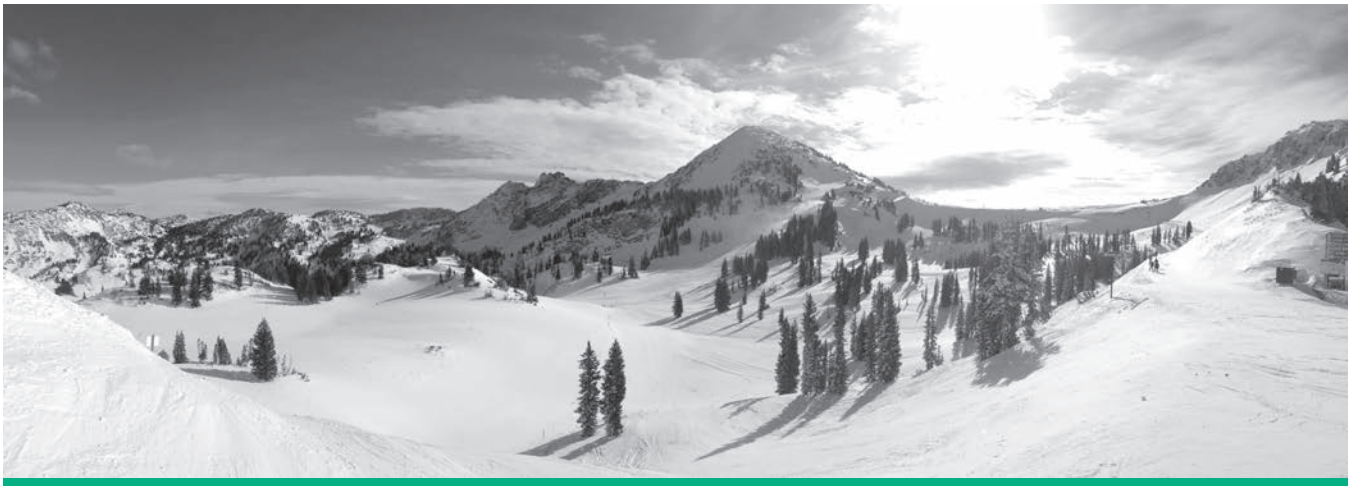
Colorado Measures of Academic Success



Grade 8 Science

Answer Key with Scoring Rubrics, Sample Responses & Annotations

Practice Resource for Students

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Table of Contents

ITEM INFORMATION

Colorado Academic Standard (CAS) Evidence Outcome

Describes the evidence that demonstrates that a student is meeting the grade level expectation at a mastery level.

Disciplinary Core Ideas

The Disciplinary Core Ideas (DCIs) form the basis for the content that students are expected to know by the end of the grade level and are present in every item.

Science and Engineering Practices

The Science and Engineering Practices (SEPs) in the CAS are interwoven within certain items, and all SEPs are assessed according to the SEP progressions. The SEP is the first few words of the Evidence Outcome. If an SEP is not present in an item, then the item will not ask the student to demonstrate knowledge of the first part of the Evidence Outcome.

Crosscutting Concepts

Crosscutting concepts (CCCs) have applications across all domains of science. As such, they are a way of linking the different domains of science. The CCCs in the CAS are interwoven within certain items. Each CCC found in the CAS is assessed according to the CCC progressions.

Scenarios for Items

Items are driven by high-quality scenarios that are grounded in phenomena or problems. All scenarios are puzzling and intriguing and are explainable using grade appropriate integration of the three dimensions of the 2020 CAS. Scenarios are presented in three ways: simulations, clusters, and standalone items.

Simulations

Students are presented with an interactive simulation of a science model or experiment and asked to make sense of the observed phenomenon. They answer multiple two- or three-dimensional questions related to the content using their knowledge of the 2020 CAS.

Clusters

Students are presented with background information, still images, graphs, tables, and additional media and asked to make sense of the described phenomenon. Using their knowledge of the 2020 CAS, they answer multiple two- or three-dimensional questions related to the content.

Standalone Items

Students are presented with a unique phenomenon and asked to make sense of that phenomenon based on the information in the stimulus. They answer the two- or three-dimensional question using their knowledge of the 2020 CAS.

Simulation and cluster scenarios comprise the majority of the assessment as students are asked to make sense of a larger phenomenon and answer questions associated with those scenarios. Standalone items are included only to target a small number of 2020 CAS Evidence Outcomes not represented in simulation and cluster scenarios. These Evidence Outcomes rotate on an annual basis.

ITEM TYPES

Items are questions that appear on the assessments. They are presented in three different ways.

Selected Response (Multiple Choice, Multiple Response, and Fill in the Blank)

For multiple choice and multiple response items, students select a correct answer out of provided choices. For fill in the blank items, students type/write their answer in a blank box.

Technology-Enhanced (Bar Graph, Drag and Drop, Inline Choice, Hot Spot, and Match Table Grid)

Students show their answer using technology, such as by creating a bar graph using a template provided by the online testing system or on the paper-based test. Drag and drop items require students to drag answer choices into correct answer bays (draw lines or write corresponding letters for paper-based testing). Inline choice items require students to select their answer from a drop-down menu (circle answer from a list of choices for paper-based testing) to complete a sentence or sentences. Hot spot items require students to select the correct response from its location in an image (write corresponding letters or circle answer for paper-based testing). Match table grid items require students to check checkboxes in cells to indicate a match between the column and row labels.

Constructed Response

Students construct an open-ended response.

STUDENT PERFORMANCE

P Value – Selected Response and Technology-Enhanced Only

The P value represents the percentage of students who answered each selected response and technology-enhanced question correctly. For example, if the P value associated with a question is 0.64, then 64% of students responded to the question with the correct answer.

Score Point Distribution – Constructed Response Only

The score point distribution provides the percentage of students who scored at each possible score point for constructed response questions.

Sample Student Responses and Annotations – Constructed Response Only

Sample student responses are provided at each score point for constructed response items. Sample responses include annotations that provide reasoning for the score. Scoring rubrics are provided for constructed response items.

Note: P values and score point distributions are only available for released items (i.e., questions that previously appeared on CMAS assessments administered statewide). Items without this information were developed as sample items.

ANSWER KEY: ITEM SET 1

Item Set 1 – Question 1 (TEI Inline Choice)

Two students notice how quickly their cups of hot chocolate cool off. The students ask an adult to boil water. The water is 100 degrees Celsius (°C) when the adult pours it into a cup. The air temperature in the room is 20°C. After 10 minutes, the students note that the water temperature is 30°C. Explain the students' observations.

