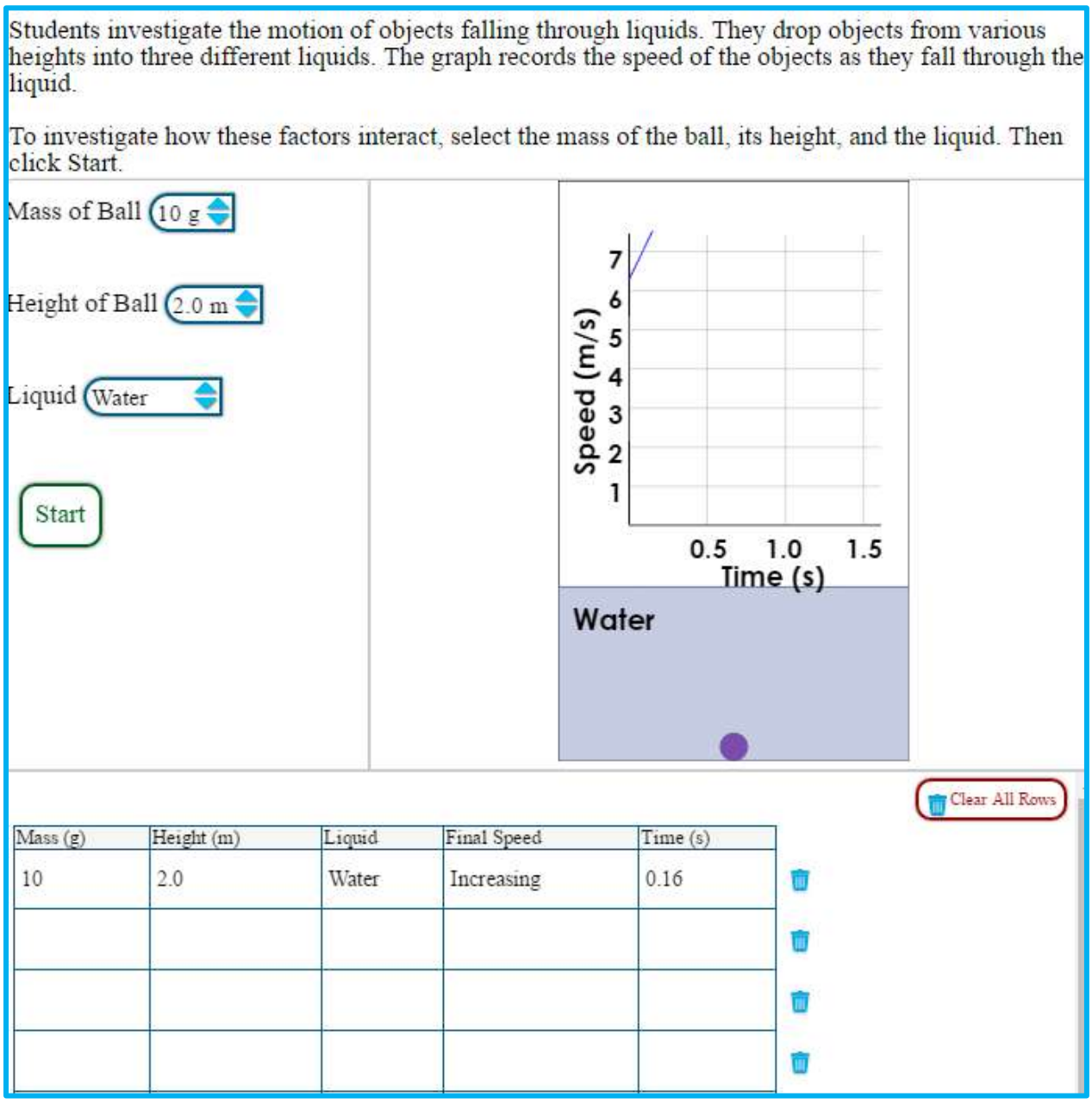
Start



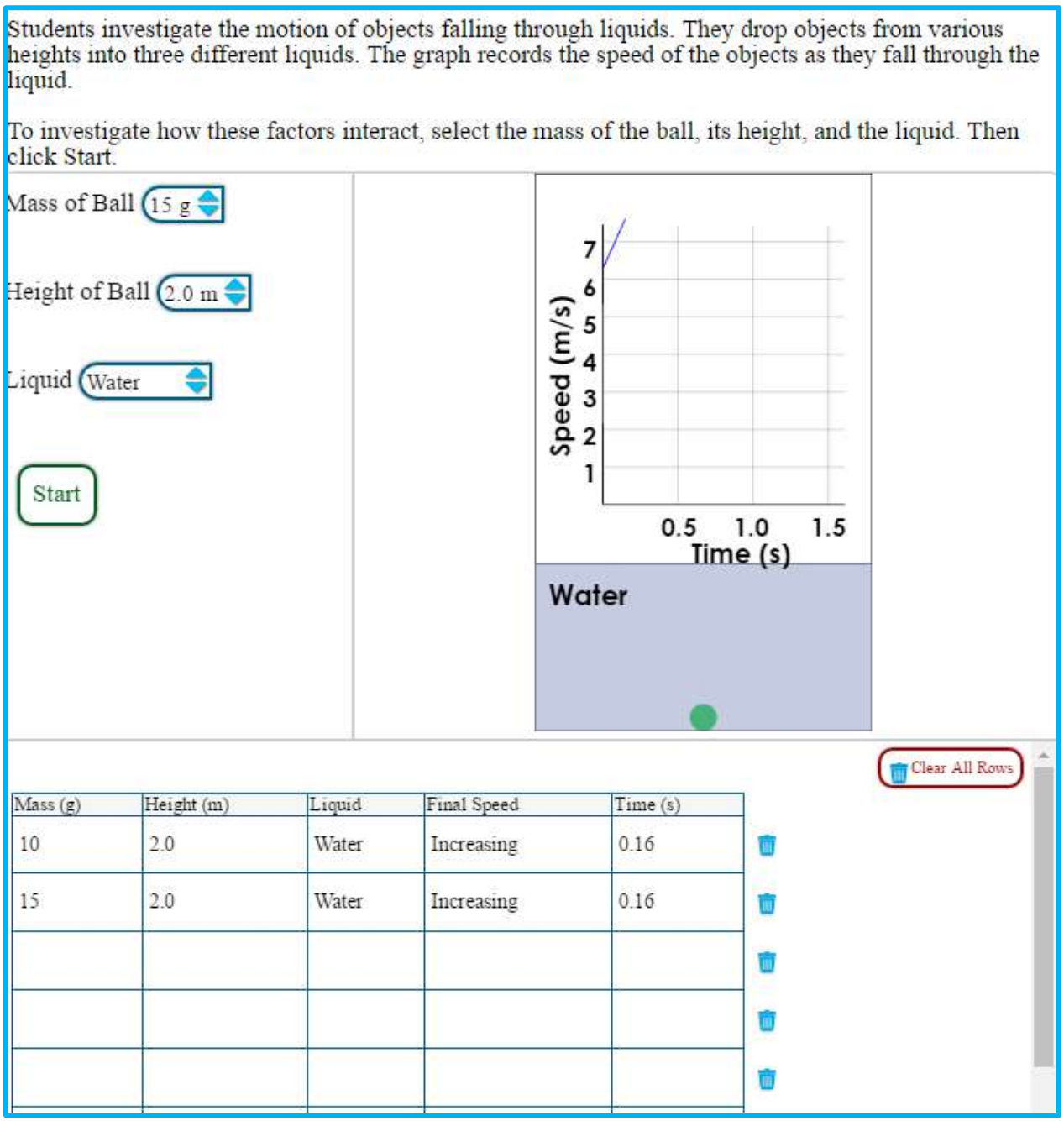
Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
10	1.0	Water	Increasing	0.20
15	1.0	Water	Increasing	0.20
25	1.0	Water	Increasing	0.20
10	1.5	Water	Increasing	0.17
15	1.5	Water	Increasing	0.17
25	1.5	Water	Increasing	0.17

When "**10 g**", "**2.0 m**" and "**Water**" are selected, the following appears:



When "**15 g**", "**2.0 m**" and "**Water**" are selected, the following appears:



When "**25 g**", "**2.0 m**" and "**Water**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through th liquid.

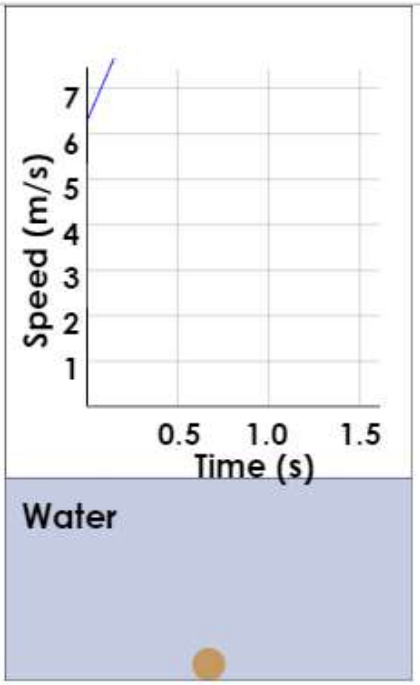
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 25 g

Height of Ball 2.0 m

Liquid Water

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
10	2.0	Water	Increasing	0.16
15	2.0	Water	Increasing	0.16
25	2.0	Water	Increasing	0.16

When "**10 g**", "**1.0 m**" and "**Glycerine**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through th liquid.

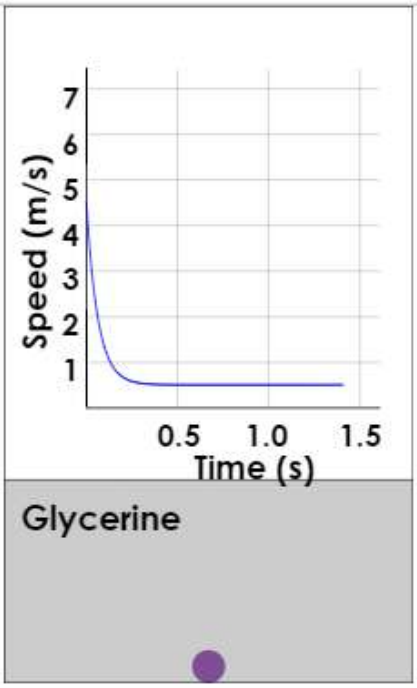
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 10 g

Height of Ball 1.0 m

Liquid Glycerine

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
10	2.0	Water	Increasing	0.16
15	2.0	Water	Increasing	0.16
25	2.0	Water	Increasing	0.16
10	1.0	Glycerine	Constant	1.42

When "**15 g**", "**1.0 m**" and "**Glycerine**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

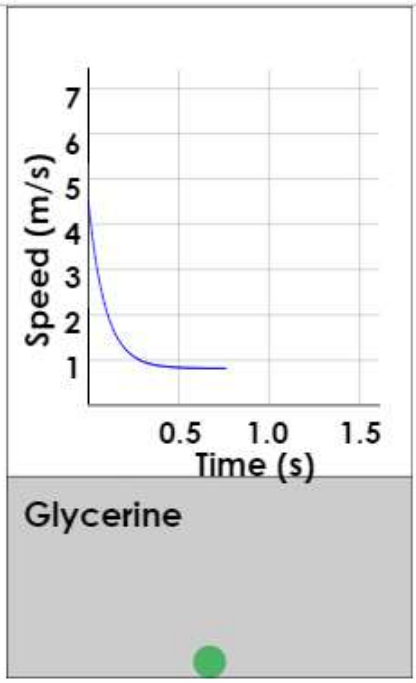
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 15 g

Height of Ball 1.0 m

Liquid Glycerine

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
10	2.0	Water	Increasing	0.16
15	2.0	Water	Increasing	0.16
25	2.0	Water	Increasing	0.16
10	1.0	Glycerine	Constant	1.42
15	1.0	Glycerine	Constant	0.77

When "**25 g**", "**1.0 m**" and "**Glycerine**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

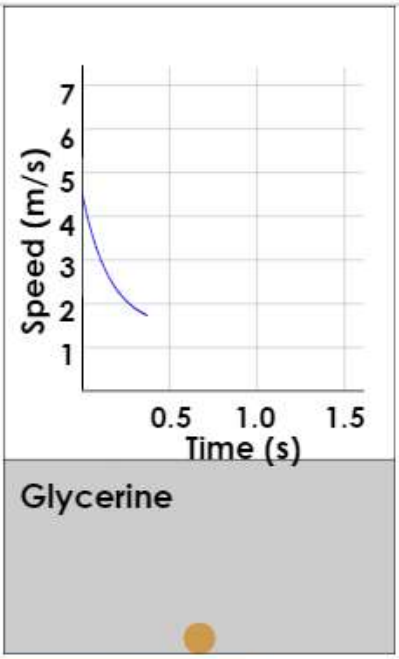
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 25 g

Height of Ball 1.0 m

Liquid Glycerine

Start



Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
10	2.0	Water	Increasing	0.16
15	2.0	Water	Increasing	0.16
25	2.0	Water	Increasing	0.16
10	1.0	Glycerine	Constant	1.42
15	1.0	Glycerine	Constant	0.77
25	1.0	Glycerine	Decreasing	0.38

When "**10 g**", "**1.5 m**" and "**Glycerine**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through th liquid.

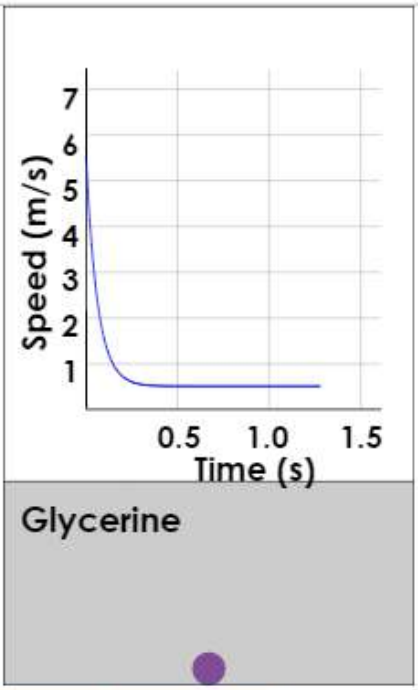
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 10 g

Height of Ball 1.5 m

Liquid Glycerine

Start



Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
10	2.0	Water	Increasing	0.16
15	2.0	Water	Increasing	0.16
25	2.0	Water	Increasing	0.16
10	1.0	Glycerine	Constant	1.42
15	1.0	Glycerine	Constant	0.77
25	1.0	Glycerine	Decreasing	0.38
10	1.5	Glycerine	Constant	1.29

When "**15 g**", "**1.5 m**" and "**Glycerine**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

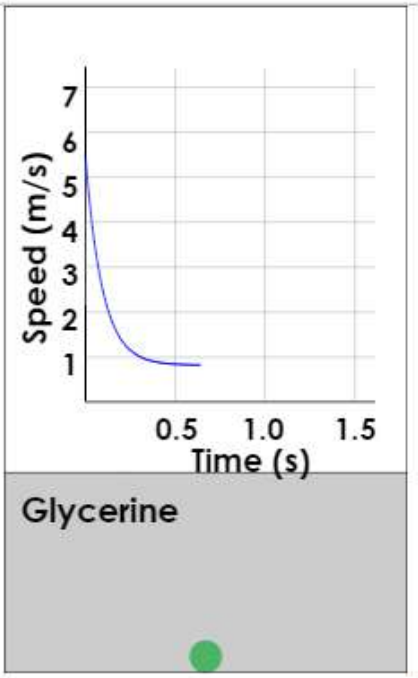
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 15 g

Height of Ball 1.5 m

Liquid Glycerine

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
15	1.5	Glycerine	Constant	0.65

When "**25 g**", "**1.5 m**" and "**Glycerine**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

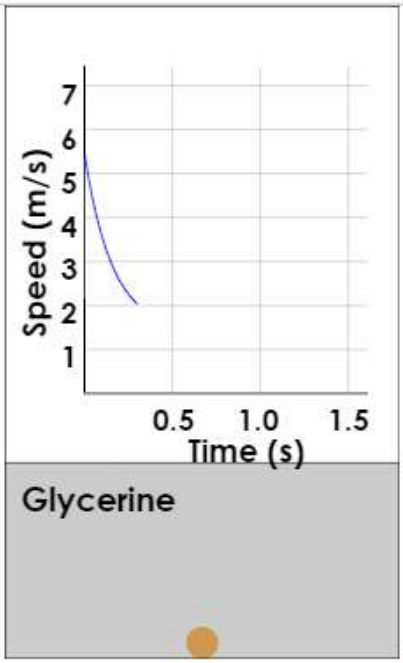
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 25 g

Height of Ball 1.5 m

Liquid Glycerine

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
15	1.5	Glycerine	Constant	0.65
25	1.5	Glycerine	Decreasing	0.31

When "**10 g**", "**2.0 m**" and "**Glycerine**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

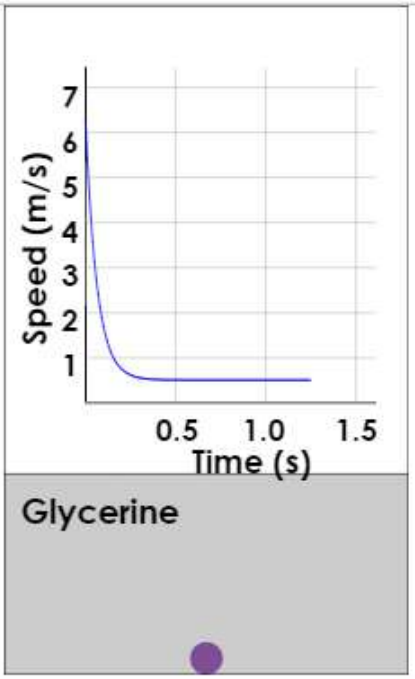
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 10 g

Height of Ball 2.0 m

Liquid Glycerine

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
15	1.5	Glycerine	Constant	0.65
25	1.5	Glycerine	Decreasing	0.31
10	2.0	Glycerine	Constant	1.26

When "**15 g**", "**2.0 m**" and "**Glycerine**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

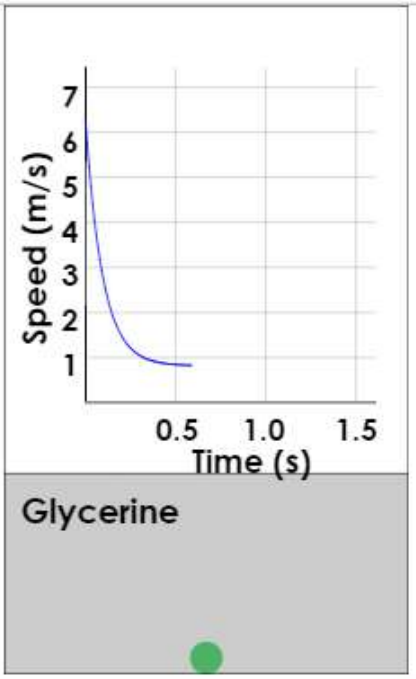
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 15 g

Height of Ball 2.0 m

Liquid Glycerine

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
15	1.5	Glycerine	Constant	0.65
25	1.5	Glycerine	Decreasing	0.31
10	2.0	Glycerine	Constant	1.26
15	2.0	Glycerine	Constant	0.60

When "**25 g**", "**2.0 m**" and "**Glycerine**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through th liquid.