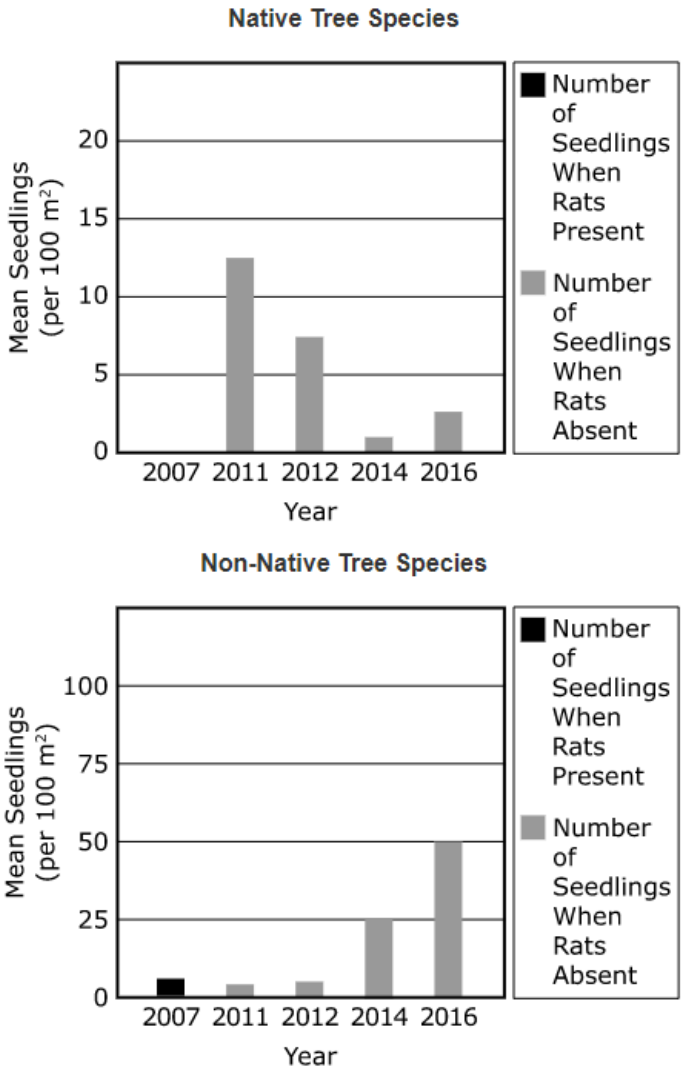
Select one correct response from each drop-down menu to complete the sentence.

Over time, the [thermal] energy of the water [decreases] because energy flows from [warmer to cooler] matter.

Item Information		
Answer	See Image	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.6.a	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. (MS PS3-3) (Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.) (Boundary Statement: Does not include calculating the total amount of thermal energy transferred.) |SEP 6 CEDS|CCC 5 EM|
Disciplinary Core Idea	SC.MS.1.6	Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter.
Science and Engineering Practice	SEP Not Assessed	N/A
Crosscutting Concept	Energy and Matter	
P Value	0.631	

Item Set 1 – Question 2 (Selected Response)

Rats were accidentally introduced onto an island in the Pacific Ocean in the 1940s. The rat population grew rapidly as the rats fed on eggs and small animals, as well as seeds and tree seedlings. In 2011, wildlife workers removed all rats from the island. The graphs show data for two tree species, before and after the removal of the rats.



How can these data **best** be evaluated to compare solutions to the problems faced by native tree species?

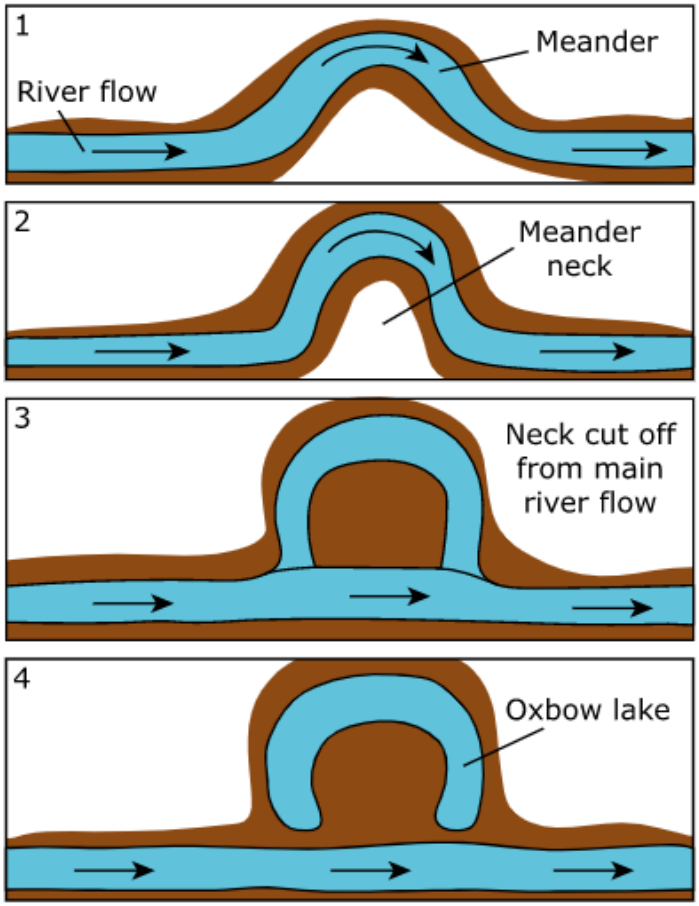
- A. Putting both graphs on the same scale would show that removing rats has aided population growth of native trees more than of non-native trees.
- B. Comparing the data and graphs shows that removing rats has had a negative effect on small animals because rat removal decreased food sources.
- C. Putting both graphs on the same scale would show that controlling non-native tree population growth is needed in addition to rat removal.
- D. Comparing the data and graphs shows that controlling the number of small animals is needed in addition to rat removal.

Item Information		
Answer	C	
Standard	Life Science	
Evidence Outcome	SC.MS.2.12.a	Evaluate competing design solutions for maintaining biodiversity and ecosystem services. **(MS-LS2-5) (Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.) |SEP 7 EAE|CCC 7 SC|**Also assessed as SC.MS.2.7.b under GLE SC.MS.2.7.
Disciplinary Core Idea	SC.MS.2.12	Biodiversity is the wide range of existing life forms that have adapted to the variety of conditions on Earth, from terrestrial to marine ecosystems.
Science and Engineering Practice	Engaging in Argument from Evidence	Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
Crosscutting Concept	Stability and Change	
P Value	0.357	

Item Set 1 – Question 3 (Constructed Response)

Rivers that flow along crooked paths sometimes form extreme U-shaped bends called meanders. Through erosion and deposition of river soil and silt, these meanders can become oxbow lakes, as shown in the diagram.

Oxbow Lake Formation



Explain the processes that change river paths to form oxbow lakes. Your response should include an explanation of:

- how erosion and deposition can change the path of the river to form the oxbow lake
- how flooding could change the timeline of an oxbow lake's formation

Item Information		
Answer	See Scoring Rubric and Sample Student Responses	
Standard	Earth and Space Science	
Evidence Outcome	SC.MS.3.4.b	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. **(MS-ESS2-2) (Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large [such as slow plate motions or the uplift of large mountain ranges] or small [such as rapid landslides or microscopic geochemical reactions], and how many geoscience processes [such as earthquakes, volcanoes, and meteor impacts] usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.) |SEP 6 CEDS|CCC 3 SPQ|**Also assessed as SC.MS.3.6.a under GLE SC.MS.3.6.
Disciplinary Core Idea	SC.MS.3.4	Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes.
Science and Engineering Practice	Constructing Explanations and Designing Solutions	Construct an explanation using models or representations.
Crosscutting Concept	Scale, Proportion, and Quantity.	
Score Point Distribution	10.3% of students earned 2 points. 21.8% of students earned 1 point. 67.9% of students earned 0 point.	

Scoring Rubric	
Points	**Attributes**
2	**The student's response should include an explanation of:** • how erosion and deposition can change the path of the river to form the oxbow lake • how flooding could change the timeline of an oxbow lake's formation **Student responses may include but are not limited to:** Soil erodes from one part of the river and is deposited in other parts of the river. The soil erodes from the outside edge of the curves and piles up on the inside edge, changing the shape and path of the river. Flooding can speed the process of oxbow lake formation by increasing erosion and changing the location of deposition. This is due to a higher water flow during the flood.
1	Student demonstrates a partial understanding of the task. The student correctly responds to **one** of the two prompts.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response**
	Sample A Response The erosion of the land to connect the bottoms of the meander, happens when the river is moving fast, and slowly wears away connections. until the it ends up running straight through. Through deposition the river slowly cuts off access to the Oxbow lake, until it is no longer connected to the river. Flooding could make the erosion happen much faster. If the river is moving fast because of flooding, it will likely overflow, which means that it will erode a path straight through much faster, and it may stick with the path dropping off sediments until the Oxbow lake is closed off. **Sample B Response** Overtime, as water flows, it erodes and deposits sediments which change it's course. To change from 1 to 2, soil is deposited, which makes the neck longer, and erosion also causes the other side to widen up to make room for the meander neck. Eventually, to go from 2 to 3, soil erodes and the river cuts through going straight forward. As time goes by, the oxbow lake forms, going from 3 to 4, because of deposition along the sides which cut the oxbow lake off. Flooding may speed up the process as water may flood straight over the neck, which would erode it even more.
	Sample Annotation
	Sample A Annotation The response explains how erosion and deposition can change the path of the river to form an Oxbow Lake (*river … slowly wears away connections. until the it ends up running straight through. Through deposition the river slowly cuts off access to the Oxbow lake, until it is no longer connected to the river*). The response addresses how flooding can change the timeline for the Oxbow Lake to form (*because of flooding, it will likely overflow, which means that it will erode a path straight through much faster*). **Sample B Annotation** The response explains how erosion and deposition can change the path of the river to form an Oxbow Lake (*Overtime, as water flows, it erodes and deposits sediments which change it's course. To change from 1 to 2, soil is deposited, which makes the neck longer, and erosion also causes the other side to widen up to make room for the meander neck. Eventually, to go from 2 to 3, soil erodes and the river cuts through going straight forward. As time goes by, the oxbow lake forms, going from 3 to 4, because of deposition along the sides which cut the oxbow lake off*). The response addresses how flooding can change the timeline for the Oxbow Lake to form (*Flooding may speed up the process as water may flood straight over the neck, which would erode it even more*).
1	**Sample Response**
	Sample A Response When the fast water hits something, over time it will erodeand move. In this system the water hits the same place over and over, moving it. it gets more and more extreme untill the water cant follow the bed anymore and makes a new one. **Sample B Response** the erosion will eventually form an oxbow lake and a flood can make it go faster because it moves more soil faster.
	Sample Annotation
	Sample A Annotation The response explains how erosion and deposition can change the path of the river to form an Oxbow Lake (*When the fast water hits something, over time it will erodeand move. In this system the water hits the same place over and over, moving it. it gets more and more extreme untill the water cant follow the bed anymore and makes a new one*). Although this response does not address the deposition that is involved in the formation of the oxbow lake, the description of the effect of erosion is sufficiently specific.

	The response does not address how flooding can change the timeline for the Oxbow Lake to form. **Sample B Annotation** The response addresses how flooding can change the timeline for the Oxbow Lake to form *(a flood can make it go faster because it moves more soil faster*). No credit is awarded for the description of the formation of the Oxbow Lake because the description is too vague **(***the erosion will eventually form an oxbow lake*).
0	**Sample Response** **Sample A Response** Erosion can remove some of the rocks and soil creating the bends. Flooding can change them becuase it forces the soil to make new paths for the water. **Sample B Response** 1. First the river startes to meander off its path of correct flow. 2. Second the meander gets alot sharper of a turn inside it. 3. After that the lake goes back to a straight path where the water is still flowing at that sharp angle. 4. Finally the lake portion of the river gets cut off of the rest of the river.
	Sample Annotation **Sample A Annotation** The response for does not receive credit for the description of the lake formation because it is not correct. The bends already exist and the erosion only exaggerates the bends. This also does not address how the lake separates from the flowing water. The explanation of the effect of flooding also does not receive credit. It is unclear how flooding would affect the timeline of the lake formation (*it forces the soil to make new paths for the water*). **Sample B Annotation** This is a literal description of what happens in the diagrams without any interpretation of the roles of erosion and deposition in the process.

Item Set 1 – Question 4 (Selected Response)

The location of the Grand Ethiopian Renaissance Dam is shown in Figure 1. Operation of this dam may change geologic processes in the area. Which change will **most likely** occur as a result of the operation of the dam?

- A. Water released from the dam will flood the area to the north with water and sediment.
- B. The area to the south of the dam that holds the water will contain more sediment.
- C. Water released from the dam will cause erosion of land to the south.
- D. Eroded material from south of the dam will be carried to the north.

Item Information		
Answer:	B	
Standard:	Earth and Space Science	
Evidence Outcome:	SC.MS.3.6.a	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. **(MS-ESS2-2) (Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large [such as slow plate motions or the uplift of large mountain ranges] or small [such as rapid landslides or microscopic geochemical reactions], and how many geoscience processes [such as earthquakes, volcanoes, and meteor impacts] usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.) |SEP 6 CEDS|CCC 3 SPQ|**Also assessed as SC.MS.3.4.b under GLE SC.MS.3.4.
Disciplinary Core Idea	SC.MS.3.6	Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features.
Science and Engineering Practice	Constructing Explanations and Designing Solutions	Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.
Crosscutting Concept	CCC Not Assessed	
P Value	0.294	

Item Set 1 – Question 5 (Selected Response)

Based on the data in Part 2, during which months should people living along the Blue Nile expect potential flooding events?

- ○ A. October and November
- ○ B. January and February
- ◉ C. July and August
- ○ D. April and May

Item Information		
Answer:	C	
Standard:	Earth and Space Science	
Evidence Outcome:	SC.MS.3.9.a	Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (MS-ESS3-2) (Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes, such as earthquakes and volcanic eruptions, surface processes, such as mass wasting and tsunamis, or severe weather events, such as hurricanes, tornadoes, and floods. Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global, such as satellite systems to monitor hurricanes or forest fires, or local, such as building basements in tornado-prone regions or reservoirs to mitigate droughts.) |SEP 4 AID|CCC 1 P |
Disciplinary Core Idea	SC.MS.3.9	Mapping the history of natural hazards in a region and understanding related geological forces.
Science and Engineering Practice	Analyzing and Interpreting Data	Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.
Crosscutting Concept	Patterns	
P Value	0.863	

Item Set 1 – Question 6 (Selected Response)

The table shows population data for Egypt, Ethiopia, and Sudan.

Population Data

Country	Population in 2020 (millions)	Projected Population in 2060 (millions)
Egypt	104	190
Ethiopia	108	225
Sudan	46	104

Based on the information provided and the Population Data table, select the statement that **best** supports the claim that these changes in population will negatively affect ecosystems in Egypt.

- ○ A. More flooding and soil erosion will occur as the volume of water in the Nile River increases.
- ○ B. Less water will flow through the Nile River in winter months than in summer months.
- ○ C. The volume of water in the Nile River will increase as humans use more water.
- ◉ D. Soil will become less fertile as the Nile River transports less sediment.

Item Information		
Answer	D	
Standard	Earth and Space Science	
Evidence Outcome	SC.MS.3.10.b	Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. (MS-ESS3-4) (Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources [such as freshwater, mineral, and energy]. Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.) |SEP 7 EAE|CCC 2 CAE|
Disciplinary Core Idea	SC.MS.3.10	Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things.
Science and Engineering Practice	Engaging in Argument from Evidence	Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system, based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.
Crosscutting Concept	Cause and Effect	
P Value	0.326	

Item Set 1 – Question 7 (Selected Response)

Based on the data in Part 2, in which month and year would a dam with a large reservoir **most likely** benefit Ethiopian water supply?