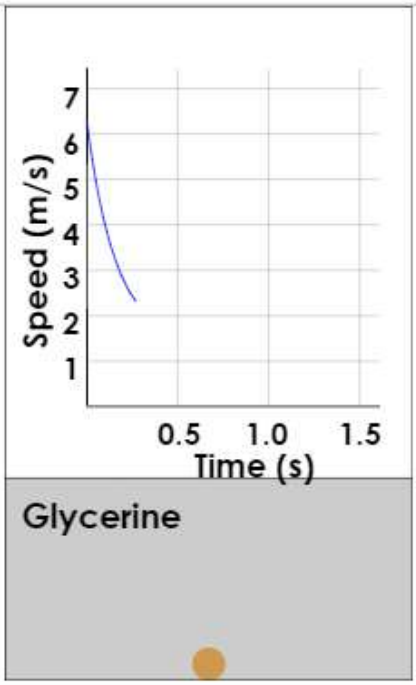
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 25 g

Height of Ball 2.0 m

Liquid Glycerine

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
15	1.5	Glycerine	Constant	0.65
25	1.5	Glycerine	Decreasing	0.31
10	2.0	Glycerine	Constant	1.26
15	2.0	Glycerine	Constant	0.60
25	2.0	Glycerine	Decreasing	0.28

When "**10 g**", "**1.0 m**" and "**Motor Oil**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

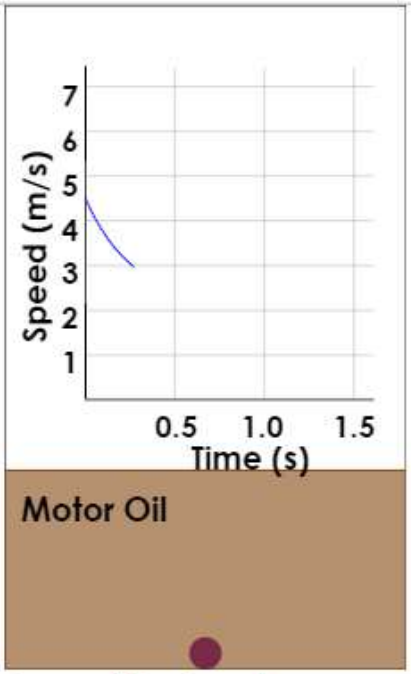
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 10 g

Height of Ball 1.0 m

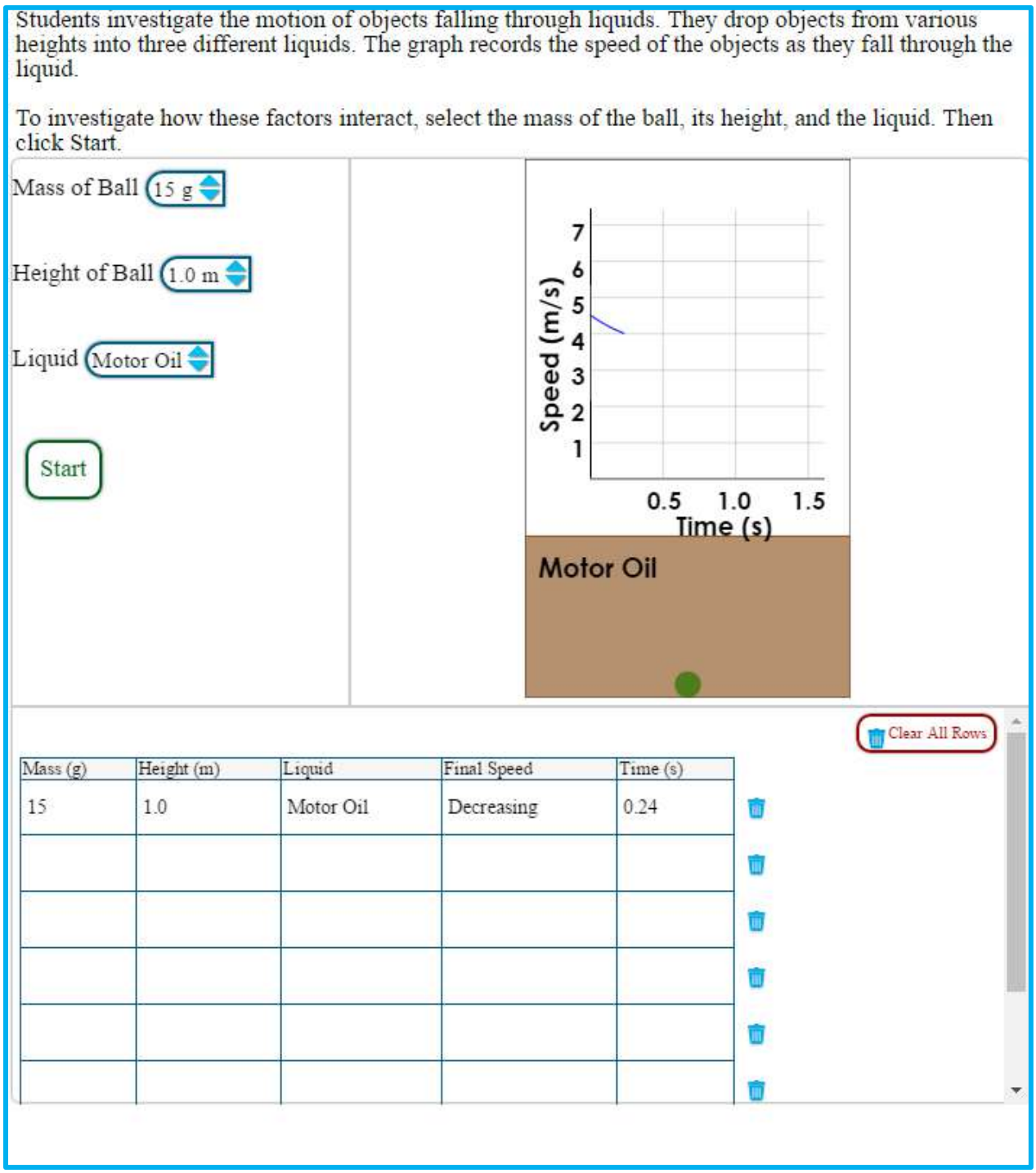
Liquid Motor Oil

Start



Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
15	1.5	Glycerine	Constant	0.65
25	1.5	Glycerine	Decreasing	0.31
10	2.0	Glycerine	Constant	1.26
15	2.0	Glycerine	Constant	0.60
25	2.0	Glycerine	Decreasing	0.28
10	1.0	Motor Oil	Decreasing	0.28

When "**15 g**", "**1.0 m**" and "**Motor Oil**" are selected, the following appears:



When "**25 g**", "**1.0 m**" and "**Motor Oil**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

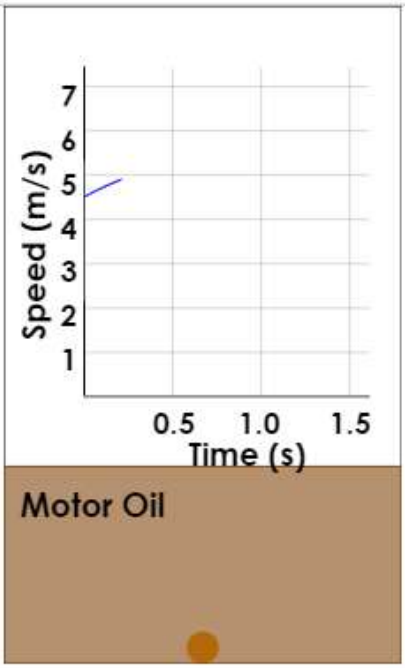
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 25 g

Height of Ball 1.0 m

Liquid Motor Oil

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
15	1.0	Motor Oil	Decreasing	0.24
25	1.0	Motor Oil	Increasing	0.22

When "**10 g**", "**1.5 m**" and "**Motor Oil**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

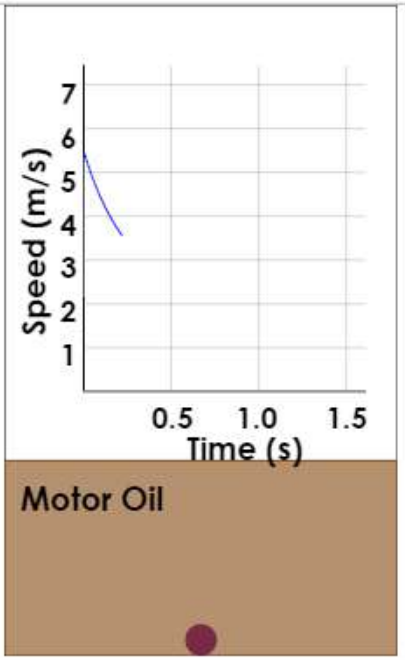
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 10 g

Height of Ball 1.5 m

Liquid Motor Oil

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
15	1.0	Motor Oil	Decreasing	0.24
25	1.0	Motor Oil	Increasing	0.22
10	1.5	Motor Oil	Decreasing	0.23

When "**15 g**", "**1.5 m**" and "**Motor Oil**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

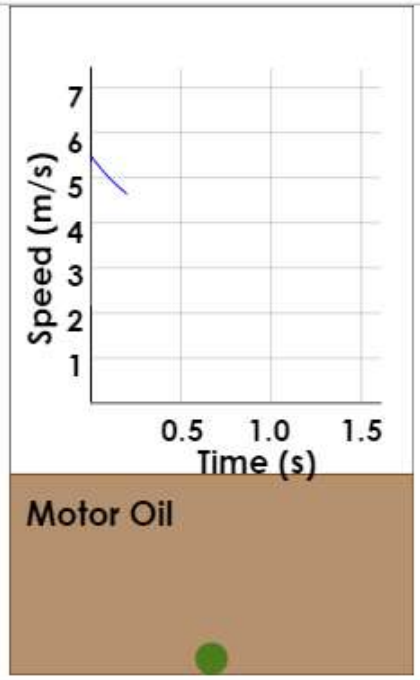
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 15 g

Height of Ball 1.5 m

Liquid Motor Oil

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
15	1.0	Motor Oil	Decreasing	0.24
25	1.0	Motor Oil	Increasing	0.22
10	1.5	Motor Oil	Decreasing	0.23
15	1.5	Motor Oil	Decreasing	0.21

When "**25 g**", "**1.5 m**" and "**Motor Oil**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

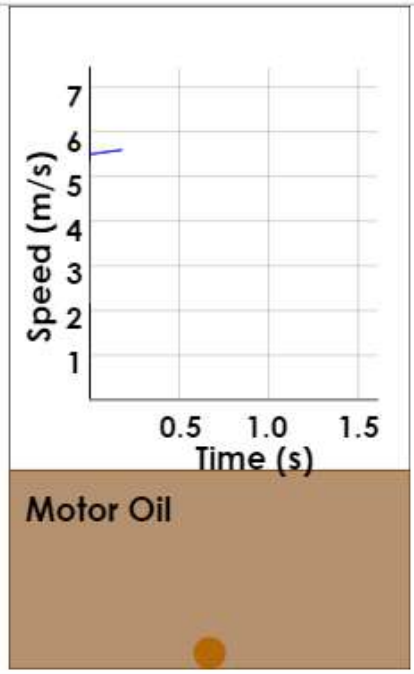
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 25 g

Height of Ball 1.5 m

Liquid Motor Oil

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
15	1.0	Motor Oil	Decreasing	0.24
25	1.0	Motor Oil	Increasing	0.22
10	1.5	Motor Oil	Decreasing	0.23
15	1.5	Motor Oil	Decreasing	0.21
25	1.5	Motor Oil	Increasing	0.19

When "**10 g**", "**2.0 m**" and "**Motor Oil**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

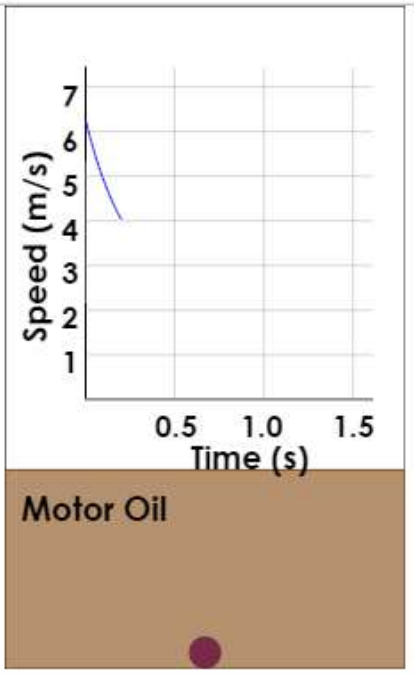
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 10 g

Height of Ball 2.0 m

Liquid Motor Oil

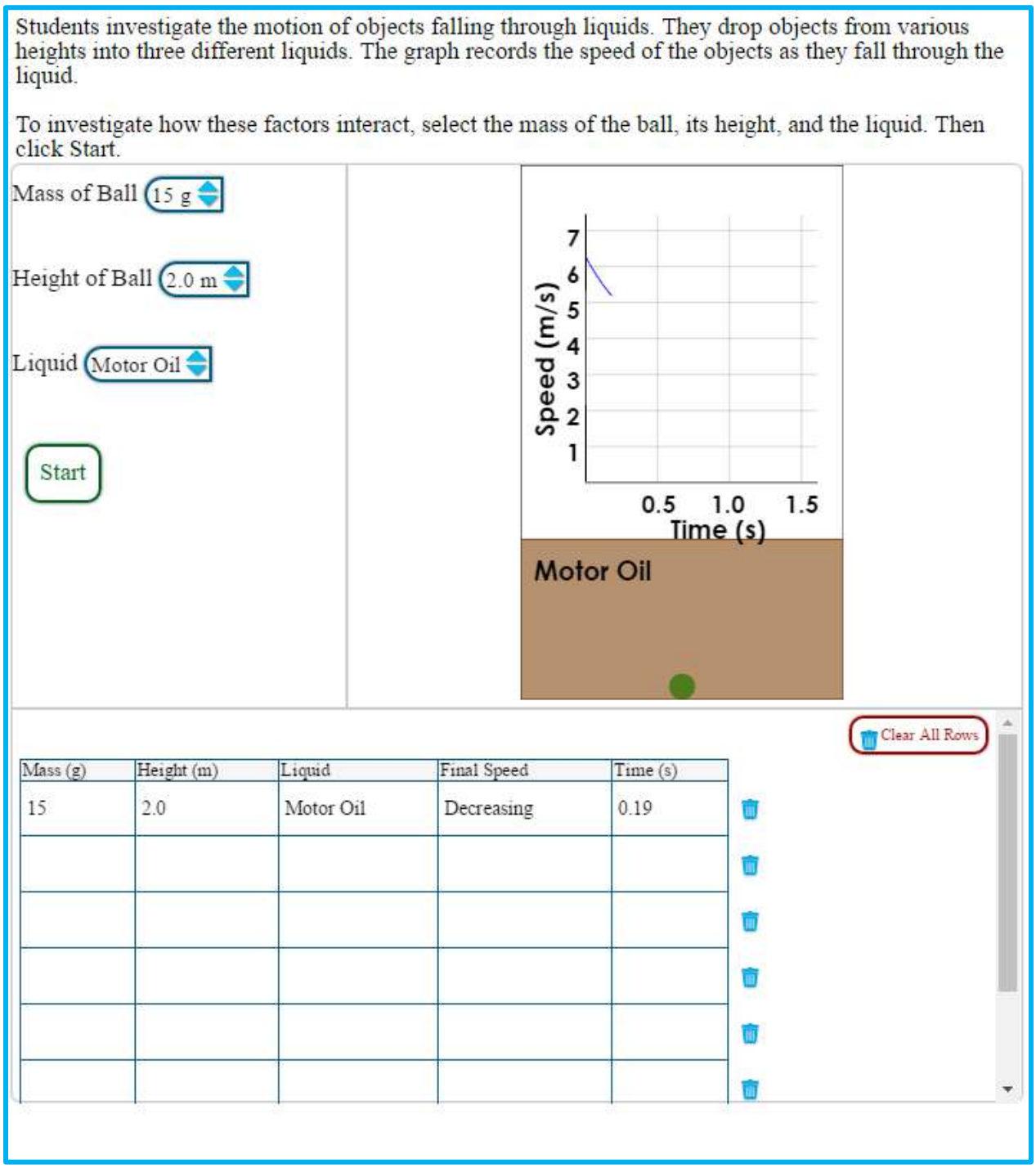
Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
15	1.0	Motor Oil	Decreasing	0.24
25	1.0	Motor Oil	Increasing	0.22
10	1.5	Motor Oil	Decreasing	0.23
15	1.5	Motor Oil	Decreasing	0.21
25	1.5	Motor Oil	Increasing	0.19
10	2.0	Motor Oil	Decreasing	0.21

When "**15 g**", "**2.0 m**" and "**Motor Oil**" are selected, the following appears:



When "**25 g**", "**2.0 m**" and "**Motor Oil**" are selected, the following appears:

Students investigate the motion of objects falling through liquids. They drop objects from various heights into three different liquids. The graph records the speed of the objects as they fall through the liquid.

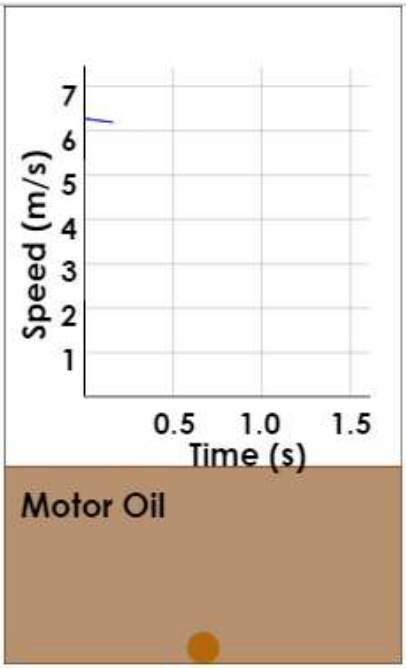
To investigate how these factors interact, select the mass of the ball, its height, and the liquid. Then click Start.

Mass of Ball 25 g

Height of Ball 2.0 m

Liquid Motor Oil

Start



Clear All Rows

Mass (g)	Height (m)	Liquid	Final Speed	Time (s)
15	2.0	Motor Oil	Decreasing	0.19
25	2.0	Motor Oil	Decreasing	0.17

Grade 8
Science
Spring 2017 Item Release

Question 5

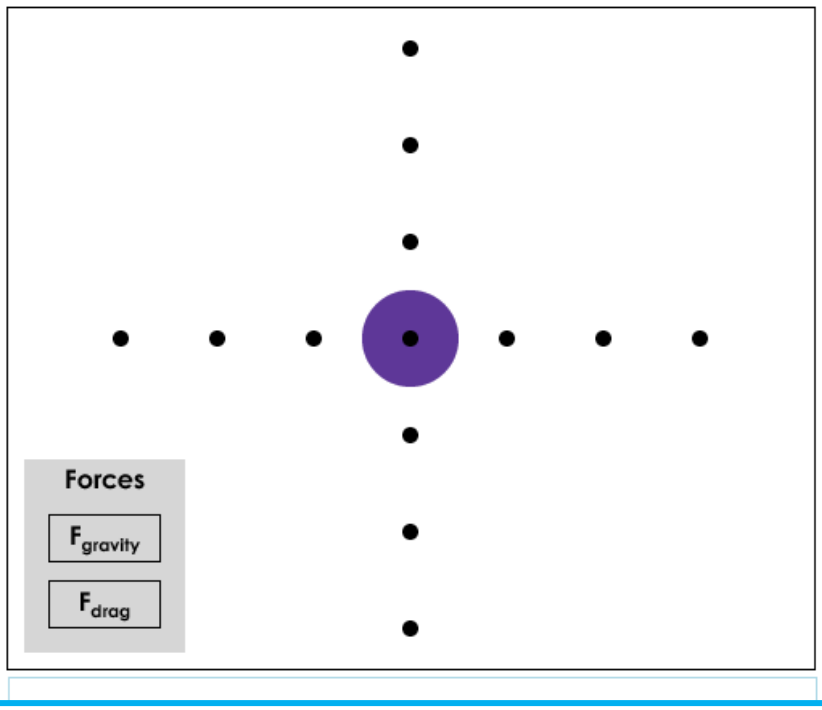
Question and Scoring Guidelines

Question 5

The students drop the 10 g ball from a height of 1.0 m into glycerine. Create a diagram of the forces acting on the ball after 1 second has passed.

A. Click on two black dots to indicate the direction and relative magnitudes of the two forces acting on the ball.

B. Move the correct force label next to each arrow.



Points Possible: 2

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- An arrow selected in the downward direction AND an arrow of the same length selected in the upward direction AND no other arrows selected (with no labels, incorrect labels or correct labels) (1 point);

  AND

- "$F_{gravity}$" placed below the ball and an arrow selected in the downward direction AND "F_{drag}" placed above the ball and an arrow selected in the upward direction AND no other arrows selected (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.

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.

Drag is a force that opposes the motion of an object when an object moves through a fluid (e.g., gas, liquid). Kinetic friction and drag affect the motion of objects and may even cause moving objects to slow to a stop unless another force is exerted in the direction of motion.

Cognitive Demand

Interpreting and Communicating Science Concepts (C)

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

Explanation of the Item

This item requires the student to use the results of a simulated experiment to determine the direction and relative strength of forces acting on an object. The student runs a simulation for the conditions stated in the item. According to the simulation, when a 10-gram ball is dropped from a height of 1.0 meters into glycerine, the ball enters the water at a speed of approximately 4.5 m/s. The speed of the ball decreases for approximately 0.25 seconds. After that time the ball maintains a constant speed of approximately 0.5 m/s. At 1 second, the ball is traveling at a constant speed as it falls through the glycerine.

Objects traveling at a constant speed have a net force of zero acting on them. The student is asked to place arrows onto a force diagram. Balanced forces are shown by equal length arrows representing the downward force of gravity and the upward drag as the ball passes through the glycerine. The student receives 1 point for recognizing that the size of the opposing forces is equal and indicating this by placing equal length arrows onto the force diagram. The student receives 1 point for dragging the proper labels to the arrows.