- (●) A. November 1985
- ( ) B. November 2003
- ( ) C. August 1992
- ( ) D. August 2010

Item Information		
Answer:	A	
Standard:	Earth and Space Science	
Evidence Outcome:	SC.MS.3.9.a	Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (MS-ESS3-2) (Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes, such as earthquakes and volcanic eruptions, surface processes, such as mass wasting and tsunamis, or severe weather events, such as hurricanes, tornadoes, and floods. Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global, such as satellite systems to monitor hurricanes or forest fires, or local, such as building basements in tornado-prone regions or reservoirs to mitigate droughts.) |SEP 4 AID|CCC 1 P |
Disciplinary Core Idea	SC.MS.3.9	Mapping the history of natural hazards in a region and understanding related geological forces.
Science and Engineering Practice	Analyzing and Interpreting Data	Analyze data to define an optimal operational range for a proposed object, tool, process, or system that best meets criteria for success.
Crosscutting Concept	Patterns	
P Value	0.335	

Item Set 1 – Question 8 (Constructed Response)

Prior to construction of dams along the Nile River, rainfall patterns had a larger effect on local agriculture. Use the information provided to explain how rainfall patterns affected soil availability and fertility:

- in the Nile River valley in Ethiopia
- in the Nile River valley in Egypt

Item Information		
Answer	See Scoring Rubric and Sample Student Responses	
Standard	Earth and Space Science	
Evidence Outcome	SC.MS.3.8.a	Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. (MS-ESS3-1) (Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum [locations of the burial of organic marine sediments and subsequent geologic traps], metal ores [locations of past volcanic and hydrothermal activity associated with subduction zones], and soil locations of active weathering and/or deposition of rock.) |SEP 6 CEDS|CCC 2 CAE|
Disciplinary Core Idea	SC.MS.3.8	Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes.
Science and Engineering Practice	Constructing Explanations and Designing Solutions	Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.
Crosscutting Concept	Cause and Effect	
Score Point Distribution:	1.0% of students earned 2 points. 4.4% of students earned 1 point. 94.6% of students earned 0 point.	

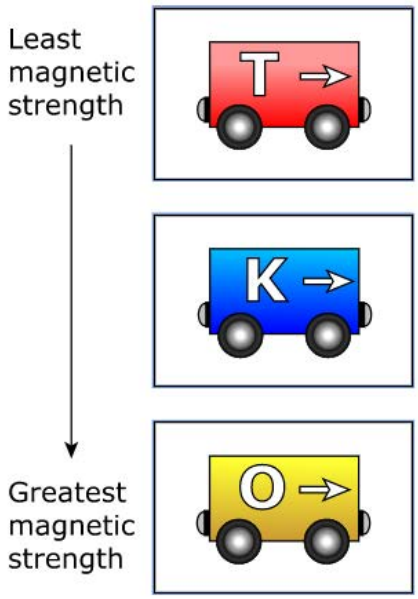
Scoring Rubric	
Points	**Attributes**
2	**The student's response should explain how rainfall patterns affected soil availability and fertility:** • in the Nile River valley in Ethiopia • in the Nile River valley in Egypt **Student responses may include but are not limited to:** Heavy rainfall along the Nile in Ethiopia caused flooding. Floodwaters eroded fertile soil and transported it away, reducing both available soil and its fertility in the Nile River valley in Ethiopia. Floodwaters flowed to the north, slowed down, and deposited the sediments in Egypt. The transported sediments increased the available soil and its fertility in the Nile River valley in Egypt.
1	Student demonstrates a partial understanding of the task. The student correctly responds to **one** of the two prompts.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response** **Sample A Response** Before the construction of Dams along the Nile River local agriculture relied greatly on rainfall. This was a grave issue in Ethiopia's Nile River Valley. Due to heavy summer rains, Ethiopia's Nile River Valley flooded destroying crops, this also likely caused soil erosion, the fertility was also taken away with the soil. Due to erosion Egypt's Nile River Valley's soil must've been great due to good fertile soil being caried to Egypt from Ethiopia. **Sample B Response** In the Nile River VAlley in Ethiopia, soil's availiblity and fetility was decreased because the river, flowing north, took the sediment with it. The Nile River Valley in Egypt, though, gained this soil so it's availibilty and fertility was increased
	Sample Annotation **Sample A Annotation** The response explains how rainfall patterns affected soil availability and fertility in the Nile River valley in Ethiopia (*caused soil erosion, the fertility was also taken away with the soil*). The response explains how rainfall patterns affected soil availability and fertility in the Nile River valley in Egypt (*soil must've been great due to good fertile soil being caried to Egypt from Ethiopia*). **Sample B Annotation** The response explains how rainfall patterns affected soil availability and fertility in the Nile River valley in Ethiopia (*decreased because the river, flowing north, took the sediment with it*). The response explains how rainfall patterns affected soil availability and fertility in the Nile River valley in Egypt (*Egypt, though, gained this soil so it's availibilty and fertility was increased*).
1	**Sample Response** **Sample A Response** Dams solved the problem of large amounts of water flooding areas along the Nile. If too much water were to flow to Ethiopia the soil would be washed with it and lack of soil would cause fertility to decrease. Egypt is already located in an area where the soil isn't as fertile. An increase in rainfall would only make it harder to grow things because sand becomes washed away easier. That means it was likely harder to grow things during July and Agust when the rainfall was at its highest. **Sample B Response** In the Nile River valley in Ehtiopia rainfall paterns would make there be less fertile soil and in the Nile River valley in Egypt there would have been more fertile soil.
	Sample Annotation **Sample A Annotation** The response explains how rainfall patterns affected soil availability and fertility in the Nile River valley in Ethiopia (*If too much water were to flow to Ethiopia the soil would be washed with it and lack of soil would cause fertility to decrease*). The response incorrectly describes the effect on the Nile River Valley in Egypt (*harder to grow things because sand becomes washed away easier. That means it was likely harder to grow things during July and Agust when the rainfall was at its highest*). **Sample B Annotation** The response addresses the fertility of the soil for both locations, but does not address the movement of the soil (*there be less fertile soil and in the Nile River valley in Egypt there would have been more fertile soil*).

0	**Sample Response**
	Sample A Response When there is more rain the river floods more and caries more sediments down river. The soil carried down stream in the river is fertile and makes it easeir to grow plants. **Sample B Response** Rainfall paterns affect soil availabilty and fertility in Ethiopia and Egypt, but why? Well this is because the Nile River brings sand with it from the Sahara to Ethiopia. And in Egypt because the Nile River is running all along the Sahara.
	Sample Annotation
	Sample A Annotation The response describes sedimentation caused by rivers in general terms, but does not apply the statement to either location. **Sample B Annotation** The response incorrectly describes the availabilty and fertility of soil being carried by the Nile River (*brings sand with it from the Sahara to Ethiopia. And in Egypt because the Nile River is running all along the Sahara*).

Item Set 1 – Question 9 (TEI Drag and Drop)

Based on the results of the simulation, place the train cars in order from least to greatest magnetic strength. Drag each train car into the correct box to show its magnetic strength. Each train car may be used once.



Item Information		
Answer	See Image	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.4.a	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. (MS-PS2-3) (Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.) (Boundary Statement: Limited to questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.) |SEP 1 AQDP|CCC 2 CAE|
Disciplinary Core Idea	SC.MS.1.4	Forces that act a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object.
Science and Engineering Practice	SEP Not Assessed	N/A
Crosscutting Concept	Cause and Effect	
P Value	0.647	

Item Set 1 – Question 10 (TEI Inline Choice)

Use the investigation in Part 1 to ask testable questions.