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Science
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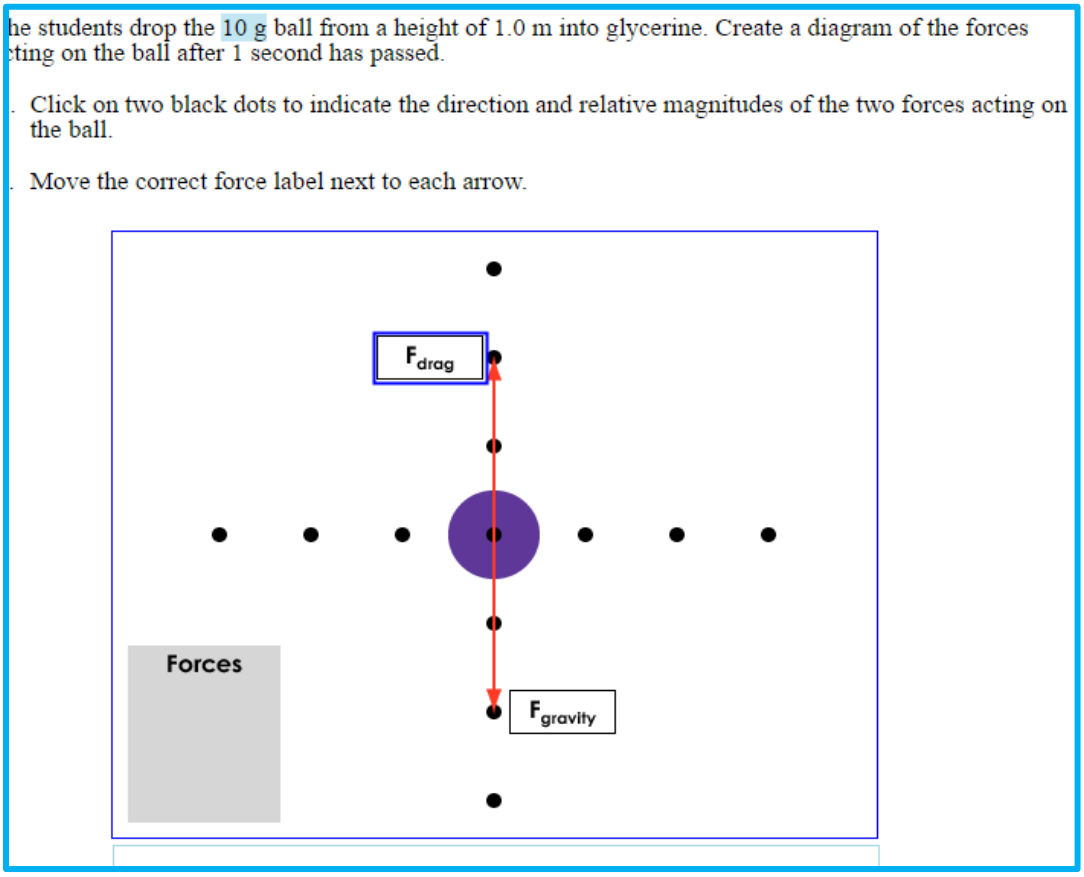
Question 5

Sample Responses

Sample Response: 2 points



Notes on Scoring

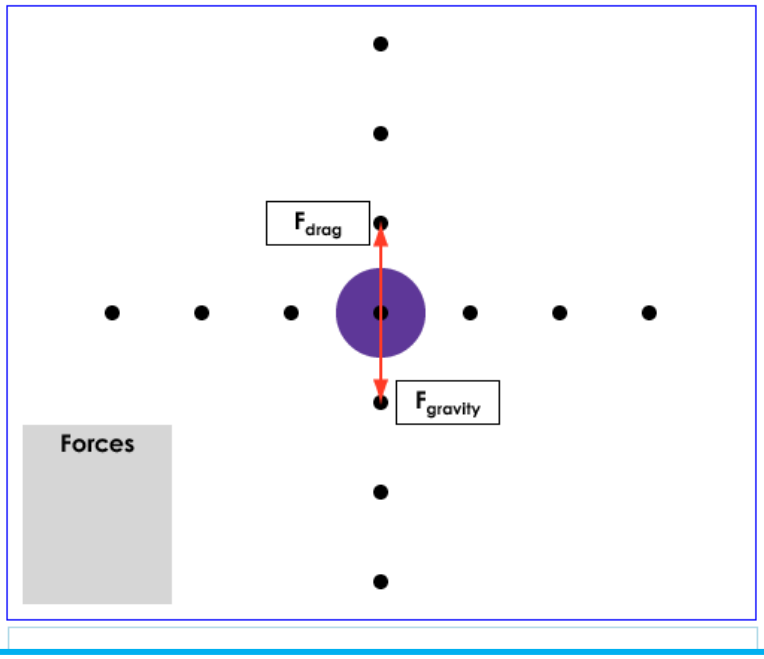
This response earns full credit (2 points) because it shows equal length arrows in the upward and downward directions and the arrows have the correct labels.

Sample Response: 2 points

The students drop the 10 g ball from a height of 1.0 m into glycerine. Create a diagram of the forces acting on the ball after 1 second has passed.

A. Click on two black dots to indicate the direction and relative magnitudes of the two forces acting on the ball.

B. Move the correct force label next to each arrow.



Notes on Scoring

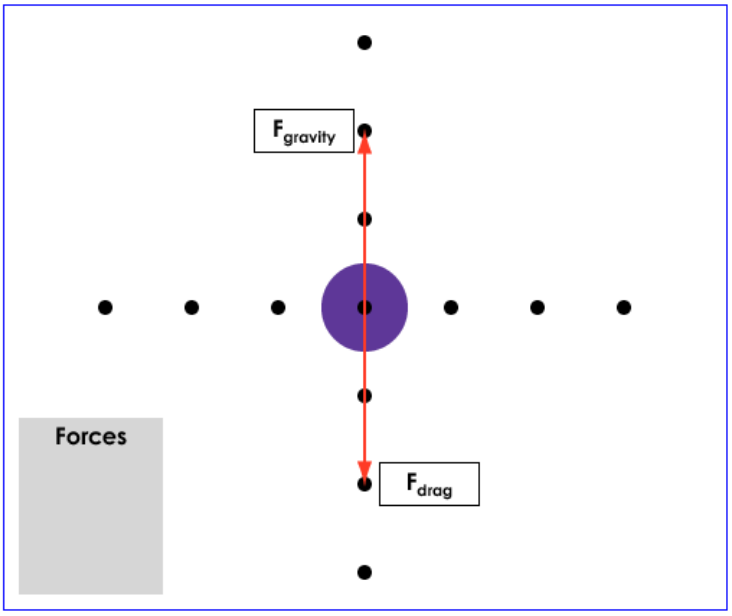
This response earns full credit (2 points) because it shows equal length arrows in the upward and downward directions and the arrows have the correct labels.

Sample Response: 1 point

The students drop the 10 g ball from a height of 1.0 m into glycerine. Create a diagram of the forces acting on the ball after 1 second has passed.

A. Click on two black dots to indicate the direction and relative magnitudes of the two forces acting on the ball.

B. Move the correct force label next to each arrow.



Notes on Scoring

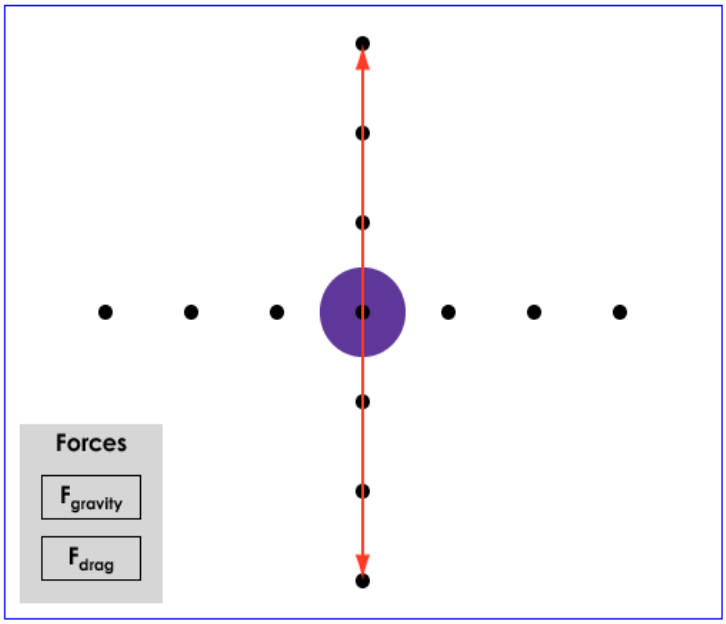
This response earns partial credit (1 point) because it shows equal length arrows in the upward and downward directions. However, the arrows do not have the correct labels. This response incorrectly indicates that gravity is exerting a force in the upward direction and that drag is exerting a force in the downward direction. Gravity acts downward toward the center of Earth. Drag acts in a direction opposite motion.

Sample Response: 1 point

The students drop the 10 g ball from a height of 1.0 m into glycerine. Create a diagram of the forces acting on the ball after 1 second has passed.

A. Click on two black dots to indicate the direction and relative magnitudes of the two forces acting on the ball.

B. Move the correct force label next to each arrow.



Notes on Scoring

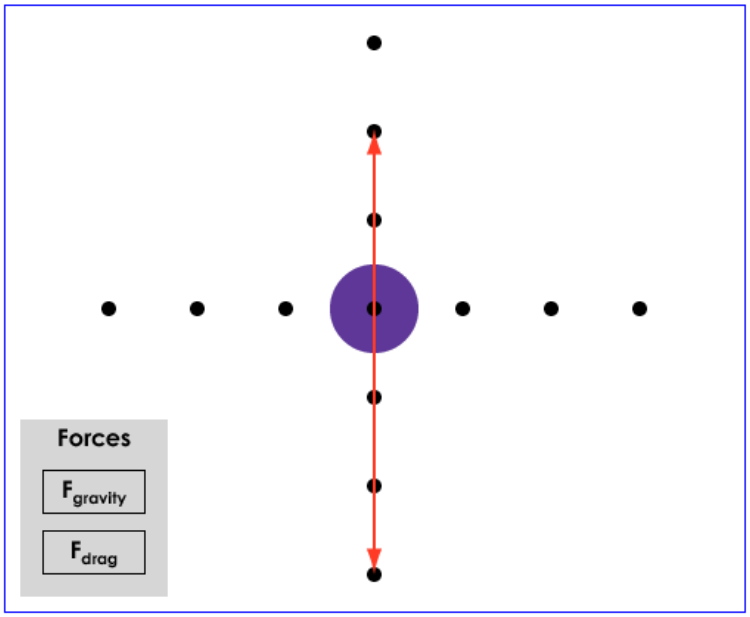
This response earns partial credit (1 point) because it shows equal length arrows in the upward and downward directions. However, the student did not place labels onto the force diagram.

Sample Response: 0 points

The students drop the 10 g ball from a height of 1.0 m into glycerine. Create a diagram of the forces acting on the ball after 1 second has passed.

A. Click on two black dots to indicate the direction and relative magnitudes of the two forces acting on the ball.

B. Move the correct force label next to each arrow.



Notes on Scoring

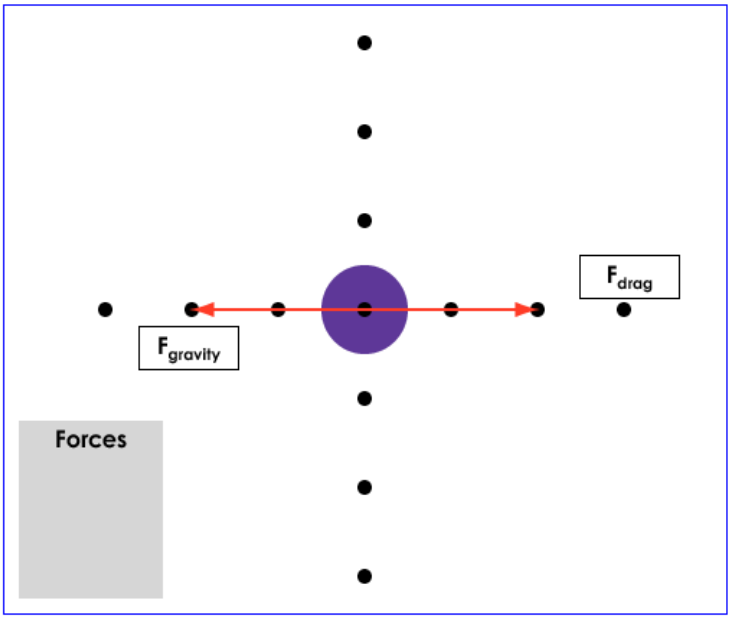
This response earns no credit (0 points) because it shows arrows that are not equal in length. Balanced forces are indicated on force diagrams by arrows of equal length. The student also did not place labels onto the force diagram.

Sample Response: 0 points

The students drop the 10 g ball from a height of 1.0 m into glycerine. Create a diagram of the forces acting on the ball after 1 second has passed.

A. Click on two black dots to indicate the direction and relative magnitudes of the two forces acting on the ball.

B. Move the correct force label next to each arrow.



Notes on Scoring

This response earns no credit (0 points) because, although the arrows are equal in length, they are pointing to the left and to the right. Gravity acts downward toward the center of Earth. Drag acts in a direction opposite motion. In this case, the ball is moving downward, so drag is upward.

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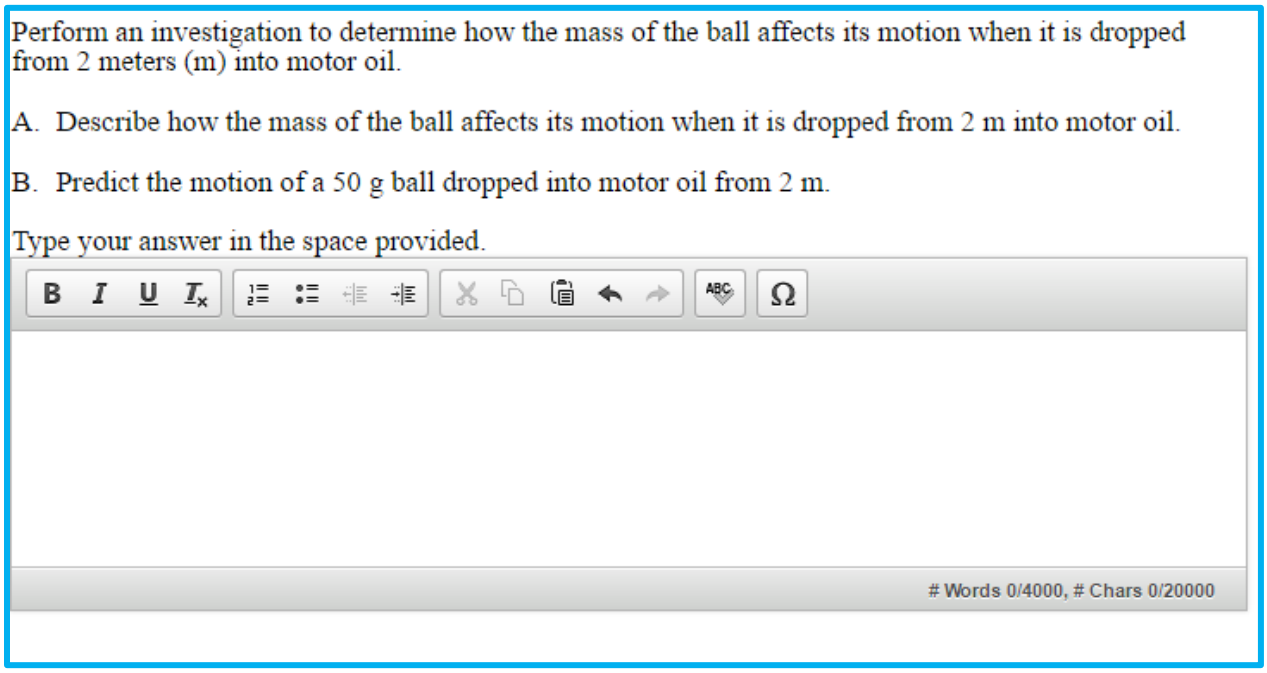
Question 6

Question and Scoring Guidelines

Question 6



Points Possible: 2

See **Alignment** for more detail.

Scoring Guidelines

Exemplar Response

The larger the mass, the faster the ball reaches the bottom. The 50 g ball will reach the bottom more quickly than the others.

Other Responses

Correct responses for the effect of mass on the motion of the ball in motor oil may include:

- The larger the mass, the faster the ball reaches the bottom.
- The larger the mass, the less the speed decreases.
- The smaller the mass, the slower the ball reaches the bottom.
- The smaller the mass, the more the speed decreases.

Correct responses for the motion of a 50 g ball dropped into motor oil may include:

- The 50 g ball will reach the bottom more quickly/faster than the others.
- The 50 g ball will have a greater/higher speed than the others.
- The 50 g ball will keep speeding up as it falls through the motor oil.
- The speed of the 50 g ball will decrease as it falls through the motor oil.
- The time for the 50 g ball will be less than 0.17 seconds.

Score Point	Description
2 points	The response includes: • A correct description of the effect mass has on the motion of the ball in motor oil; AND • A correct prediction of the motion of a 50 g ball in motor oil.
1 point	The response includes: • A correct description of the effect mass has on the motion of the ball in motor oil; OR • A correct prediction of the motion of a 50 g ball in motor oil.
0 points	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. It may only repeat information given in the test item. The response may provide an incorrect solution/response and the provided supportive information may be 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
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.
When the net force is greater than zero, the object's speed and/or direction will change.

Drag is a force that opposes the motion of an object when an object moves through a fluid (e.g. gas, liquid).

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 Accurate Science.

Explanation of the Item
This item requires the student to use the results of a simulated investigation to predict the motion of a ball with a greater mass than those in the original experiment. When balls of varying mass are dropped into motor oil in the simulation, there is a pattern to the data. For balls with masses of 10, 15 and 25 grams, the speed is decreasing as they fall through the motor oil. As the mass of the ball increases, the time to fall through the motor oil decreases. Based on these experimental results, the student can predict that a 50-gram ball will fall though the motor oil in less time than the tested balls and that its speed will be decreasing as it falls through the motor oil.

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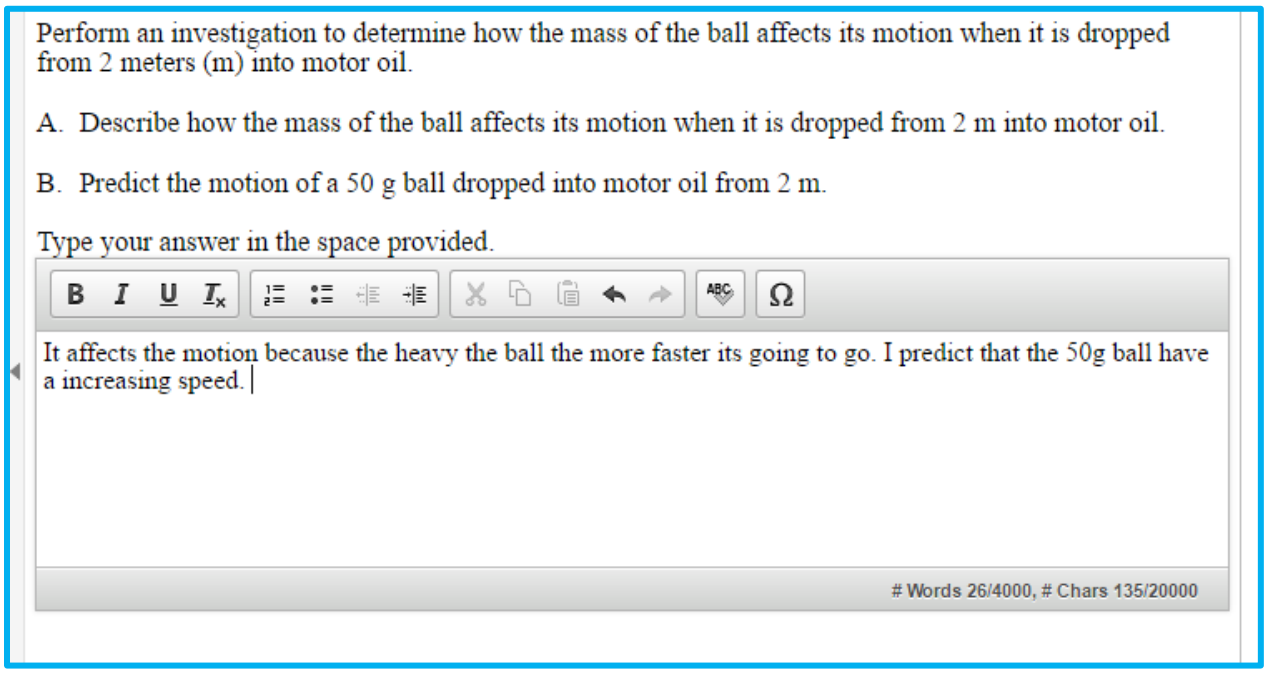
Question 6

Sample Responses

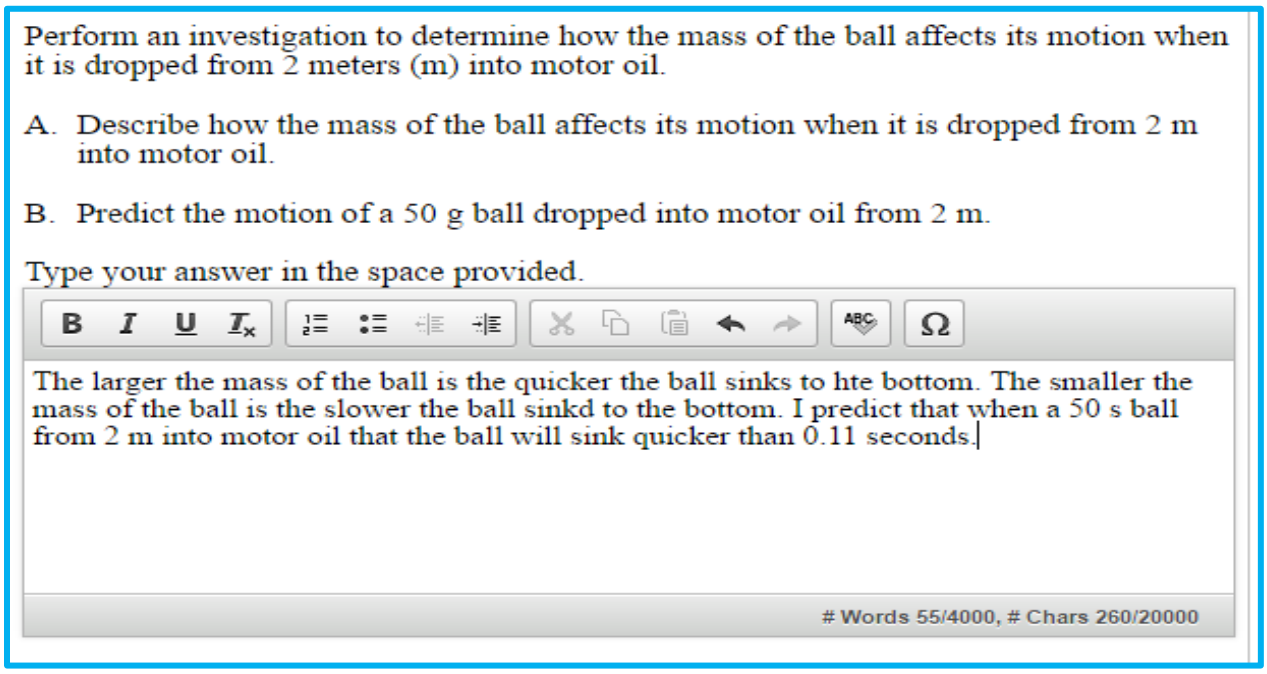
Sample Response: 2 points



Notes on Scoring

This response earns full credit (2 points) because it correctly describes how the mass of the ball affects its motion by stating "the heavy the ball the more faster its going to go." It also predicts that the 50 g ball will "have a increasing speed" as it passes through the motor oil. This is a reasonable prediction based on the simulation results at lower heights.