Select one correct response from each drop-down menu to complete the sentences.

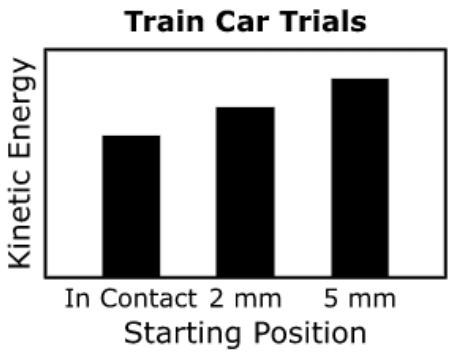
How does the [distance between the train cars] affect the distance the engine travels? Do different [train car magnets] have the same magnetic force?

Item Information		
Answer	See Image	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.4.a	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. (MS-PS2-3) (Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.) (Boundary Statement: Limited to questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.) |SEP 1 AQDP|CCC 2 CAE|
Disciplinary Core Idea	SC.MS.1.4	Forces that act a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object.
Science and Engineering Practice	Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.	Ask questions to determine relationships between independent and dependent variables and relationships in models.
Crosscutting Concept	Cause and Effect	
P Value	0.454	

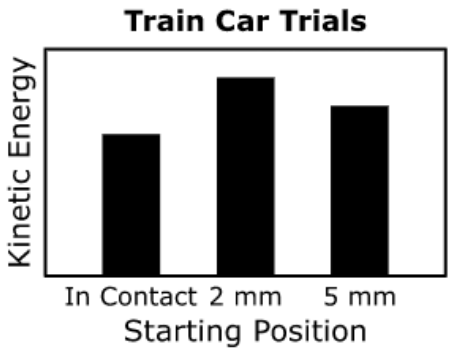
Item Set 1 – Question 11 (Selected Response)

Which graph shows the correct comparison of the kinetic energy that resulted from each starting position during the train car trials in Part 1?

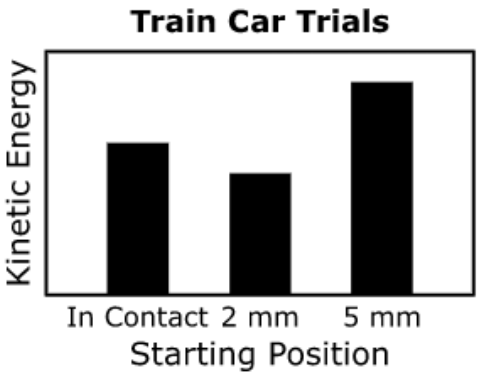
○ A.



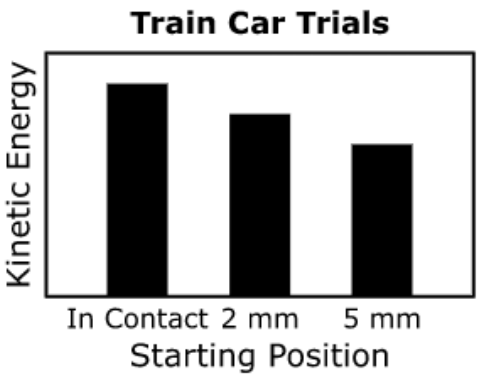
○ B.



○ C.



◉ D.



Item Information		
Answer	D	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.5.a	Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and the speed of an object. (MS-PS3-1) (Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.) |SEP 4 AID|CCC 3 SPQ|
Disciplinary Core Idea	SC.MS.1.5	Kinetic energy can be distinguished from the various forms of potential energy.
Science and Engineering Practice	Analyzing and Interpreting Data	Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
Crosscutting Concept	Scale, Proportion, and Quantity	
P Value	0.588	

Item Set 1 – Question 12 (Constructed Response)

Write a question about the strength of the train car magnets that is answered by the iron filings investigation in Part 2. Your response should include:

- a question about the strength of the magnet as it relates to the iron filings investigation
- an explanation of how the results in Part 2 answer the question

Item Information		
Answer	See Scoring Rubric and Sample Student Responses	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.4.a	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. (MS-PS2-3) (Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.) (Boundary Statement: Limited to questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.) |SEP 1 AQDP|CCC 2 CAE|
Disciplinary Core Idea	SC.MS.1.4	Forces that act a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object.
Science and Engineering Practice	Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.	Ask questions that require sufficient and appropriate empirical evidence to answer.
Crosscutting Concept	Cause and Effect	
Score Point Distribution:	11.3% of students earned 2 points. 21.8% of students earned 1 point. 67.0% of students earned 0 point.	

Scoring Rubric	
Points	**Attributes**
2	**The student's response should include:** • a question about the strength of the magnet as it relates to the iron filings investigation • an explanation of how the results in Part 2 answer the question **Student responses may include but are not limited to:** A question about the strength of the train car magnets is, "How can the movement of iron filings be used to find out the strength of a magnet?" A stronger magnet pushes or pulls with more force, so it will make the filings move more. A weaker magnet will make the filings move less.
1	Student demonstrates a partial understanding of the task. The student correctly responds to **one** of the two prompts.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response** **Sample A Response** Why do the magnets create different sizes of pattern on magnetic filling? All 3 magnets have a diffrent strength to them. Car O has the strongest magnet,Car K has a medium strength magnet, and Car T has a the weakest magnet. When the magnet makes contact with the iron it varies how much of that iron it can collect and because Cae O has a stronger magnet it collects the most and it makes a bigger circle than the others. So it all depends on how strng the magnet is. **Sample B Response** Question: Which magnet is the strongest? How does the iron filings prove this? Answer/Explanation: Magnet O is the strongest. I know this because magnet O pulled the most of the iron filings towards itself.
	Sample Annotation **Sample A Annotation** The response provides a question about the strength of the magnet as it relates to the iron filings investigation (*Why do the magnets create different sizes of pattern on magnetic filling?*). The response gives an explanation of how the results in Part 2 answer the question (*When the magnet makes contact with the iron it varies how much of that iron it can collect and because Cae O has a stronger magnet it collects the most and it makes a bigger circle than the others*). **Sample B Annotation** The response provides a question about the strength of the magnet as it relates to the iron filings investigation (*Which magnet is the strongest? How does the iron filings prove this?*). The hypothesis is divided into two separate questions, but this is acceptable. The response gives an explanation of how the results in Part 2 answer the question (*I know this because magnet O pulled the most of the iron filings towards itself*).
1	**Sample Response** **Sample A Response** Does the strength of the train car magnet determine the amount of iron fillings it'll move? In

	Part 1 it showed that train car O has the stongest magnet, but in Part 2 it shows that they all have the same amount of iron fillings. **Sample B Response** the bigger the pile of the iron filings shows how strong a magnet is and the results show car O being strongest because it has the biggest force and biggest pile of iron filings
	Sample Annotation
	Sample A Annotation The response provides a question about the strength of the magnet as it relates to the iron filings investigation (D*oes the strength of the train car magnet determine the amount of iron fillings it'll move?*). The response incorrectly states the results of the trials in Part 2 (*train car O has the stongest magnet, but in Part 2 it shows that they all have the same amount of iron fillings*). **Sample B Annotation** Although the response does not provide a question, it does explain how the results in Part 2 would show a relationship between the strength of a magenet and the results of the iron filings experiment (*results show car O being strongest because it has the biggest force and biggest pile of iron filings*).
0	**Sample Response**
	Sample A Response it shows that car o is the stongest with car t being the weakest. **Sample B Response** How does the distance traveled measure the magnetic stregth The stronger the magnet is in Part 2 the farther it pushes the traincar in part 1
	Sample Annotation
	Sample A Annotation The response does not provide a question or explain how the results of the iron filings experiment relate to the strength of the magnets. **Sample B Annotation** The question and results given are from Part 1, not Part 2, and therefore do not relate the strength of the magnets to the effect on the iron filings.