Sample Response: 2 points


Perform an investigation to determine how the mass of the ball affects its motion when it is dropped from 2 meters (m) into motor oil.

A. Describe how the mass of the ball affects its motion when it is dropped from 2 m into motor oil.

B. Predict the motion of a 50 g ball dropped into motor oil from 2 m.

Type your answer in the space provided.

The larger the mass of the ball is the quicker the ball sinks to hte bottom. The smaller the mass of the ball is the slower the ball sinkd to the bottom. I predict that when a 50 s ball from 2 m into motor oil that the ball will sink quicker than 0.11 seconds.

Words 55/4000, # Chars 260/20000

Notes on Scoring

This response earns full credit (2 points) because it correctly describes, "The larger the mass of the ball is the quicker the ball sinks to hte bottom." It also correctly predicts that the 50 g ball will "sink quicker" "into motor oil" than the 25 g ball.

Sample Response: 2 points

Perform an investigation to determine how the mass of the ball affects its motion when it is dropped from 2 meters (m) into motor oil.

A. Describe how the mass of the ball affects its motion when it is dropped from 2 m into motor oil.

B. Predict the motion of a 50 g ball dropped into motor oil from 2 m.

Type your answer in the space provided.

mass will affect its motion by how much mass it has if its has a lot of mass it will go faster of it has less mass it will fall slower

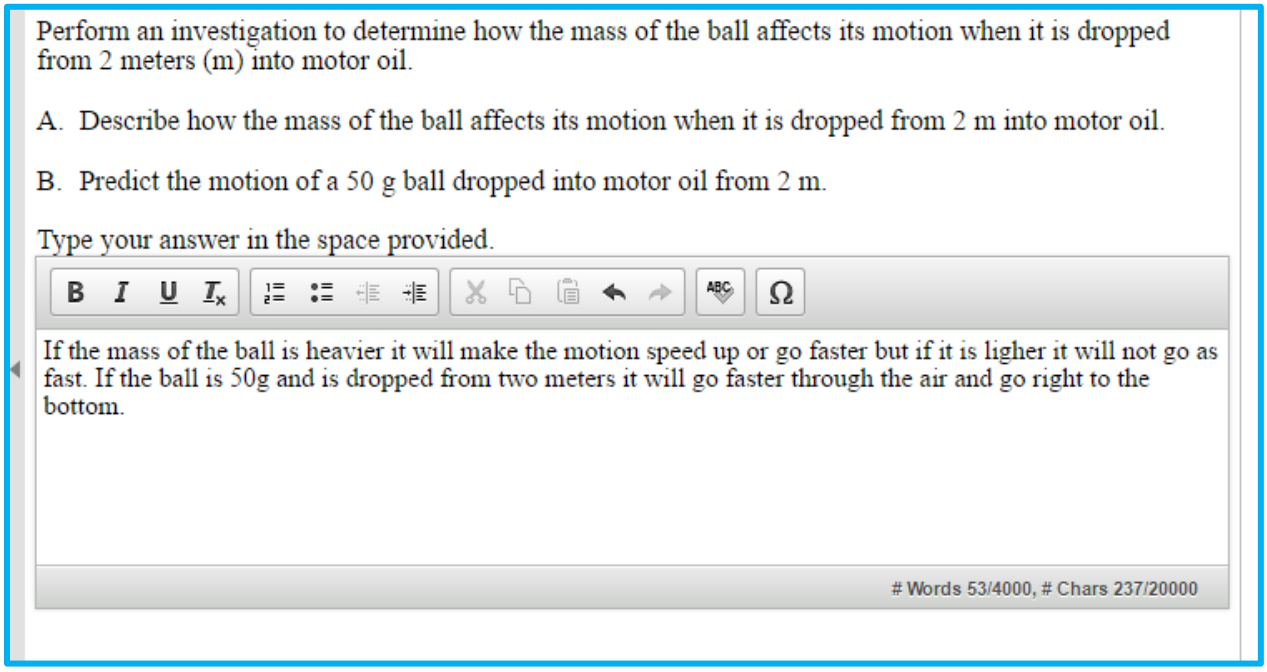
the ball will go stright down and the speed of the ball with decrease a little bit

Words 47/4000, # Chars 217/20000

Notes on Scoring

This response earns full credit (2 points) because it correctly describes how the mass of the ball affects its motion by stating "if its has a lot of mass it will go faster". The response also predicts that the 50 g ball will "decrease a little bit" in speed as it passes through the motor oil. This is a reasonable prediction based on the simulation results for the other balls dropped from 2 m.

Sample Response: 1 point



Notes on Scoring

This response earns partial credit (1 point) because it correctly describes how the mass of the ball affects its motion by stating that if the ball is heavier it will "go faster". However, the response does not earn credit for predicting the motion of a 50 g ball, stating it will "go right to the bottom", which does not describe anything specific about the motion of the 50 g ball.

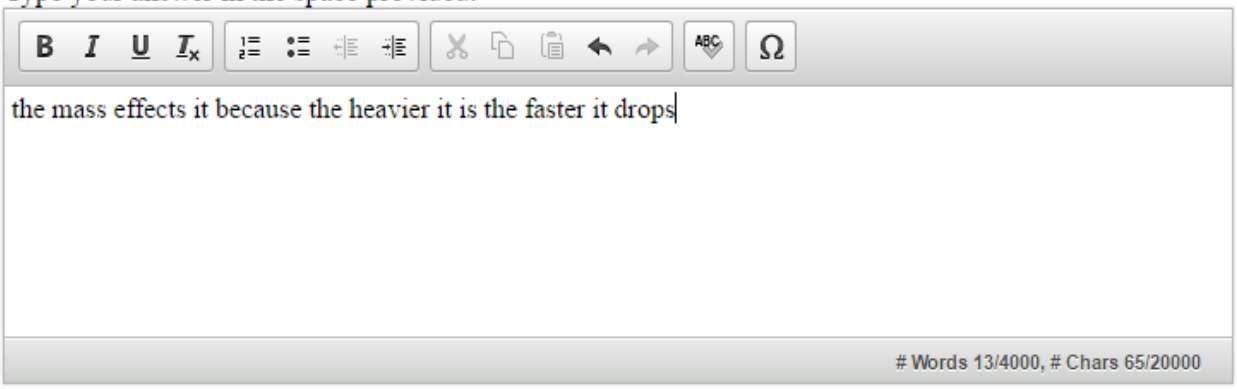
Sample Response: 1 point

Perform an investigation to determine how the mass of the ball affects its motion when it is dropped from 2 meters (m) into motor oil.

A. Describe how the mass of the ball affects its motion when it is dropped from 2 m into motor oil.

B. Predict the motion of a 50 g ball dropped into motor oil from 2 m.

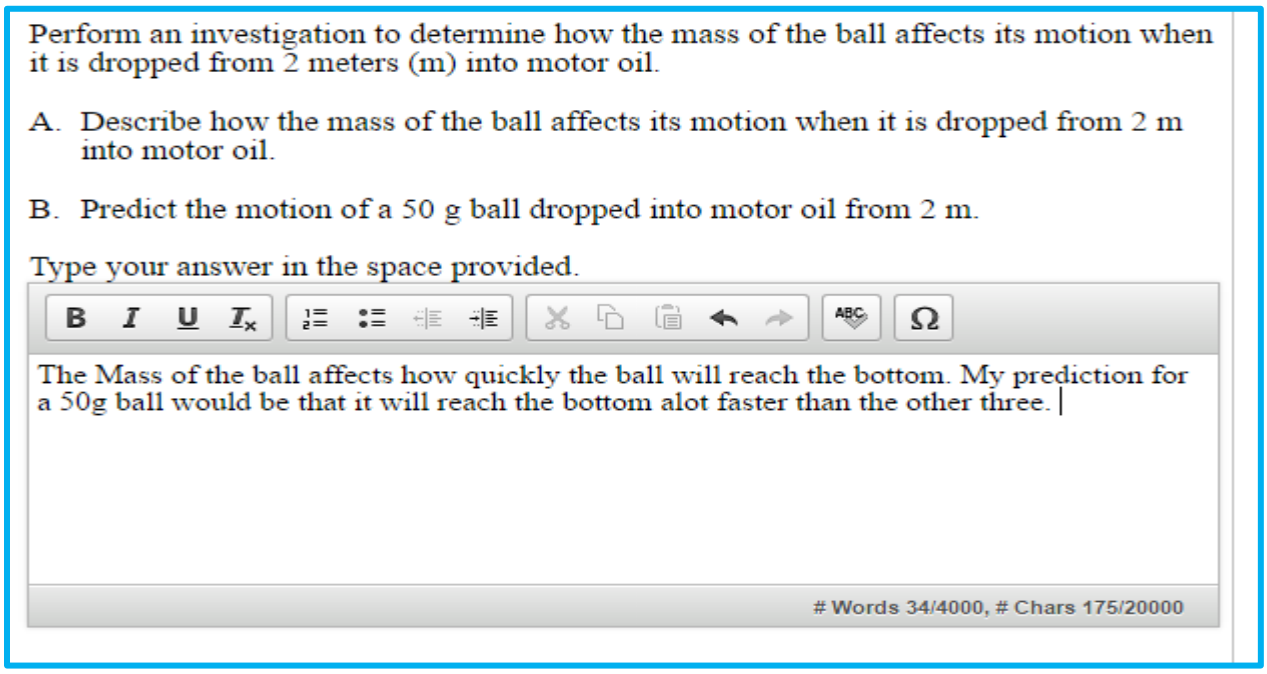
Type your answer in the space provided.



Notes on Scoring

This response earns partial credit (1 point) because it correctly describes how the mass of the ball affects its motion by stating that "the heavier it is the faster it drops". However, the response does not include a prediction about the motion of a 50 g ball.

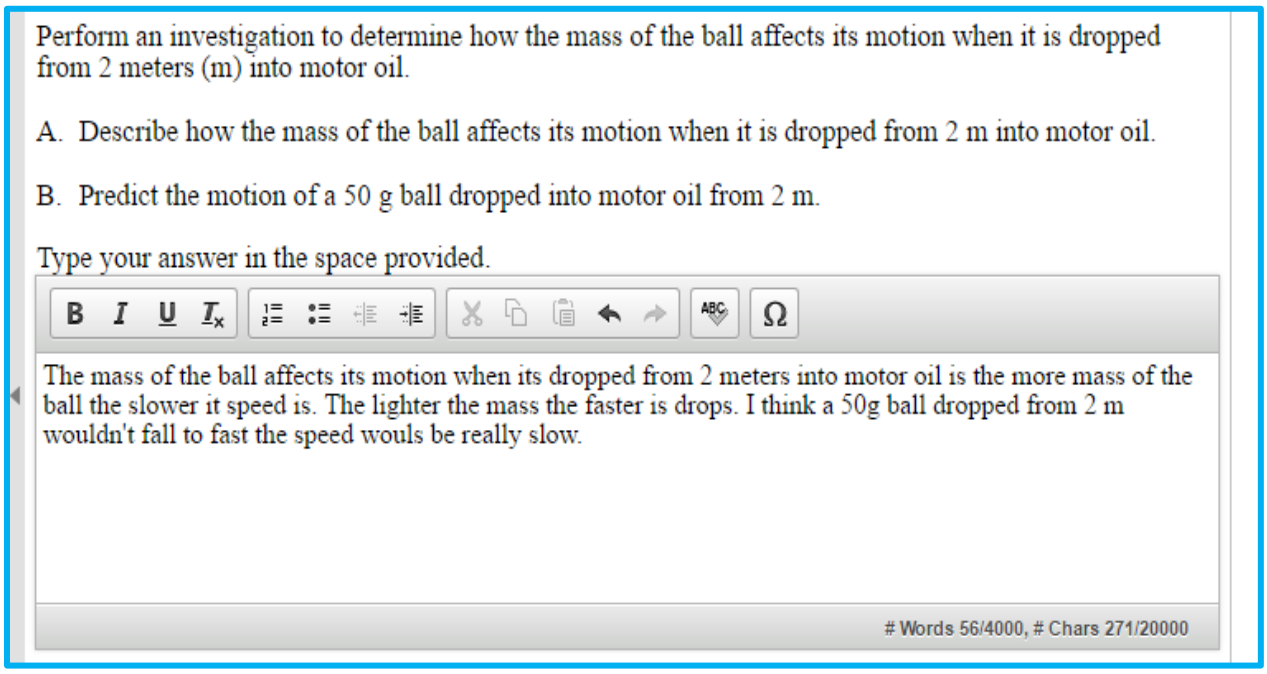
Sample Response: 1 point



Notes on Scoring

This response earns partial credit (1 point) because it predicts that the 50 g ball "will reach the bottom alot faster than the other three". This response recognizes a relationship between mass and time to reach the bottom, but it fails to state the direction of the trend (more mass equals less time to reach the bottom). Although this is implied by the prediction made in the second sentence, it needs to be stated explicitly to earn full credit.

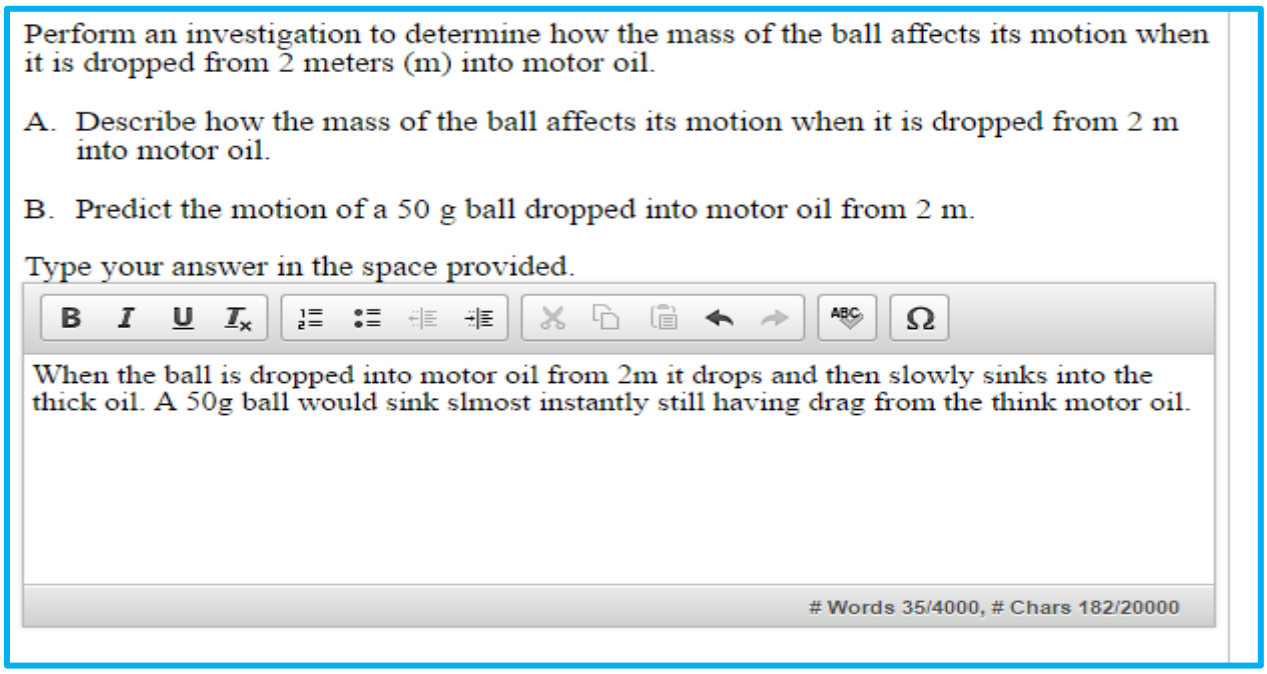
Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because it does not describe how the mass of the ball affects the motion (more mass equals greater speed). This response describes the opposite relationship (more mass equals slower speed). It then uses the incorrect relationship to make an incorrect prediction for the 50 g ball.

Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because it does not describe how the mass of the ball affects the motion (more mass equals greater speed). This response also does not correctly predict the motion of a 50 g ball.

Sample Response: 0 points

Perform an investigation to determine how the mass of the ball affects its motion when it is dropped from 2 meters (m) into motor oil.

A. Describe how the mass of the ball affects its motion when it is dropped from 2 m into motor oil.

B. Predict the motion of a 50 g ball dropped into motor oil from 2 m.

Type your answer in the space provided.

The mass of the ball affects its motion because the lighter the ball, the longer it took to hit/land in the motor oil. If the ball had a large mass then it landed in/hit the motor oil quicker.

I think a 50 g ball would take about 10 seconds to land in the motor oil.

Words 55/4000, # Chars 267/20000

Notes on Scoring

This response earns no credit (0 points) because it does not describe how the mass of the ball affects its motion. It also does not correctly predict the motion of a 50 g ball falling through motor oil. The response misinterprets the task by describing what happens to the balls while they are in the air before hitting the motor oil rather than throughout the entire investigation.

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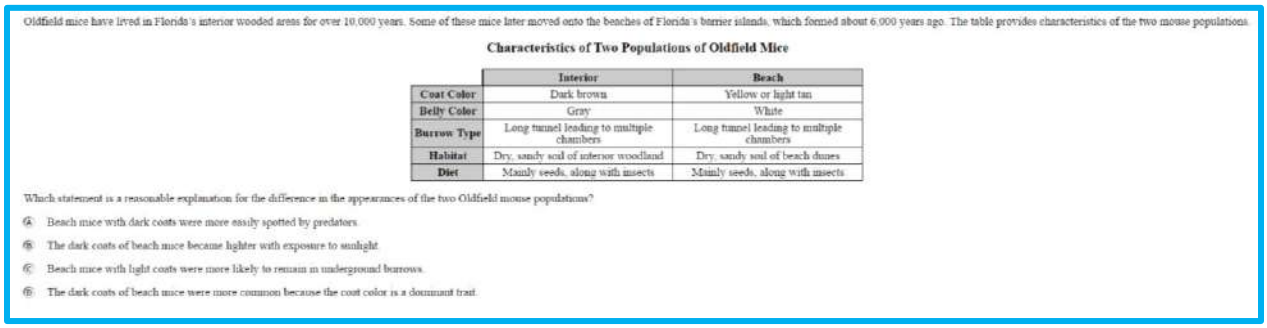
Question 7

Question and Scoring Guidelines

Question 7



Oldfield mice have lived in Florida's interior wooded areas for over 10,000 years. Some of these mice later moved onto the beaches of Florida's barrier islands, which formed about 6,000 years ago. The table provides characteristics of the two mouse populations.

Characteristics of Two Populations of Oldfield Mice

	Interior	Beach
Coat Color	Dark brown	Yellow or light tan
Belly Color	Gray	White
Burrow Type	Long tunnel leading to multiple chambers	Long tunnel leading to multiple chambers
Habitat	Dry, sandy soil of interior woodland	Dry, sandy soil of beach dunes
Diet	Mainly seeds, along with insects	Mainly seeds, along with insects

Which statement is a reasonable explanation for the difference in the appearances of the two Oldfield mouse populations?

Ⓐ Beach mice with dark coats were more easily spotted by predators.

Ⓑ The dark coats of beach mice became lighter with exposure to sunlight.

Ⓒ Beach mice with light coats were more likely to remain in underground burrows.

Ⓓ The dark coats of beach mice were more common because the coat color is a dominant trait.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: **Key** – Oldfield mice lived in the woods of present-day Florida 10,000 years ago. When beaches formed 4,000 years later, some mice moved to the beaches. There, lighter-colored mice were better camouflaged against the sandy background. This trait spread through the populations.

Rationale for Option B: This is incorrect. This is a change to an organism's traits in its lifetime, not a change in traits over multiple generations.

Rationale for Option C: This is incorrect. The differences between the two populations were not due to differences in burrowing behavior.

Rationale for Option D: This is incorrect. Dominance does not make a trait more common or "better."

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

Changes in environmental conditions can affect how beneficial a trait will be for the survival and reproductive success of an organism or an entire species.

Diversity can result from sexual reproduction. The sorting and combination of genes results in different genetic combinations, which allow offspring to be similar to, yet different from, their parents and each other. These variations may allow for survival of individuals when the environment changes.

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 choose a reasonable explanation for the differences in coat color for mice living in two different environments. Having a coat that blends in with the environment decreases the likelihood of being spotted by a predator. Mice who survive long enough to reproduce can pass the trait for this coat color to their offspring. Over time this process provides a method for a population to change in response to environmental conditions.

Sample Response: 1 point

Oldfield mice have lived in Florida's interior wooded areas for over 10,000 years. Some of these mice later moved onto the beaches of Florida's barrier islands, which formed about 6,000 years ago. The table provides characteristics of the two mouse populations.

Characteristics of Two Populations of Oldfield Mice

	Interior	Beach
Coat Color	Dark brown	Yellow or light tan
Belly Color	Gray	White
Burrow Type	Long tunnel leading to multiple chambers	Long tunnel leading to multiple chambers
Habitat	Dry, sandy soil of interior woodland	Dry, sandy soil of beach dunes
Diet	Mainly seeds, along with insects	Mainly seeds, along with insects

Which statement is a reasonable explanation for the difference in the appearances of the two Oldfield mouse populations?

- ● Beach mice with dark coats were more easily spotted by predators.
- Ⓑ The dark coats of beach mice became lighter with exposure to sunlight.
- Ⓒ Beach mice with light coats were more likely to remain in underground burrows.
- Ⓓ The dark coats of beach mice were more common because the coat color is a dominant trait.

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Question 8

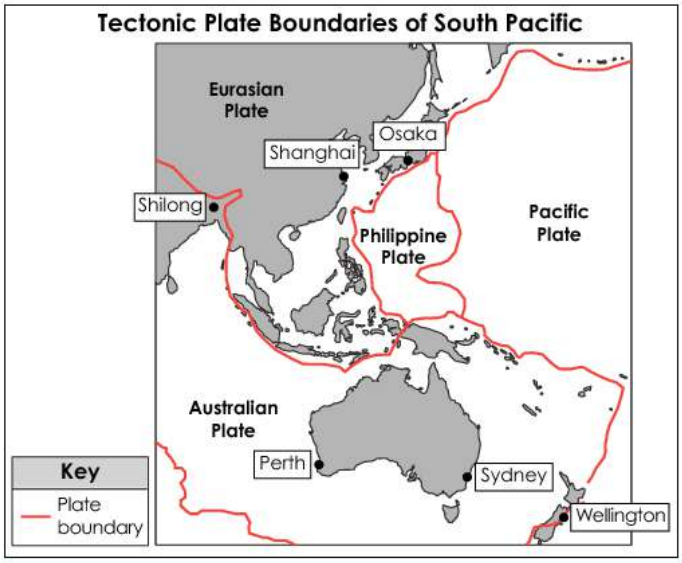
Question and Scoring Guidelines

Question 8

The map shows the boundaries of tectonic plates in the South Pacific. Several cities on the map are labeled.

A company wants to build skyscrapers in all of these cities.

Click on the three cities where earthquake-resistant technology would be most important in building these skyscrapers.



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- Selection of Shilong;
  AND
- Selection of Osaka;
  AND
- Selection of Wellington (1 point).

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

There are three main types of plate boundaries: divergent, convergent and transform. Each type of boundary results in specific motion and causes events (such as earthquakes or volcanic activity) or features (such as mountains or trenches) that are indicative of the type of boundary.

Cognitive Demand

Interpreting and Communicating Science Concepts (C)

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

Explanation of the Item

This item requires the student to select three cities that should use earthquake resistant technology. Cities that are located near plate boundaries are likely to experience earthquakes.

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Question 8

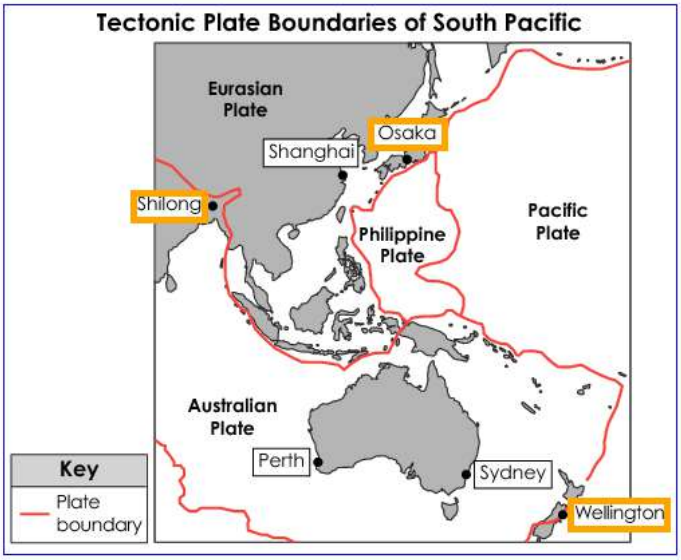
Sample Responses

Sample Response: 1 point

The map shows the boundaries of tectonic plates in the South Pacific. Several cities on the map are labeled.

A company wants to build skyscrapers in all of these cities.

Click on the three cities where earthquake-resistant technology would be most important in building these skyscrapers.



Notes on Scoring

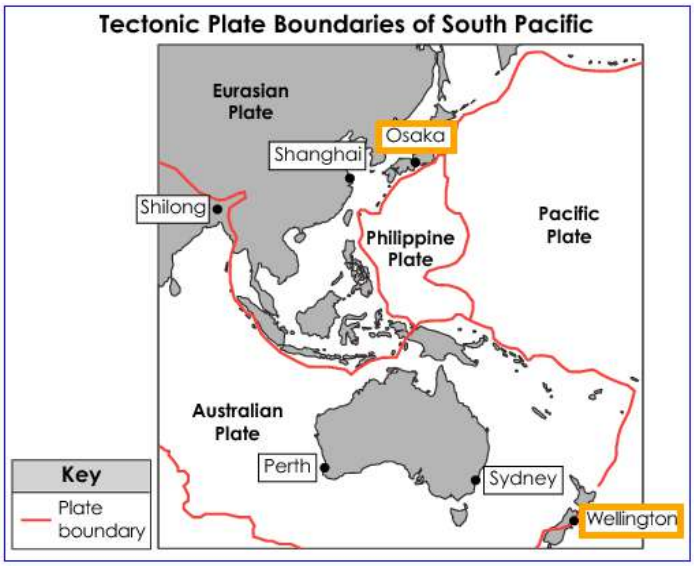
This response earns full credit (1 point) because it correctly identifies three cities that are located along plate boundaries.

Sample Response: 0 points

The map shows the boundaries of tectonic plates in the South Pacific. Several cities on the map are labeled.

A company wants to build skyscrapers in all of these cities.

Click on the three cities where earthquake-resistant technology would be most important in building these skyscrapers.



Notes on Scoring

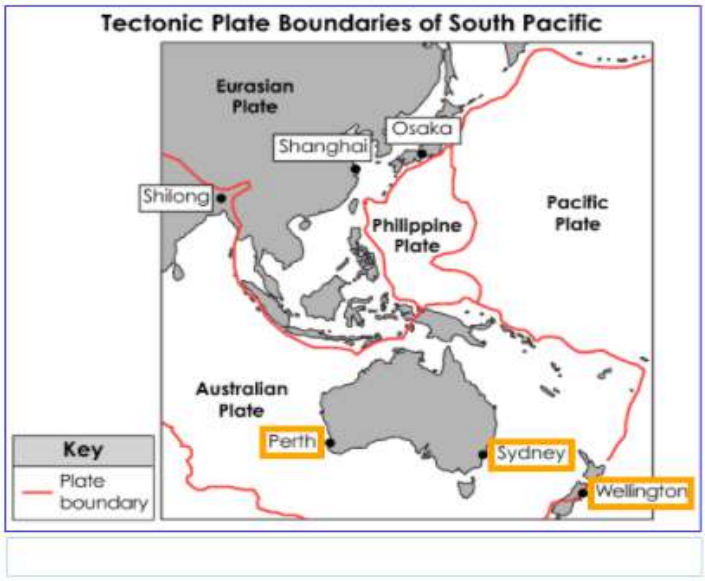
This response earns no credit (0 points) because it correctly identifies two cities that are located along plate boundaries but does not identify a third city.

Sample Response: 0 points

The map shows the boundaries of tectonic plates in the South Pacific. Several cities on the map are labeled.

A company wants to build skyscrapers in all of these cities.

Click on the three cities where earthquake-resistant technology would be most important in building these skyscrapers.



Notes on Scoring

This response earns no credit (0 points) because it correctly identifies only one city that is located along plate boundaries. The response identifies two cities that are not located along plate boundaries.

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Question 9

Question and Scoring Guidelines

Question 9

Which feature does **not** result from seismic activity?

(A) faults

(B) volcanoes

(C) glacial deposits

(D) folded rock layers

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. Rocks near Earth's surface behave in a brittle fashion when acted upon by differential stress and tend to fracture causing faults.

Rationale for Option B: This is incorrect. Andesite volcanoes form at subduction boundaries where tectonic movement creates seismic activity.

Rationale for Option C: **Key** – Glacial deposits are the sediments left behind as a glacier retreats.

Rationale for Option D: This is incorrect. Folded rock layers form when rocks near Earth's surface experience compressional forces as a result of seismic activity due to tectonic movement.

Alignment

Content Strand
Earth and Space Science

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

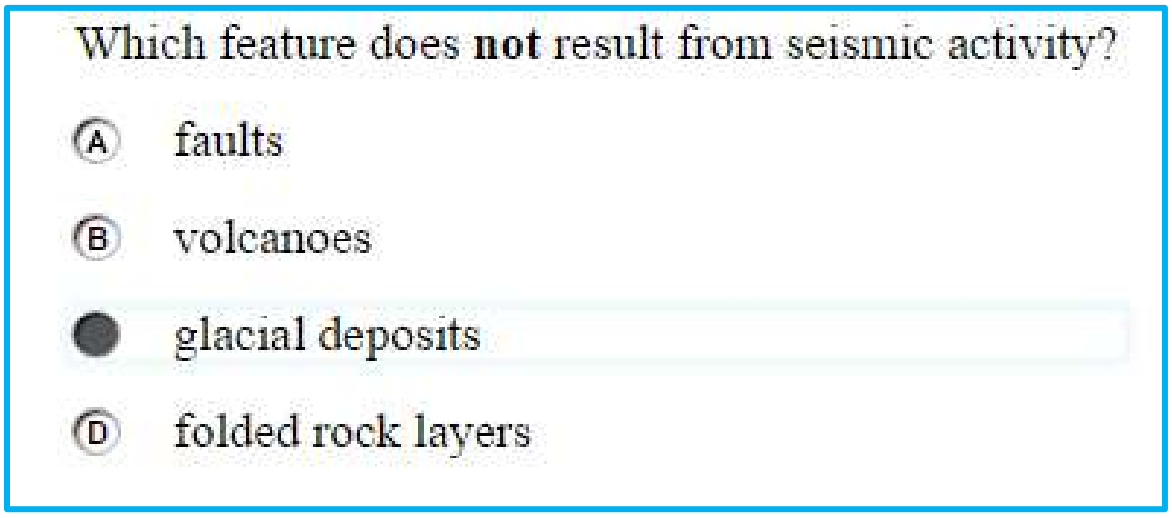
Content Elaboration
Distinguishing between major geologic processes (e.g. tectonic activity, erosion, deposition) and the resulting features on the surface of Earth is the focus of this content statement.

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 tasks. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures (being able to describe how) and basic principles.

Explanation of the Item
This item requires the student to identify a feature that does not result from seismic activity. Glacial deposits occur when glaciers retreat and are not a result of seismic activity.

Sample Response: 1 point



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Science
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Question 10

Question and Scoring Guidelines

Question 10

NASA has recently sent several spacecraft, called rovers, to Mars to explore the planet's surface. One of these rovers has a mass of about 900 kilograms. The mass of Mars is about one-tenth the mass of Earth.

How does the weight of the rover on Mars compare to its weight on Earth?

(A) Its weight is zero on Mars because Mars lacks a gravitational field.

(B) Its weight is lower on Mars because the mass of Mars is smaller than Earth's mass.

(C) Its weight is the same on Mars because its mass remains the same on both planets.

(D) Its weight is higher on Mars because the density of Mars is greater than the density of Earth.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. All masses have gravitational fields, though smaller planets will have weaker fields than larger planets.

Rationale for Option B: **Key** – Weight depends on the force of gravity acting on a mass. A less massive planet, such as Mars, will have a weaker gravitational field than a more massive planet, such as Earth. The same mass will weigh less on Mars than on Earth.

Rationale for Option C: This is incorrect. While the mass of the rover remains the same, weight depends on the force of gravity exerted by a planet, which is a function of the planet's mass.

Rationale for Option D: This is incorrect. Weight depends on the force of gravity exerted by a planet, which is a function of the planet's mass, not density.

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 on 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 item requires the student to compare the weight of a rover on Mars with its weight on Earth. Since the mass of Mars is less than the mass of Earth, the gravitational force between the rover and Mars will be less than the gravitational force between the rover and Earth. Therefore, the rover will weigh less on Mars.

Sample Response: 1 point

NASA has recently sent several spacecraft, called rovers, to Mars to explore the planet's surface. One of these rovers has a mass of about 900 kilograms. The mass of Mars is about one-tenth the mass of Earth.

How does the weight of the rover on Mars compare to its weight on Earth?

Ⓐ Its weight is zero on Mars because Mars lacks a gravitational field.

● Its weight is lower on Mars because the mass of Mars is smaller than Earth's mass.

Ⓒ Its weight is the same on Mars because its mass remains the same on both planets.

Ⓓ Its weight is higher on Mars because the density of Mars is greater than the density of Earth.

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Science
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Question 11

Question and Scoring Guidelines

Question 11

Which statement about seismic waves is accurate?

(A) Seismic waves only relate to earthquakes.

(B) Seismic waves have uniform motion within Earth's layers.

(C) Seismic waves change speed when density changes in Earth's layers.

(D) Seismic waves determine differences in temperature in Earth's layers.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. This is a misconception; seismic waves do not relate only to earthquakes.

Rationale for Option B: This is incorrect. The motion of seismic waves changes as the layers of Earth change in composition.

Rationale for Option C: **Key** – Seismic wave speed increases with density.

Rationale for Option D: This is incorrect. Temperature can affect the speed of seismic waves since changes in temperature cause changes in density. However, seismic wave behavior does not distinguish temperature differences from other factors affecting density.

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.

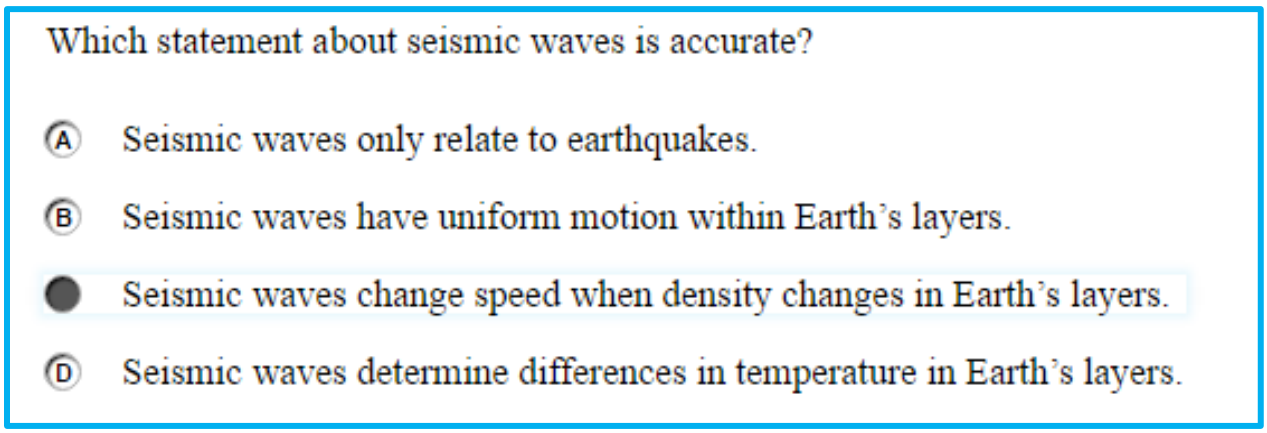
Content Elaboration
The refraction and reflection of seismic waves as they move through one type of material to another are used to differentiate the layers of Earth's interior. Actual data from the refraction and reflection of seismic waves can be used to demonstrate how scientists have determined the different layers of Earth's interior.

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 recall information about the behavior of seismic waves. Seismic waves are waves of energy produced by a variety of events, such as landslides, volcanic eruptions, large explosions and earthquakes. These waves travel through the interior of Earth at various speeds depending on the density of the materials through which they travel.

Sample Response: 1 point



Grade 8
Science
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Question 12

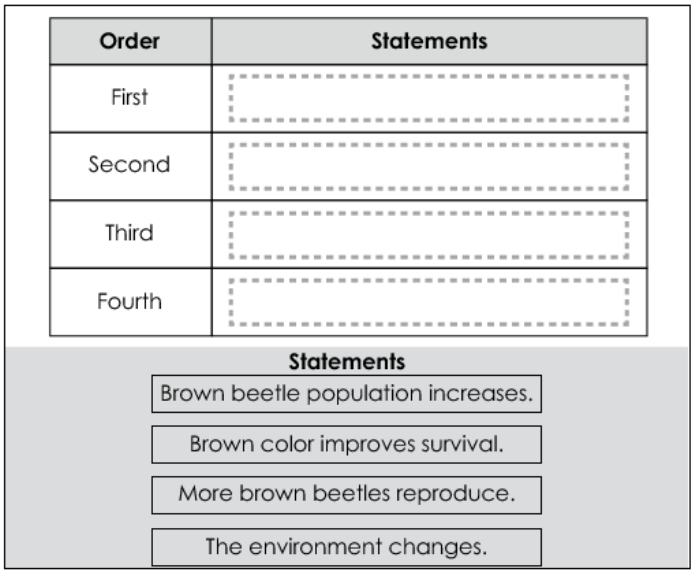
Question and Scoring Guidelines

Question 12

A population of beetles has both green and brown individuals. Initially, the beetle population contained mostly green individuals, but then the population changed so that most of the population was brown.

Move the statements into the blank boxes to sequence the changes in the order in which they must have occurred to result in this change in the beetle population.

- Move only **one** statement into each blank box.



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "The environment changes." in the First box, "Brown color improves survival." in the Second box, "More brown beetles reproduce." in the Third box AND "Brown beetle population increases." in the Fourth box (1 point).

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

Changes in environmental conditions can affect how beneficial a trait will be for the survival and reproductive success of an organism or an entire species.

Diversity can result from sexual reproduction. The sorting and combination of genes results in different genetic combinations, which allow offspring to be similar to, yet different from, their parents and each other. 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 the student to sequence a list of events to explain how the prevalence of beetle colors changes over time in response to an environmental change. When the likelihood of survival increases if the beetle is brown, more brown individuals will survive long enough to reproduce. Over time this trend can increase the percentage of the population exhibiting the brown trait.