Item Set 1 – Question 13 (Constructed Response)

Use the investigations in Part 1 and Part 2 to consider whether the two investigations are designed well enough to show that fields exist and exert forces even when the objects are not in contact. Then choose one investigation and explain why it is designed well enough to show evidence about fields that exert forces. Your response should include:

- an explanation of how the design of the investigation tests for the presence of a magnetic field
- evidence from the investigation that shows the magnetic field produces a force at a distance

Item Information		
Answer	See Scoring Rubric and Sample Student Responses	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.4.c	Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. (MS-PS2-5) (Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically charged strips of tape, and electrically charged pith balls. Examples of investigations could include firsthand experiences or simulations.) (Boundary Statement: Assessment is limited to electric and magnetic fields and limited to qualitative evidence for the existence of fields.) |SEP 3 PCOI|CCC 2 CAE|
Disciplinary Core Idea	SC.MS.1.4	Forces that act a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object.
Science and Engineering Practice	Planning and Carrying Out Investigations	Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
Crosscutting Concept	Cause and Effect	
Score Point Distribution:	14.7% of students earned 2 points. 20.2% of students earned 1 point. 65.1% of students earned 0 point.	

Scoring Rubric	
Points	**Attributes**
2	**The student's response should include:** • an explanation of how the design of the investigation tests for the presence of a magnetic field • evidence from the investigation that shows the magnetic field produces a force at a distance **Student responses may include but are not limited to:**

	Evidence from the Part 1 investigation is designed to test for the presence of a magnetic field because it uses trains equipped with magnets that repel each other and the distance travelled can be used to determine how strong the forces between them are. The fact that the magnets repel each other even when they aren't touching shows that the magnetic field produces force at a distance, since no other force is acting on the trains to make them move. **-OR-** Evidence from the Part 2 investigation is designed to test for the presence of a magnetic field because it uses iron filings that are attracted to a magnet. The fact that the magnets attract the filings even before the magnet touches the plate shows that the magnetic field produces force at a distance, since no other force is acting on the filings to make them move.
1	Student demonstrates a partial understanding of the task. The student correctly responds to **one** of the two prompts.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response**
	Sample A Response The investigation tests shows the presence of a magnetic feild because it shows us how the carts move when there at different distances from each other. The investigation shows the magnetic field produces a force at a distance beause when the cars were at a distance from each other they still moved away from eaching from the force of the magnets. Although the force wasn't as strong as when they were touching, there was still a magentic field. **Sample B Response** The investigation in Part 2 is designed for testing the presence of a magnetic field because the iron fillings were affected from far away by the magnetic field of all three cars, thus being moved by a force no other than magnets, proving that the magnetic field produces force at a distance.
	Sample Annotation
	Sample A Annotation The response provides an explanation of how the design of the investigation tests for the presence of a magnetic field (*it shows us how the carts move when there at different distances from each other... Although the force wasn't as strong as when they were touching, there was still a magentic field*). The response provides evidence from the investigation that shows the magnetic field produces a force at a distance (*when the cars were at a distance from each other they still moved away from eaching from the force of the magnets*). Although this is not as specific as "when they were 5 mm away fron each other, it is still considered to be evidence from the investigation. **Sample B Annotation** The response provides an explanation of how the design of the investigation tests for the presence of a magnetic field (being moved by a force no other than magnets, proving that the magnetic field produces force at a distance). The response provides evidence from the investigation that shows the magnetic field produces a force at a distance (*the iron fillings were affected from far away by the magnetic field of all three cars*).
	Sample Response

1	**Sample A Response** The tests are designed well enough to show magnetic fields because the objects aren't physically touching, but they can show movement between the two objects, since there is a magnetic field between them. Even though the objects aren't physically touching, people can still see that the magnetic field is strong enough to show both objects and how they effect each other. **Sample B Response** The design ofthe simulation shows you the different magnetic fields for each of theses occurences. The investigation proves that thier is force at a distance because at 5mm thier is still force being collided with each other causing it too move.
	Sample Annotation
	Sample A Annotation The response provides an explanation of how the design of the investigation tests for the presence of a magnetic field *(the objects aren't physically touching, but they can show movement between the two objects, since there is a magnetic field between them*). The response does not provide evidence from the investigation, since the descriptions are too vague to determine whether the trains or the iron filings are being referenced (*Even though the objects aren't physically touching, people can still see that the magnetic field is strong enough to show both objects and how they effect each other*). **Sample B Annotation** The response provides evidence from the investigation that shows the magnetic field produces a force at a distance (*because at 5mm thier is still force being collided with each other causing it too move*). The response does not evaluate how well the investigation is designed to show the presence of a magnetic field.
0	**Sample Response**
	Sample A Response It shows if it pushes or pulls based on the strength. K= in contact, 10.6 in 2 mm, 7.8 and finally 5 mm, 3.6 O= in conatact, 12.8 in 2 mm, 11.7 and finally 5 mm, 4.1 T= in conatact, 9.0 in 2 mm, 6.0 and finally 5 mm, 3.5 **Sample B Response** The two investigations are designed well enough to show that feild exsist and how they work. They also show how magnets work well and how they can push each other away easily**.**
	Sample Annotation
	Sample A Annotation The response does not evaluate the design of the experiment for its success in proving the existence of a magnetic field and also does not give evidence from the investigation showing that the field produces a force at a distance. The response repeats the data provided in the investigation but does not make an attempt to interpret the data. **Sample B Annotation** The response does not address the presence of a magnetic field and does not show how the investigation proves that fields produce force at a distance.

ANSWER KEY: ITEM SET 2

Item Set 2 – Question 1 (Selected Response)

The skunk cabbage is a plant that usually grows in wet areas.

Characteristics of this plant include:

- blooms in early spring
- produces heat in flower buds to protect against freezing temperatures
- smells like rotting meat
- has leaves that decompose quickly

Certain characteristics of the skunk cabbage increase its chances for successful reproduction. Which statement **best** identifies those characteristics?

○ A. The leaves decompose quickly so that there is less plant matter on the ground.

○ B. Deer and other herbivores eat the flowers and leaves in early spring.

◉ C. The smell of the plant attracts insects that can pollinate the flowers.

○ D. The flower structure provides a hiding place for spiders.