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Question 12

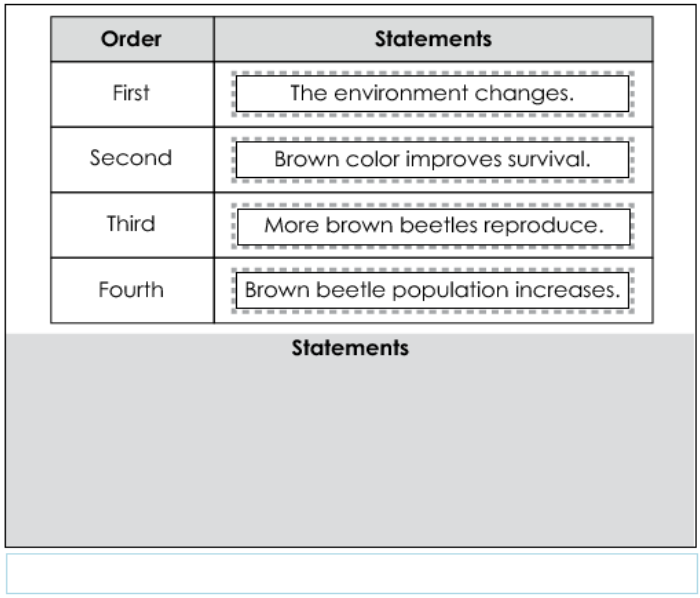
Sample Responses

Sample Response: 1 point

A population of beetles has both green and brown individuals. Initially, the beetle population contained mostly green individuals, but then the population changed so that most of the population was brown.

Move the statements into the blank boxes to sequence the changes in the order in which they must have occurred to result in this change in the beetle population.

- Move only **one** statement into each blank box.



Notes on Scoring

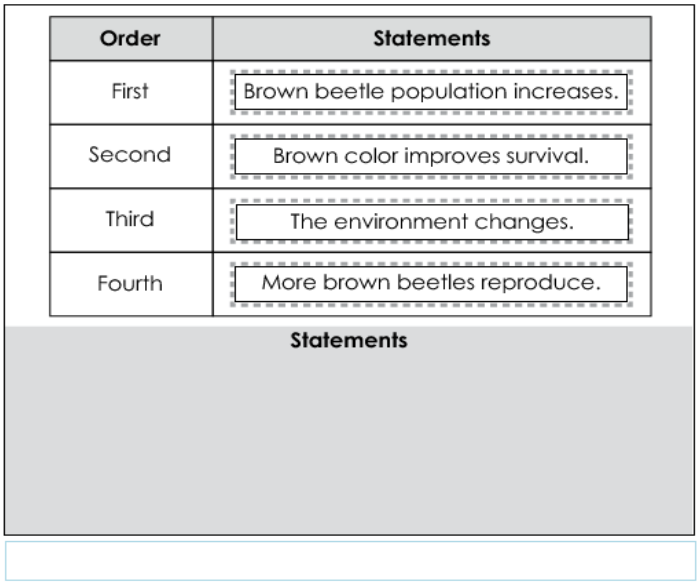
This response earns full credit (1 point) because the events leading to an increase in the brown beetle population resulting from an environmental change are in the correct sequence.

Sample Response: 0 points

A population of beetles has both green and brown individuals. Initially, the beetle population contained mostly green individuals, but then the population changed so that most of the population was brown.

Move the statements into the blank boxes to sequence the changes in the order in which they must have occurred to result in this change in the beetle population.

- Move only **one** statement into each blank box.



Notes on Scoring

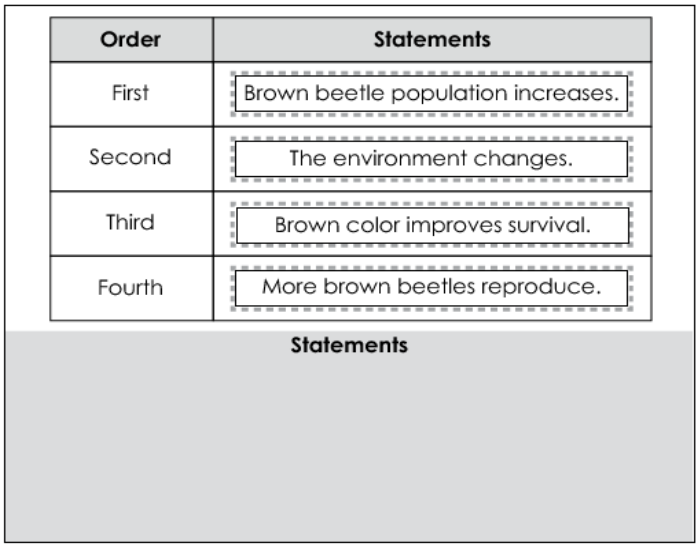
This response earns no credit (0 points) because the events leading to an increase in the brown beetle population are not in the correct sequence. Brown color improving the chance for survival is a response to a change in the environment and would not occur prior to the environment changing.

Sample Response: 0 points

A population of beetles has both green and brown individuals. Initially, the beetle population contained mostly green individuals, but then the population changed so that most of the population was brown.

Move the statements into the blank boxes to sequence the changes in the order in which they must have occurred to result in this change in the beetle population.

- Move only **one** statement into each blank box.



Notes on Scoring

This response earns no credit (0 points) because the events leading to an increase in the brown beetle population are not in the correct sequence. The brown beetle population increase would occur as a result of the other events and should appear last on the list rather than first.

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Science
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Question 13

Question and Scoring Guidelines

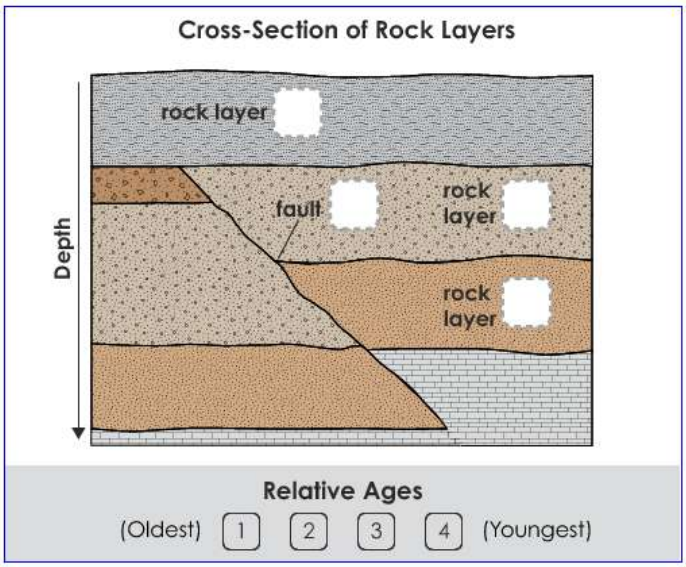
Question 13

The diagram represents a cross-section of some rock layers. A fault is present in these rock layers.

Determine the relative ages of the rock layers and the fault. The number 1 represents the oldest feature and the number 4 represents the youngest feature.

Move each number into a blank box to correctly identify the relative ages of the rock layers and the fault line.

- Move only **one** number into each blank box.



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- The top rock layer is numbered "4", the fault is numbered "3", the middle rock layer is numbered "2" AND the bottom tan rock layer is numbered "1" (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

There are different methods to determine relative and absolute ages of some rock layers in the geologic record. Within a sequence of undisturbed sedimentary rocks, the oldest rocks are at the bottom (superposition). 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 student to use knowledge of the relative age of rocks to sequence layers in a cross-section. The oldest rocks are located on the bottom and the youngest layers are located at the top in an undisturbed cross-section. Faults cut through rock layers that exist at the time the fault occurs. A rock layer with no faults running through it that is at the top of a cross-section is the youngest layer present.

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Science
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Question 13

Sample Responses

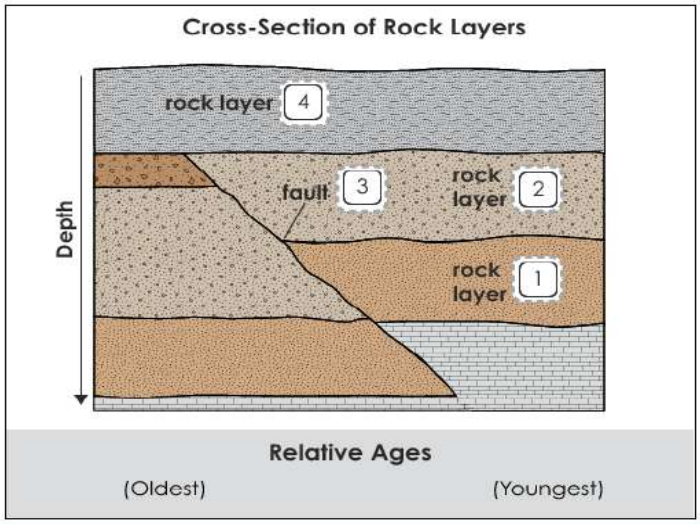
Sample Response: 1 point

The diagram represents a cross-section of some rock layers. A fault is present in these rock layers.

Determine the relative ages of the rock layers and the fault. The number 1 represents the oldest feature and the number 4 represents the youngest feature.

Move each number into a blank box to correctly identify the relative ages of the rock layers and the fault line.

- Move only **one** number into each blank box.



Notes on Scoring

This response earns full credit (1 point) because the layers in the cross-section have been correctly labeled in order of their relative ages.

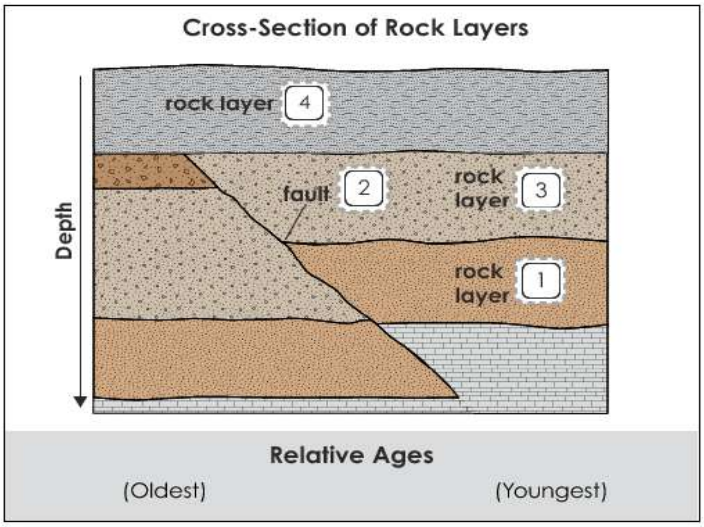
Sample Response: 0 points

The diagram represents a cross-section of some rock layers. A fault is present in these rock layers.

Determine the relative ages of the rock layers and the fault. The number 1 represents the oldest feature and the number 4 represents the youngest feature.

Move each number into a blank box to correctly identify the relative ages of the rock layers and the fault line.

- Move only **one** number into each blank box.



Notes on Scoring

This response earns no credit (0 points) because the layers in the cross-section have not been correctly labeled in order of their relative ages. The fault crosses all the layers except the top layer. The fault should be labeled "3" to show that only the top layer formed after the fault occurred.

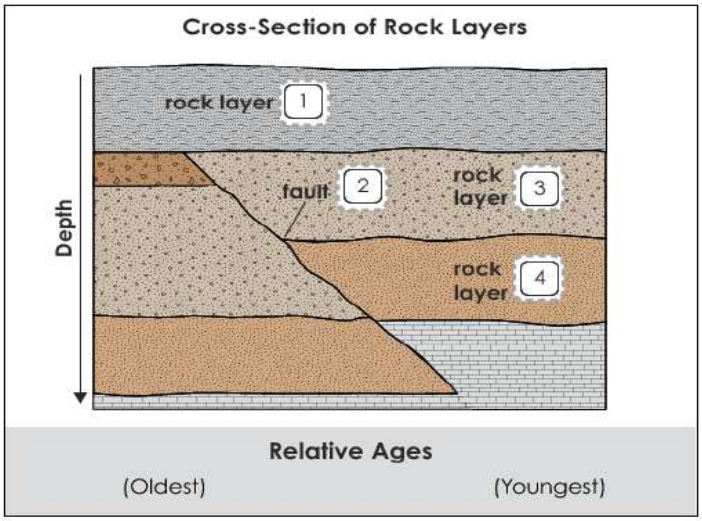
Sample Response: 0 points

The diagram represents a cross-section of some rock layers. A fault is present in these rock layers.

Determine the relative ages of the rock layers and the fault. The number 1 represents the oldest feature and the number 4 represents the youngest feature.

Move each number into a blank box to correctly identify the relative ages of the rock layers and the fault line.

- Move only **one** number into each blank box.



Notes on Scoring

This response earns no credit (0 points) because the layers in the cross-section have been labeled in the reverse order of their relative ages.

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Question 14

Question and Scoring Guidelines

Question 14

Aphids are small insects that feed on plants and can reproduce sexually and asexually.

Which statement describes an advantage of asexual reproduction of aphids?

(A) Offspring are more rapidly produced.

(B) Diversity is increased in the population.

(C) Offspring are genetically different from the parent.

(D) Genetic information is passed from both parents to offspring.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: **Key** – Asexual reproduction is generally a faster form of reproduction.

Rationale for Option B: This is incorrect. This is an advantage of sexual reproduction.

Rationale for Option C: This is incorrect. This is an advantage of sexual reproduction.

Rationale for Option D: This is incorrect. This is an advantage of sexual reproduction.

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. In sexual reproduction, a single specialized cell from a female (egg) merges with a specialized cell from a male (sperm). Typically, half of the genes come from each parent. The fertilized cell, carrying genetic information from each parent, multiplies to form the complete organism. The same genetic information is copied in each cell of the new organism. In sexual reproduction, new combinations of traits are produced which may increase or decrease an organism's chances for survival.

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 recall information about the advantages of asexual reproduction. Asexual reproduction produces offspring that are genetically identical to the single parent, thereby limiting diversity among the population. It often occurs more rapidly than sexual reproduction.

Sample Response: 1 point

Aphids are small insects that feed on plants and can reproduce sexually and asexually.

Which statement describes an advantage of asexual reproduction of aphids?

- ● Offspring are more rapidly produced.
- Ⓑ Diversity is increased in the population.
- Ⓒ Offspring are genetically different from the parent.
- Ⓓ Genetic information is passed from both parents to offspring.

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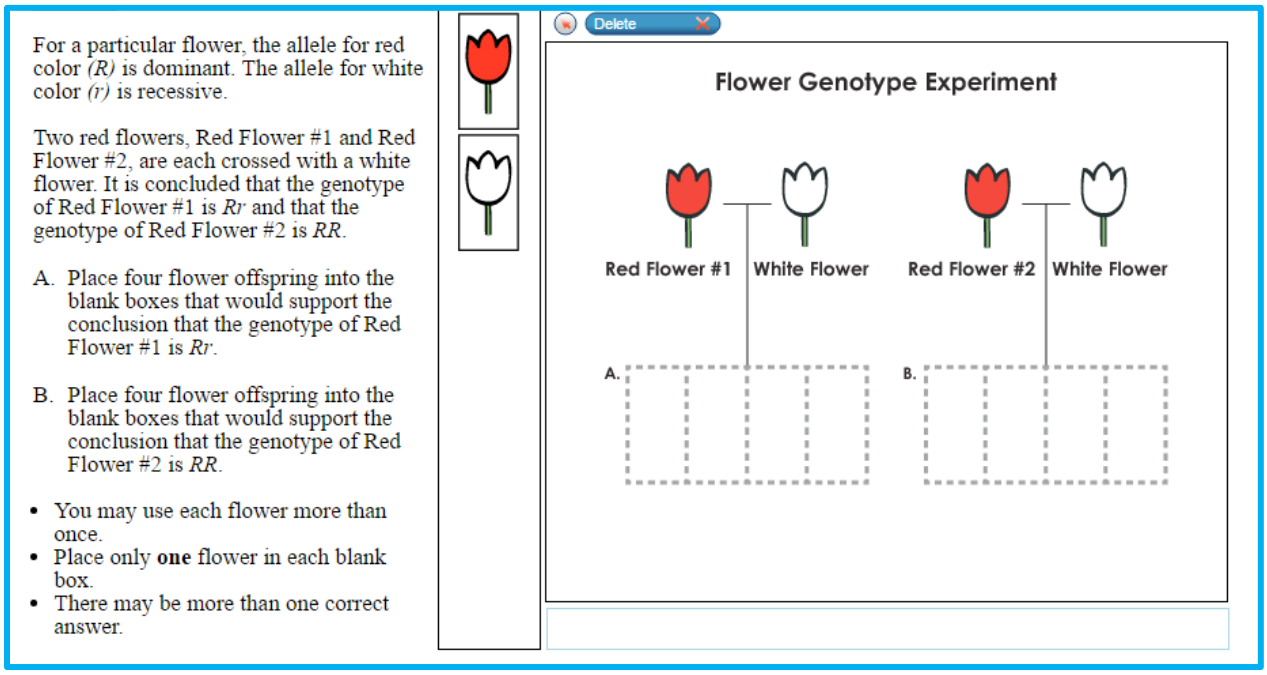
Question 15

Question and Scoring Guidelines

Question 15



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- Four flowers in the left-hand box, at least one of which is white;
  AND
- Four red flowers in the right-hand box (1 point).

Alignment

Content Strand

Life Science

Content Statement

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

Content Elaboration

During reproduction, genetic information (DNA) is transmitted between parent and offspring. In sexual reproduction, both parents contribute DNA to the offspring. Genes have different forms called alleles. The concepts of dominant and recessive genes are appropriate at this grade level.

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 students to select offspring exhibiting phenotypic traits that support conclusions about the genotypes of the parents during an example of sexual reproduction in flowers. Rr x rr will result in offspring that can be red (Rr) or white (rr). RR x rr will result in offspring that can be only red (Rr).

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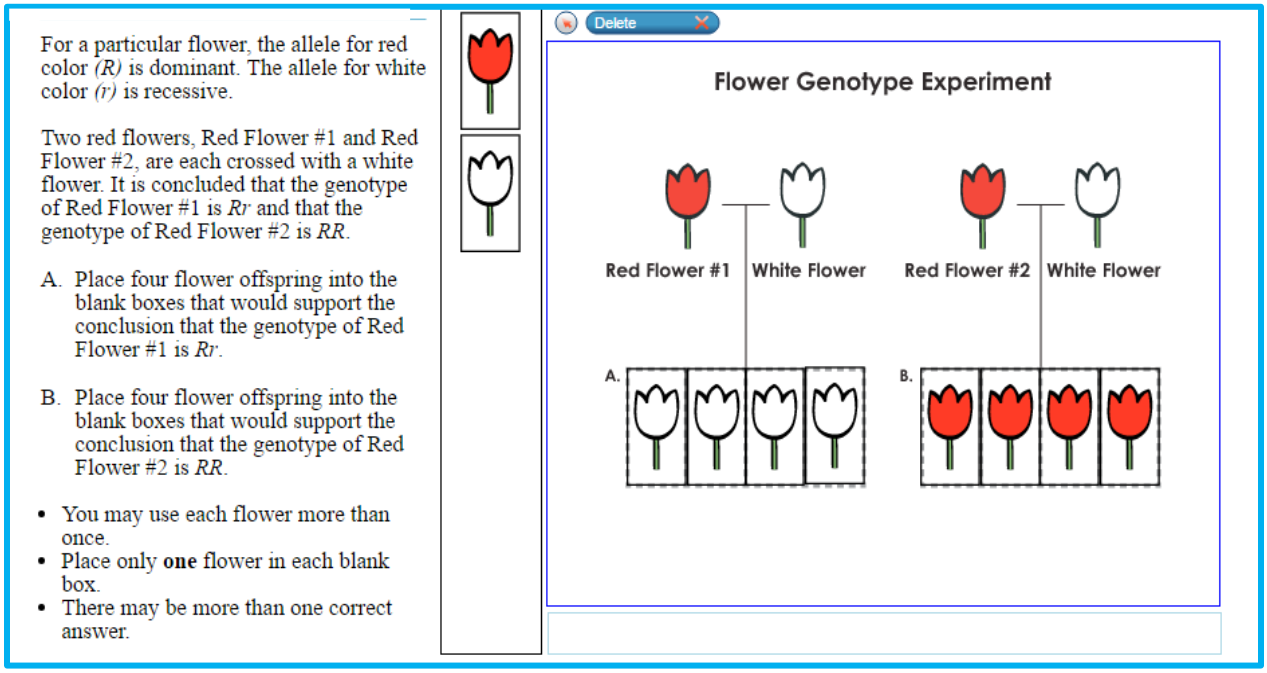
Question 15

Sample Responses

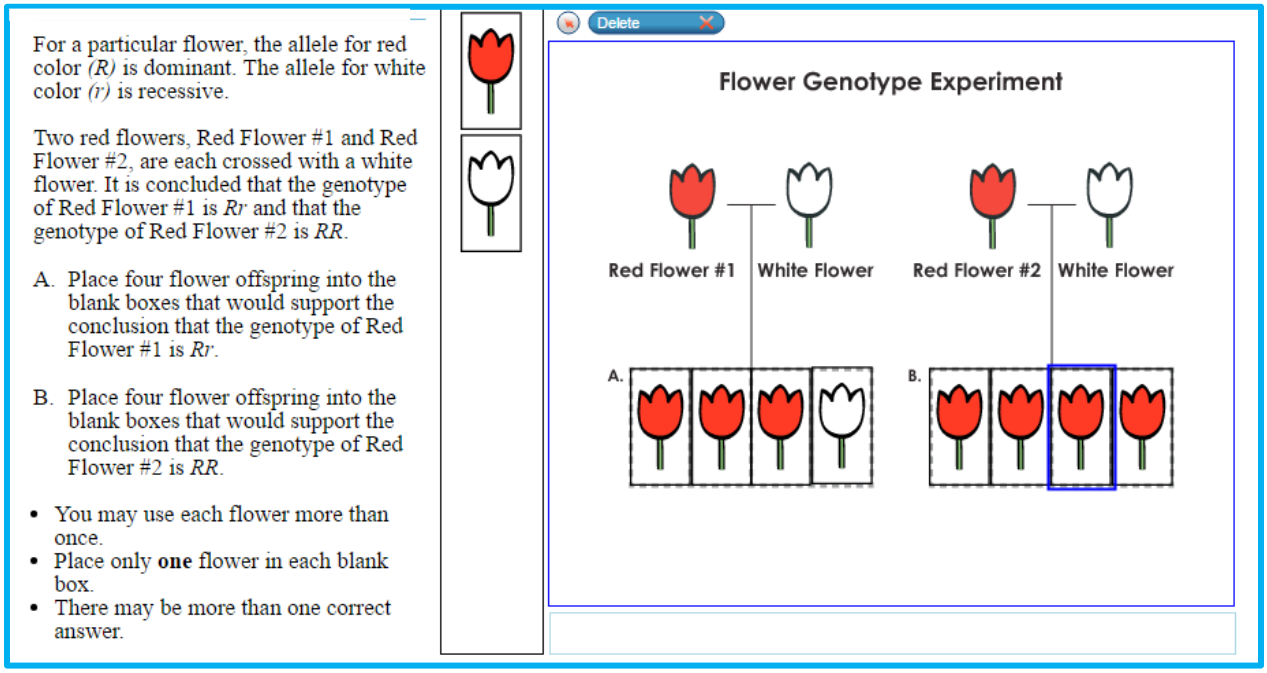
Sample Response: 1 point



Notes on Scoring

This response earns full credit (1 point) because it shows two sets of offspring that support the conclusions about the genotypes of the parents. The offspring of Red Flower #1 and a white flower could be either red or white (Rr or rr). The only way Red Flower #1 can produce a white offspring is to be Rr. The offspring of Red Flower #2 and a white flower can be red (Rr) only.

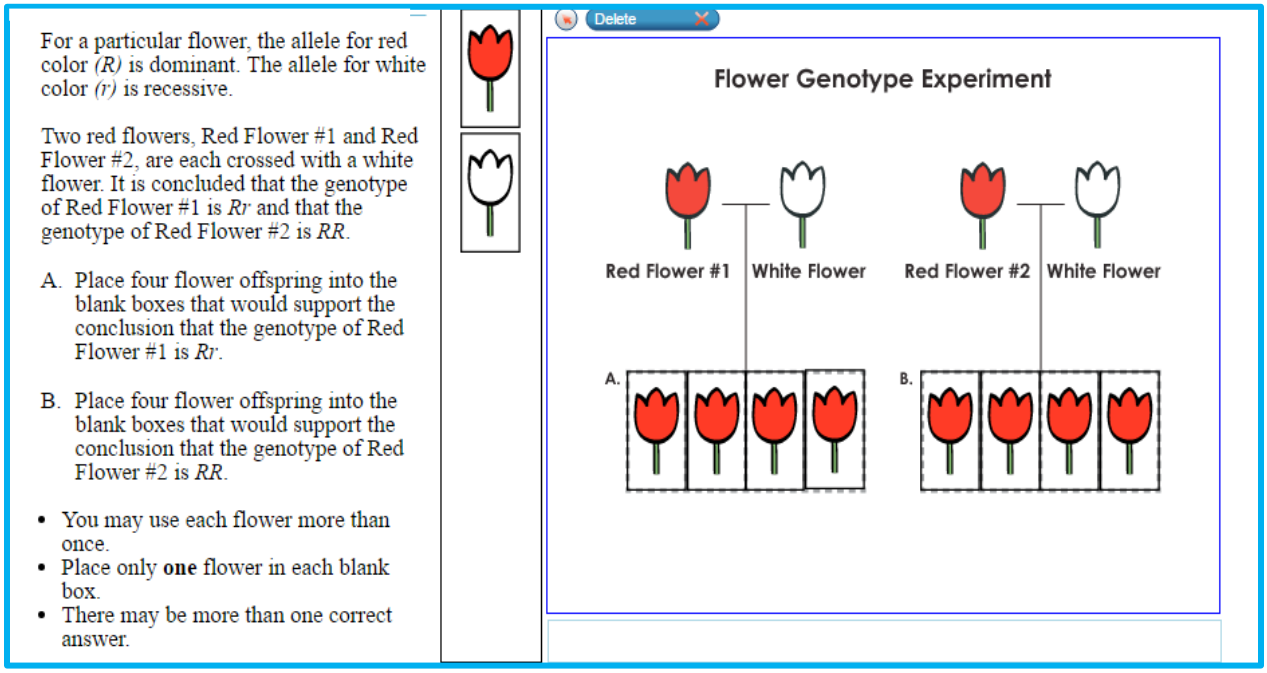
Sample Response: 1 point



Notes on Scoring

This response earns full credit (1 point) because it shows two sets of offspring that support the conclusions about the genotypes of the parents. The offspring of Red Flower #1 and a white flower could be either red or white (Rr or rr). The offspring of Red Flower #2 and a white flower can be red (Rr) only.

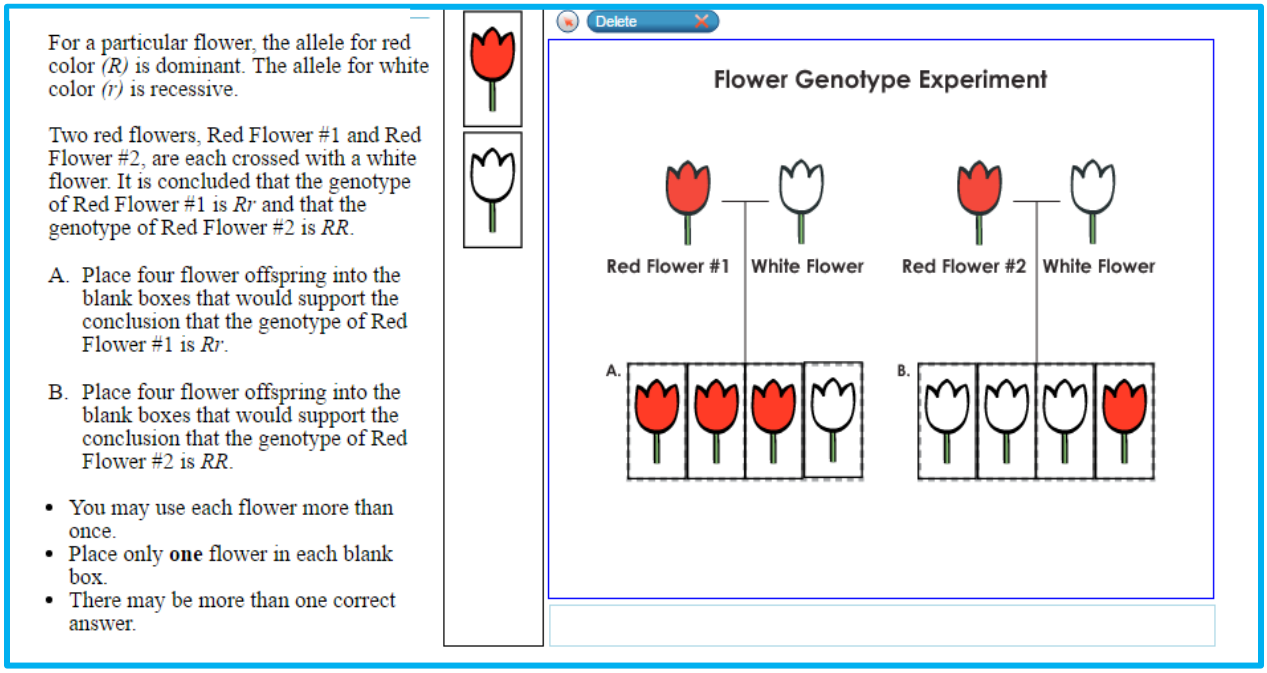
Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because it does not show two sets of offspring that support the conclusions about the genotypes of the parents. Although it shows two sets of offspring that are possible for the suggested parental phenotypes, only the offspring for Red Flower #2 support the conclusion about the genotypes of the parents. The offspring of Red Flower #1(Rr) and a white flower could be either red or white. This response shows four red offspring, which gives no indication of the recessive allele r, which is present in Red Flower #1.

Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because it does not show two sets of offspring that support the conclusions about the genotypes of the parents. The offspring for Red Flower #2 and a white flower can be red (Rr) only.

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Question 16

Question and Scoring Guidelines

Question 16

Some plants can reproduce by sprouting new plants from their roots.

Which statement describes a disadvantage of this type of reproduction?

(A) The new plants lack genetic variety.

(B) Each new plant can reproduce only once.

(C) The new plants are poorly adapted to the environment.

(D) Each new plant develops different characteristics quickly.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: **Key** – In asexual reproduction, all inherited traits come from one parent. This eliminates the possibility of new combinations of traits, resulting in a lack of genetic variety.

Rationale for Option B: This is incorrect. The new plants would also be able to create multiple new plants from their existing roots.

Rationale for Option C: This is incorrect. New plants would be as well-adapted to their environment as the parent plants.

Rationale for Option D: This is incorrect. The plants would have the same characteristics as the parent plants.

Alignment

Content Strand
Life Science

Content Statement
Reproduction is necessary for the continuation of every species.

Content Elaboration
In asexual reproduction, all genes come from a single parent, which usually means the offspring are genetically identical to their parent, allowing genetic continuity.

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 select a disadvantage of asexual reproduction. During asexual reproduction, all of the genetic material passing to the offspring originates from one parent, making the offspring genetically identical to the parent. This produces offspring that lack genetic variety.

Sample Response: 1 point

Some plants can reproduce by sprouting new plants from their roots.

Which statement describes a disadvantage of this type of reproduction?

- ● The new plants lack genetic variety.
- Ⓑ Each new plant can reproduce only once.
- Ⓒ The new plants are poorly adapted to the environment.
- Ⓓ Each new plant develops different characteristics quickly.

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Science
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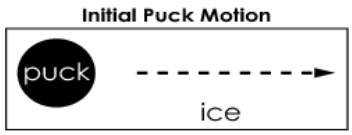
Question 17

Question and Scoring Guidelines

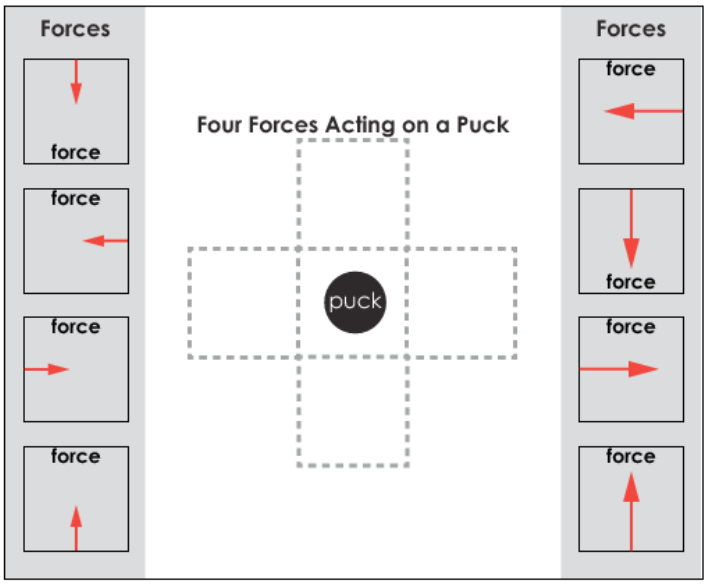
Question 17

A hockey puck is moving across ice as indicated by the arrow.



Move four forces around the puck so that it speeds up along its direction of motion.

- Place only **one** force in a box.
- You do **not** need to use all the forces.
- The length of the arrows represents the relative strength of the forces.
- There may be more than one correct answer.



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- One upward-pointing arrow in the box above/below the puck AND one downward-pointing arrow of the same length in the box below/above the puck;

  AND

- One rightward-pointing arrow in the box to the left of the puck AND one rightward-pointing arrow to the right of the puck (1 point);

  OR

- One long rightward-pointing arrow in the box to the left/right of the puck AND one short leftward-pointing arrow in the box to the right/left of the puck (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. When the net force is greater than zero, the object's speed and/or direction will change. 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.

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 place arrows on a force diagram to show a combination of four forces that will speed up a moving object. A net force in the direction of motion will speed up a moving object. Forces that are perpendicular to the direction of motion must be balanced in order for an object to continue moving in its current direction.

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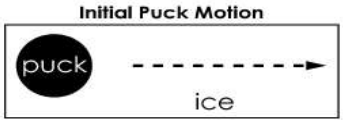
Question 17

Sample Responses

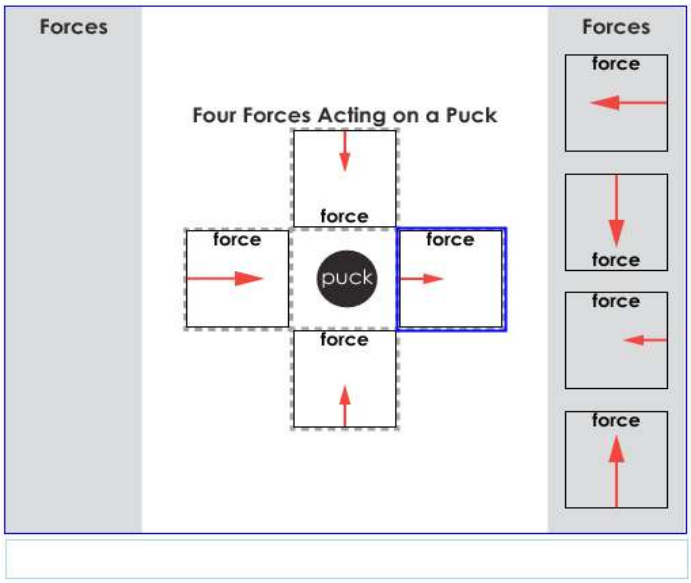
Sample Response: 1 point

A hockey puck is moving across ice as indicated by the arrow.



Move four forces around the puck so that it speeds up along its direction of motion.

- Place only **one** force in a box.
- You do **not** need to use all the forces.
- The length of the arrows represents the relative strength of the forces.
- There may be more than one correct answer.

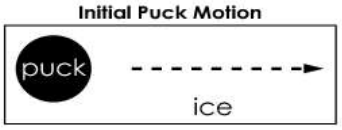


Notes on Scoring

This response earns full credit (1 point) because it shows four forces acting on a hockey puck that will cause the puck to speed up while continuing to travel in its current direction. There is a net force in the direction of motion.

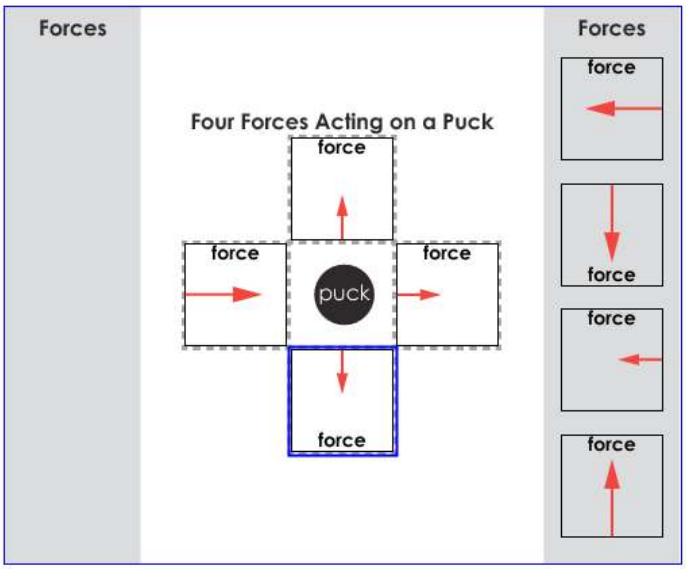
Sample Response: 1 point

A hockey puck is moving across ice as indicated by the arrow.



Move four forces around the puck so that it speeds up along its direction of motion.

- Place only **one** force in a box.
- You do **not** need to use all the forces.
- The length of the arrows represents the relative strength of the forces.
- There may be more than one correct answer.

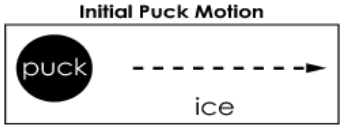


Notes on Scoring

This response earns full credit (1 point) because it shows four forces acting on a hockey puck that will cause the puck to speed up while continuing to travel in its current direction. There is a net force in the direction of motion.

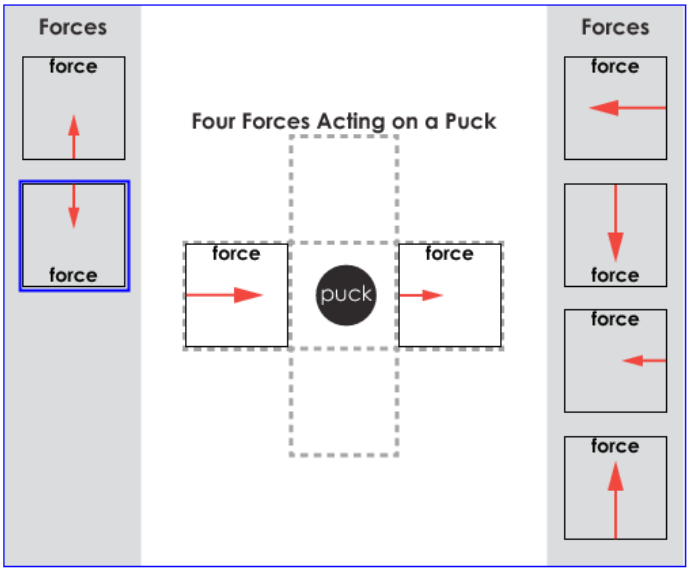
Sample Response: 0 points

A hockey puck is moving across ice as indicated by the arrow.



Move four forces around the puck so that it speeds up along its direction of motion.

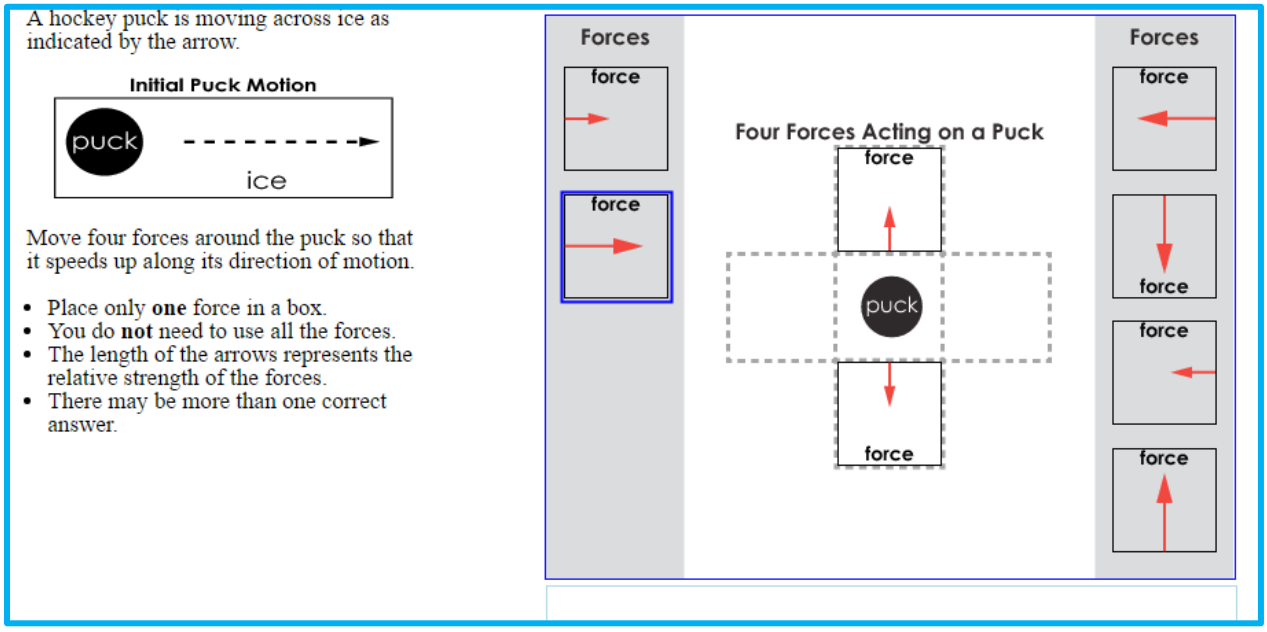
- Place only **one** force in a box.
- You do **not** need to use all the forces.
- The length of the arrows represents the relative strength of the forces.
- There may be more than one correct answer.