Item Information		
Answer	C	
Standard	Life Science	
Evidence Outcome	SC.MS.2.2.a	Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. (MS-LS1-4) (Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.) |SEP 7 EAE|CCC 2 CAE|
Disciplinary Core Idea	SC.MS.2.2	Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.
Science and Engineering Practice	SEP Not Assessed	N/A
Crosscutting Concept	Cause and Effect	
P Value	0.559	

Item Set 2 – Question 2 (Constructed Response)

When a student bites into a slice of lemon, muscles in the student's face begin to contract. The student learns that the muscles contract after acid in the lemon activates sensory receptors on the tongue. A week later, the student sees a lemon and notices that the same face muscles contract, even though the student did not bite into the lemon. Explain how a similar response occurs when the student bites into the lemon slice and when the student sees a lemon. Your response should include an explanation of:

- how information is transferred as the student bites into the lemon slice
- why the muscles in the student's face contract after seeing a lemon

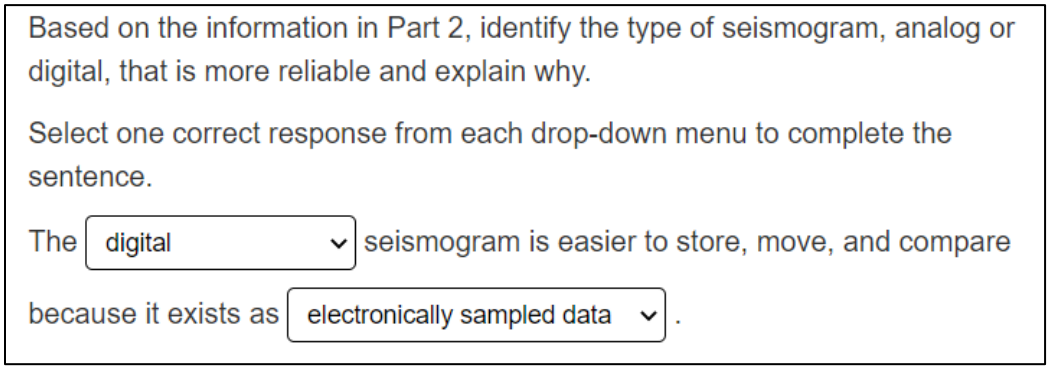
Item Information		
Answer	See Scoring Rubric and Sample Student Responses	
Standard	Life Science	
Evidence Outcome	SC.MS.2.4.a	Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. (MS-LS1-8) (Boundary Statement: Does not include mechanisms for the transmission of this information.) |SEP 8 OECI|CCC 2 CAE|
Disciplinary Core Idea	SC.MS.2.4	Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain.
Science and Engineering Practice	Obtaining, Evaluating, And Communicating Information	Communicate scientific and/or technical information (e.g., about a proposed object, tool, process, system) in writing and/or through oral presentations.
Crosscutting Concept	Cause and Effect	
Score Point Distribution:	14.9% of students earned 2 points. 34.6% of students earned 1 point. 50.5% of students earned 0 point.	

Scoring Rubric	
Points	**Attributes**
2	**The student's response should include an explanation of:** • How information is transferred as the student bites into the lemon slice. • Why the muscles in the student's face contract after seeing a lemon. **Student responses may include but are not limited to:** As the student bit into the lemon slice, the sensory receptors on the tongue sent information to the brain to be processed. The student's brain told the muscles in the face to contract, and the sensory input was stored in a memory. When the student saw the lemon a week later, the memory caused the brain to tell the muscles in the face to contract.
1	Student response demonstrates a partial understanding of the task.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response** **Sample A** The information is transferred as the student bites into the lemon slice because when the acid in the lemon triggers receptors on the tongue, they send a signal that travels to the brain and the brain activates the facial muscles. The student's brain remembers what the lemon looks like, tastes like and etc. When the student sees the lemon again, the brain remembers what the lemon tastes like, and the facial muscles contracted again. **Sample B** The information that lemons are bitter and do not taste good is gathered by the student's taste buds on his tongue. This information is sent up through his nervous system to his brain where it remembers that lemons do not in fact taste good and therefore shouldn't be eaten. Because of this he has a memory that lemons are not to be eaten. Therefore when he sees a lemon he remembers that bad experience and because of muscle memory his face clenches back up.
	Sample Annotation **Sample A** • The response explains how information is transferred as the student bites into the lemon slice (*the acid in the lemon triggers receptors on the tongue, they send a signal that travels to the brain and the brain activates the facial muscles*). • The response explains why the muscles in the student's face contract after seeing a lemon (*The student's brain remembers what the lemon looks like, tastes like and etc. When the student sees the lemon again, the brain remembers what the lemon tastes like, and the facial muscles contracted again*). **Sample B** • The response explains how information is transferred as the student bites into the lemon slice (*The information ... is gathered by the student's taste buds on his tongue. This information is sent up through his nervous system to his brain*). • The response explains why the muscles in the student's face contract after seeing a lemon (*Because of this he has a memory that lemons are not to be eaten. Therefore when he sees a lemon he remembers that bad experience and because of muscle memory his face clenches back up*).

1	**Sample Response**
	Sample A The taste receptors on the tongue can tell that the lemon is sour and sends signals to the brain which causes the face muscles to retract because of the sourness. When the student looks at the lemon his face is getting prepared for him to bite it because his tongue sends signals to the brain to be prepared. **Sample B** The information from the first time the student bites into the lemon is stored in their brain. When they see the lemon again, the brain reminds them of what happened the first time. Muscle memory makes the student's face contract after seeing a lemon.
	Sample Annotation
	Sample A • The response explains how information is transferred as the student bites into the lemon slice (*The taste receptors on the tongue can tell that the lemon is sour and sends signals to the brain which causes the face muscles to retract because of the sourness*). • The response gives an incorrect reason why the muscles contract (*his tongue sends signals to the brain to be prepared*). It is the memory of the taste, not the receptors in the tongue, that are causing the muscle contractions in the later scenario. **Sample B** • The response explains why the muscles in the student's face contract after seeing a lemon (*When they see the lemon again, the brain reminds them of what happened the first time. Muscle memory makes the student's face contract after seeing a lemon*). To satisfy this element, the student must explain that the facial contraction is a result of a stored memory. • The response does not explain how information is transferred as the student bites into the lemon slice.
0	**Sample Response**
	Sample A The student may be thinking of how the lemon already tastes so they make a certain face. **Sample B** Information is transferred as the student bites into the lemon slice
	Sample Annotation
	Sample A • The response does not explain how information is transferred as the student bites into the lemon slice. The information given (*The student may be thinking of how the lemon already tastes*) is not specific enough to indicate understanding of the taste receptors sending signals to the brain which stores a memory. • The response does not explain why the muscles in the student's face contract after seeing a lemon. Any explanation stating that the muscle contraction is voluntary is incorrect. **Sample B** • The response does not explain how information is transferred as the student bites into the lemon slice. The statement is a repeat of the prompt and does not give specific information of how the signal travels. • The response does not attempt an explanation of why the facial muscles contract.

Item Set 2 – Question 3 (TEI Inline Choice)



Item Information		
Answer	See Image	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.10.a	Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. (MS-PS4-3) (Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in Wi-Fi devices, and conversion of stored binary patterns to make sound or text on a computer screen.) (Boundary Statement: Does not include binary counting or the specific mechanism of any given device.) |SEP 8 OECI|CCC 6 SF|
Disciplinary Core Idea	SC.MS.1.10	Designed technologies can transmit digital information as wave pulses.
Science and Engineering Practice	SEP Not Assessed	N/A
Crosscutting Concept	Structure and Function	

Item Set 2 – Question 4 (TEI Inline Choice)

Based on the seismogram in Figure 7, compare the energy of the wave when it peaks at 47 seconds to the energy of the wave when it peaks at 36 seconds.

Select one correct response from each drop-down menu to complete the sentence.

The energy at 47 seconds will be [four times] as great because the [amplitude] is [twice] as great.