Notes on Scoring

This response earns no credit (0 points) because although it shows forces acting on a hockey puck that will cause the puck to speed up while continuing to travel in its current direction, it does not show four forces on the puck.

Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because it does not show four forces acting on a hockey puck that will cause the puck to speed up while continuing to travel in its current direction. With the forces shown, the puck will continue moving at a constant speed.

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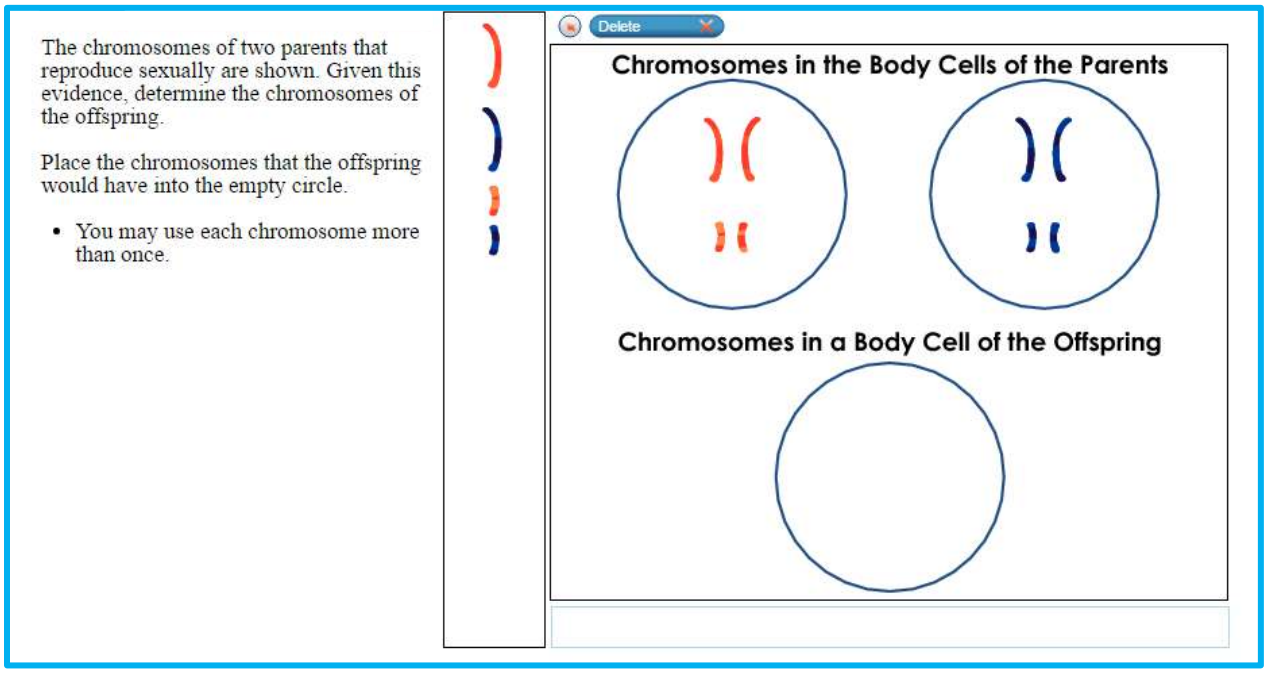
Question 18

Question and Scoring Guidelines

Question 18



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- One long and one short orange-red chromosome and one long and one short blue-purple chromosome are placed in the empty circle (1 point).

Alignment

Content Strand
Life Science

Content Statement
Reproduction is necessary for the continuation of every species.

Content Elaboration
Reproduction is the transfer of genetic information from one generation to the next. It can occur with mixing of genes from two individuals (sexual reproduction).

The end products of mitotic and meiotic cell divisions are compared as they relate to asexual and sexual reproduction. It is important that both mitosis and meiosis are addressed. In sexual reproduction, a single specialized cell from a female (egg) merges with a specialized cell from a male (sperm). Typically, half of the genes come from each parent.

Cognitive Demand
Recalling Accurate Science (R)

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

Explanation of the Item
This item requires the student to predict chromosomes in a body cell of an offspring given the chromosomes in body cells of the two parents involved in sexual reproduction. During sexual reproduction, cells undergo meiosis to produce specialized cells in the male and the female. These cells then unite to form a fertilized cell. One-half of the genetic information in this fertilized cell comes from each parent.

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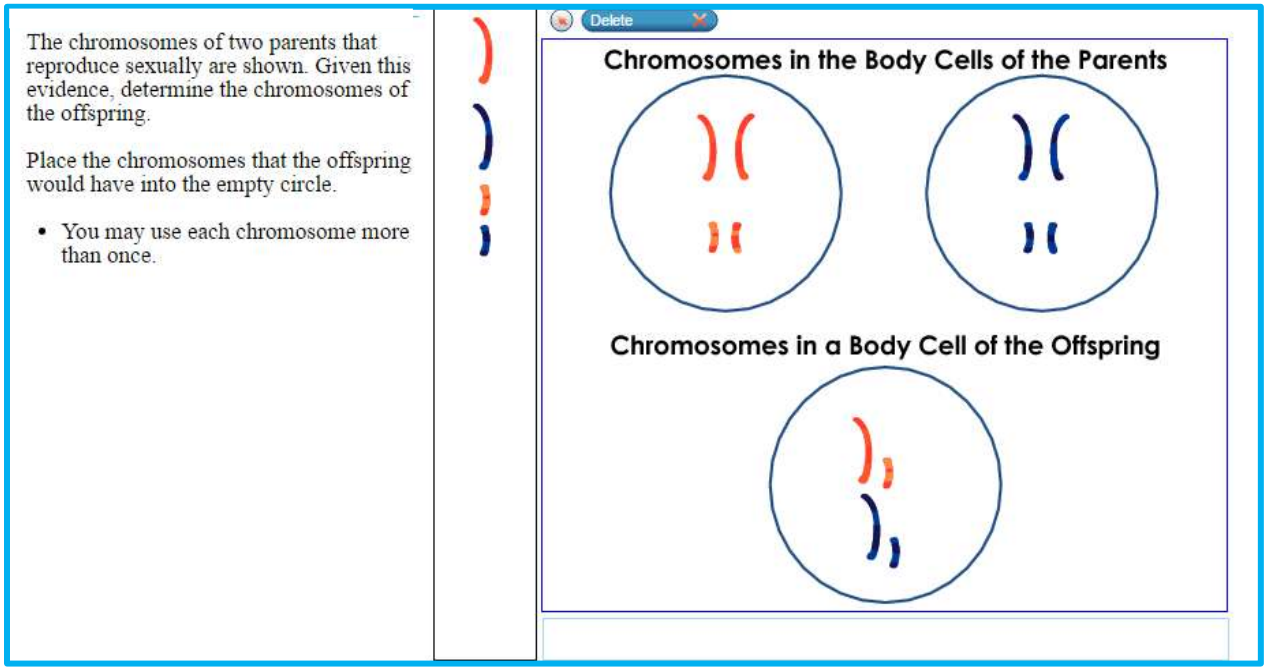
Question 18

Sample Responses

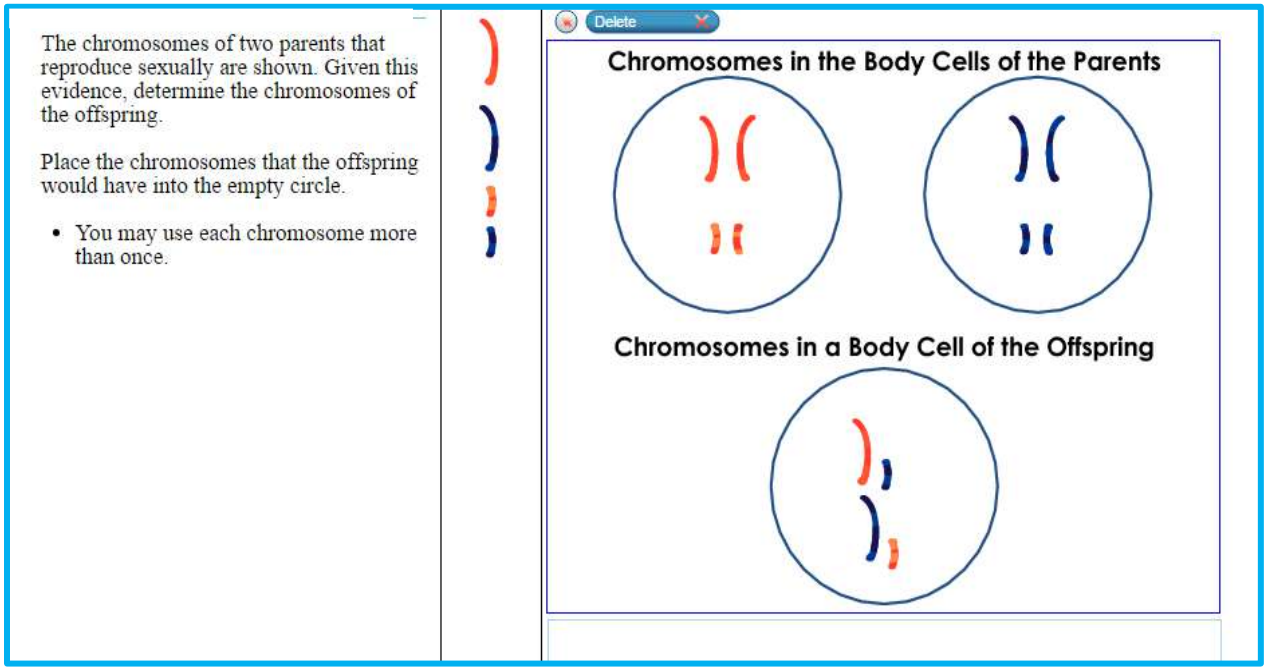
Sample Response: 1 point



Notes on Scoring

This response earns full credit (1 point) because it correctly shows the chromosomes in a body cell of an offspring of the given parents. One chromosome from each chromosome pair in the parent generation is passed on to the offspring.

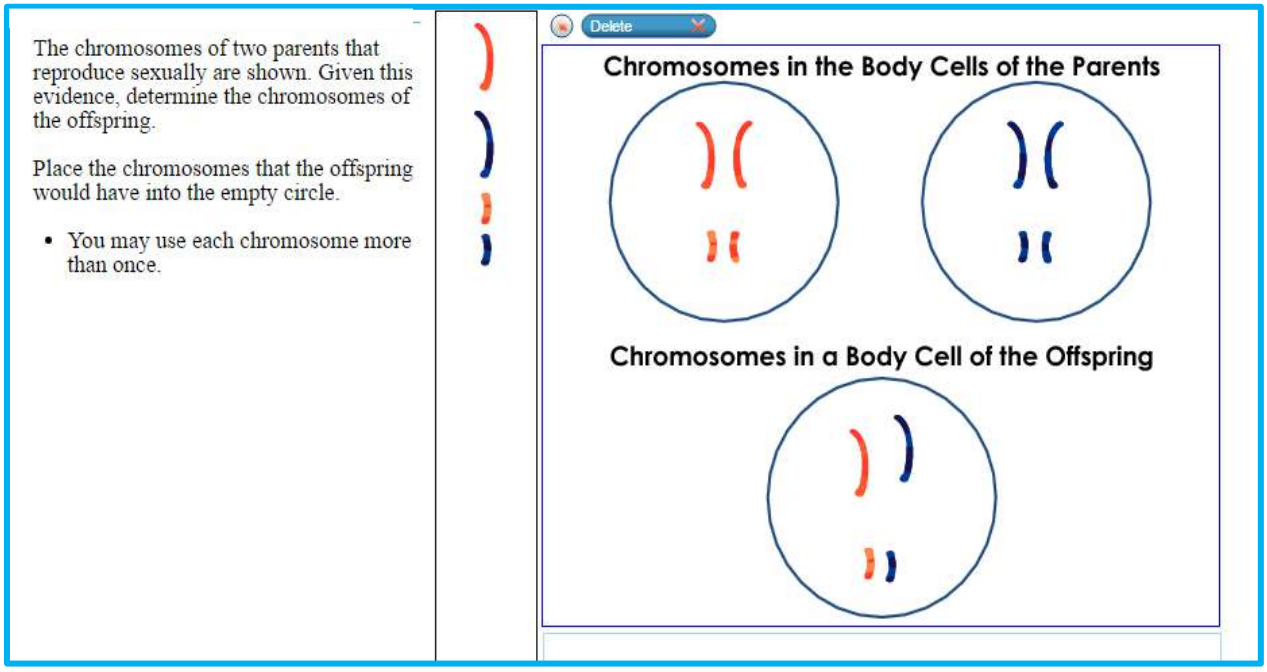
Sample Response: 1 point



Notes on Scoring

This response earns full credit (1 point) because it correctly shows the chromosomes in a body cell of an offspring of the given parents. One chromosome from each chromosome pair in the parent generation is passed on to the offspring.

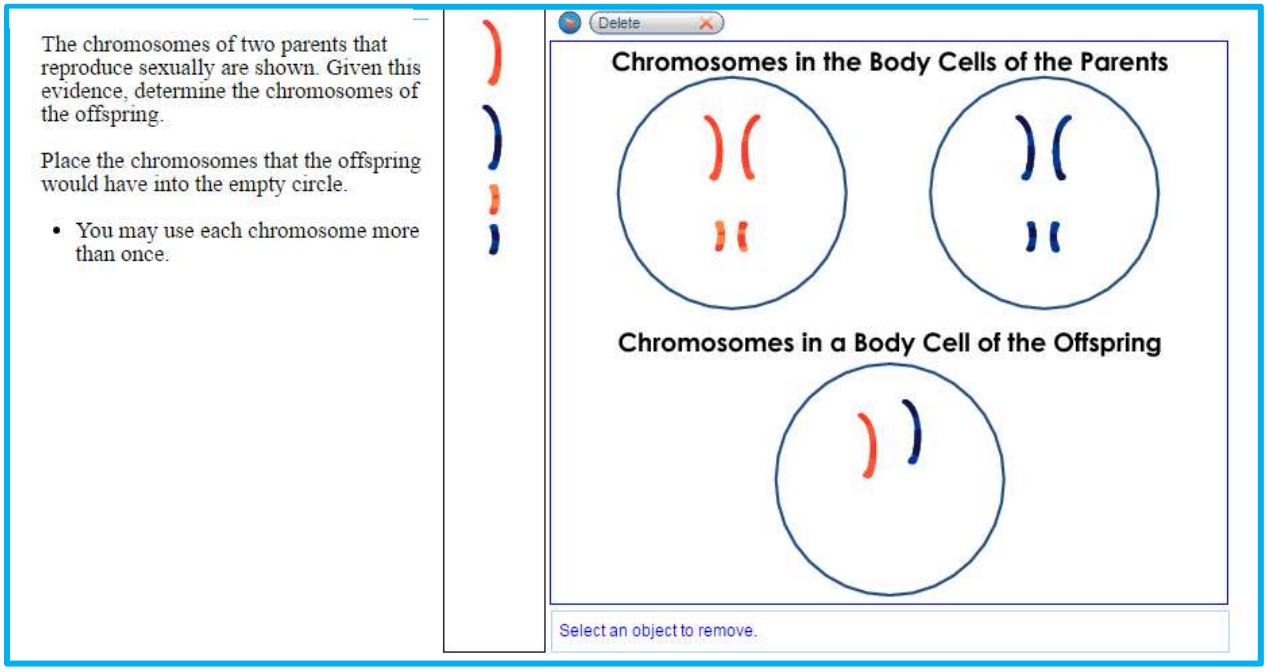
Sample Response: 1 point



Notes on Scoring

This response earns full credit (1 point) because it correctly shows the chromosomes in a body cell of an offspring of the given parents. One chromosome from each chromosome pair in the parent generation is passed on to the offspring.

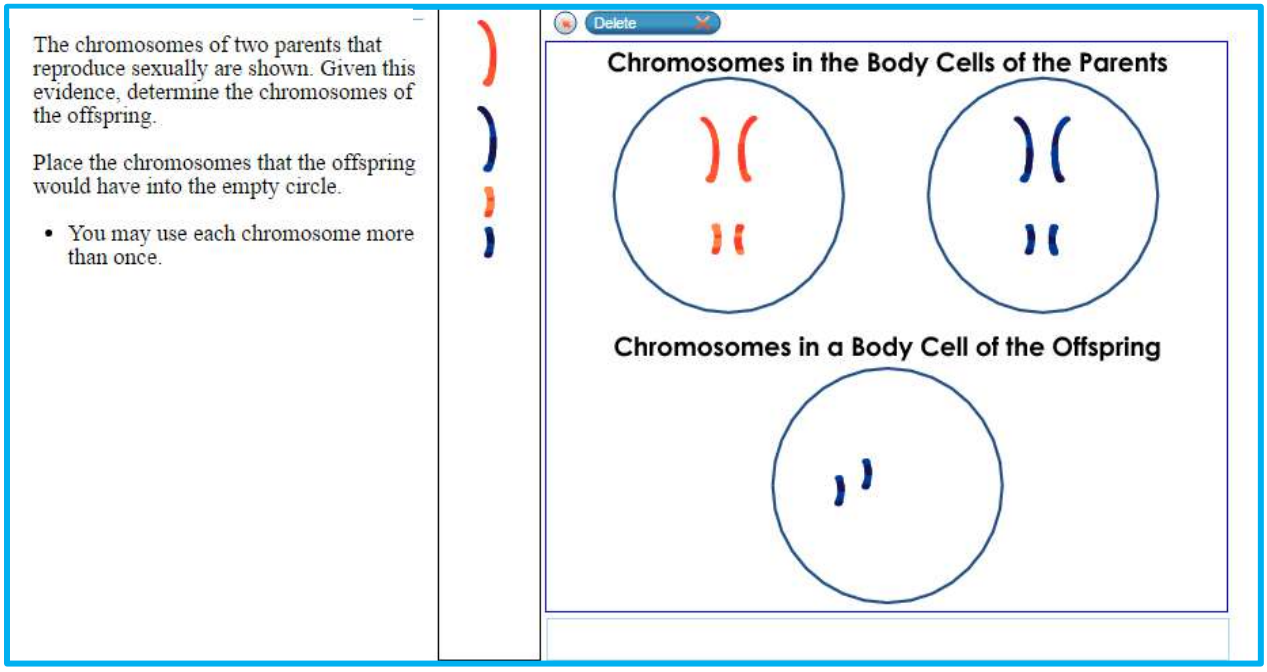
Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because it does not show all of the chromosomes in a body cell of an offspring of the given parents. One chromosome from each chromosome pair in the parent generation is passed on to the offspring. This response shows only two of the four chromosomes.

Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because it does not show the correct chromosomes in a body cell of an offspring of the given parents. One chromosome from each chromosome pair in the parent generation is passed on to the offspring. This response shows that the offspring inherits both the small blue chromosomes from one parent and none of the chromosomes from the other three pairs.

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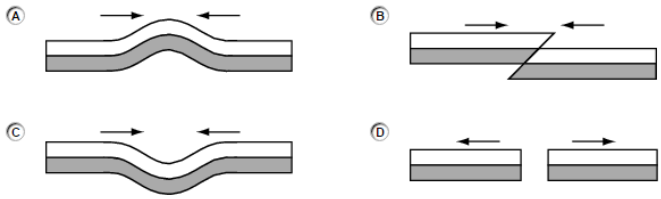
Question 19

Question and Scoring Guidelines

Question 19

The diagrams show two rock units being affected in different ways by tectonic stress. The arrows in each diagram represent the general direction of the stress.

Which diagram shows rocks responding to tectonic stress in a way that could lead to the formation of new crust?



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. This graphic shows a sequence of strata being folded under regional compression. No new crust is being formed.

Rationale for Option B: This is incorrect. This graphic shows a sequence of strata being displaced by a reverse fault under regional compression. No new crust is being formed.

Rationale for Option C: This is incorrect. This graphic shows a sequence of strata being folded under regional compression. No new crust is being formed.

Rationale for Option D: **Key** – This graphic shows a divergent plate boundary, such as a mid-ocean ridge, where magma rises and crystallizes to form new oceanic crust.

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
There are three main types of plate boundaries: divergent, convergent and transform. Each type of boundary results in specific motion and causes events (such as earthquakes or volcanic activity) or features (such as mountains or trenches)that are indicative of the type of boundary.

Plate boundary identification (converging, diverging, transform) must be based on the resulting features or events. The focus must be on the cause of plate movement, the type and direction of plate movement, and the result of the plate movement, not on memorizing plate names.

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 recall features produced by various stresses in Earth's crust. The item asks the student to identify a location where new crust is being formed. New crust is formed at divergent plate boundaries where molten material from the mantle reaches the surface and cools.

Sample Response: 1 point