Item Information		
Answer	See Image	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.8.a	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in the wave. (MS PS4-1) (Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.) (Boundary Statement: Does not include electromagnetic waves and is limited to standard repeating waves.) |SEP 5 UMCT|CCC 1 P |
Disciplinary Core Idea	SC.MS.1.8	A simple wave model has a repeating pattern with specific wavelength, frequency, and amplitude and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena which include light and sound.
Science and Engineering Practice	Using Mathematics and Computational Thinking	Apply mathematical concepts and/or processes (such as ratio, rate, percent, basic operations, and simple algebra) to scientific and engineering questions and problems.
Crosscutting Concept	No CCC Alignment	

Item Set 2 – Question 5 (Selected Response)

Figure 5 shows that a spring is included between the weight and the arm of the seismograph, which allows the pen to remain stationary as the drum moves beneath it. Which property of waves **best** explains why this spring is included?

- A. Waves can be absorbed, and the spring stretches so that the vibrations move everything but the weight and pen.
- B. Waves can be reflected, and the spring reverses vibrations from the arm before they reach the pen.
- C. Waves can be amplified, and the spring increases the vibrations as they reach the weight and pen.
- D. Waves can be transmitted, and the spring transfers the wave energy from the weight to the pen.

Item Information		
Answer	A	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.8.b	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. **(MS-PS4-2) (Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.) (Boundary Statement: Limited to qualitative applications pertaining to light and mechanical waves.) |SEP 2 DUM|CCC 6 SF|**Also assessed as SC.MS.1.9.a under GLE SC.MS.1.9.
Disciplinary Core Idea	SC.MS.1.8	A simple wave model has a repeating pattern with specific wavelength, frequency, and amplitude and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena which include light and sound.
Science and Engineering Practice	SEP Not Assessed	N/A
Crosscutting Concept	Structure and Function	

Item Set 2 – Question 6 (Selected Response)

Some seismic waves are pressure waves. Pressure waves can cause the density of the substance they are passing through to change. Based on this information and the information in Part 1, which statement **best** explains why light from the laser is distorted and scattered when a seismic wave disturbs the cable?

- (●) A. The change in density of the glass changes the way light is transmitted through it.
- ( ) B. Light responds to the change in pressure by traveling in the opposite direction.
- ( ) C. The change in density of the cable changes the amplitude of the light.
- ( ) D. Light responds to the change in pressure by changing frequencies.

Item Information		
Answer	A	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.9.a	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. **(MS-PS4-2) (Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.) (Boundary Statement: Limited to qualitative applications pertaining to light and mechanical waves.) |SEP 2 DUM|CCC 6 SF|**Also assessed as SC.MS.1.8.b under GLE SC.MS.1.8.
Disciplinary Core Idea	SC.MS.1.9	A wave model of light is useful to explain how light interacts with objects through a variety of properties.
Science and Engineering Practice	SEP Not Assessed	N/A
Crosscutting Concept	Structure and Function	

Item Set 2 – Question 7 (Constructed Response)

Explain why the two seismographs in Figure 4 would record different amplitudes for the earthquake. Your response should include an explanation of:

- why distance from the epicenter affects the amplitude of the seismic waves
- which seismograph would record a higher amplitude and how that amplitude is related to the energy in the wave

Item Information		
Answer	See Scoring Rubric and Sample Student Responses	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.8.a	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in the wave. (MS PS4-1) (Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.) (Boundary Statement: Does not include electromagnetic waves and is limited to standard repeating waves.) |SEP 5 UMCT|CCC 1 P |
Disciplinary Core Idea	SC.MS.1.8	A simple wave model has a repeating pattern with specific wavelength, frequency, and amplitude and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena which include light and sound.
Science and Engineering Practice	Using Mathematics and Computational Thinking	Use mathematical representations to describe and/or support scientific conclusions and design solutions.
Crosscutting Concept	Patterns	

Scoring Rubric	
Points	**Attributes**
2	**The student's response should include an explanation of:** • Why distance from the epicenter affects the amplitude of the seismic waves. • Which seismograph would record a higher amplitude and how that amplitude is related to the energy in the wave. **Student responses may include but are not limited to:** At distances farther from the epicenter, the amplitude is smaller because seismic waves lose energy as they travel. Seismograph 1 will show a greater amplitude and higher energy.
1	Student response demonstrates a partial understanding of the task.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response** **Sample A** As waves travel away from the epicenter of the earthquake, they begin to lose energy. When they lose energy, the amplitude of the waves decreases. Therefore, the closer seismograph, number 1, will record higher wave amplitudes than the further one. This is confirmed by the statement that "Seismograph 1 records a maximum amplitude of 75 microns, while a maximum amplitude of 37 microns is recorded at Seismograph 2." **Sample B** The waves would be taller when they had more energy, right after the earthquake. So, by the time they travelled to the further seismograph, #2, they would have lost some energy and would be shorter.
	Sample Annotation **Sample A** • The response explains why distance from the epicenter affects the amplitude of the seismic waves (*As waves travel away from the epicenter of the earthquake, they begin to lose energy. When they lose energy, the amplitude of the waves decreases*). • The response explains which seismograph would record a higher amplitude and how that amplitude is related to the energy in the wave (*When they lose energy, the amplitude of the waves decreases. Therefore, the closer seismograph, number 1, will record higher wave amplitudes than the further one*). **Sample B** • The response explains why distance from the epicenter affects the amplitude of the seismic waves (*The waves would be taller when they had more energy, right after the earthquake…they would have lost some energy and would be shorter*). "Taller" is an acceptable term to represent the amplitude, but when the term "shorter" is used. It must be determined that the student is referring to amplitude and not wave length. • The response explains which seismograph would record a higher amplitude and how that amplitude is related to the energy in the wave (*So, by the time they travelled to the further seismograph, #2, they would have lost some energy and would be shorter*). It is equally acceptable to say that seismograph 1 would measure higher amplitudes or that seismograph 2 would measure shorter amplitudes.

1	**Sample Response** **Sample A** The waves start out really big when they are produced by the earthquake, but they lose amplitude as they travel farther away. **Sample B** The waves would have the most amount of energy when they hit seismograph 1.
	Sample Annotation **Sample A** • The response explains why distance from the epicenter affects the amplitude of the seismic waves (The waves start out really big when they are produced by the earthquake, but they lose amplitude as they travel farther away). Although discussing losing energy would be a better way to answer the question, this response is acceptable and demonstrates partial understanding of the standard. • The response does not explain which seismograph would record a higher amplitude and how that amplitude is related to the energy in the wave. **Sample B** • The response explains which seismograph would record a higher amplitude and how that amplitude is related to the energy in the wave (most amount of energy when they hit seismograph 1). Even though the response does not indicate that the waves would also have the highest amplitude at seismograph 1, this is sufficient to demonstrate partial understanding of the standard. • The response does not explain why distance from the epicenter affects the amplitude of the seismic waves.
0	**Sample Response** **Sample A** Seismograph 1 because it says 75 microns. **Sample B** Seismograph 2 because that location is using fiber optic cables.
	Sample Annotation **Sample A** • The response does not explain why distance from the epicenter affects the amplitude of the seismic waves. • The response does not explain which seismograph would record a higher amplitude and how that amplitude is related to the energy in the wave. Citing the data without making a comparison to the other seismograph does not demonstrate understanding of what the data means. **Sample B** • The response does not explain why distance from the epicenter affects the amplitude of the seismic waves. • The response does not explain which seismograph would record a higher amplitude and how that amplitude is related to the energy in the wave. It is not reasonable to assume that the technologies of the two seismographs vary, since they are being used in a way which requires comparison of the data.

Item Set 2 – Question 8 (Selected Response)

A student claims that less algae would grow in the pond if people living near the pond stopped using fertilizer. Based on the information in Part 2, which statement **best** provides evidence to support the student's claim?

- A. The growth of algae stopped after eight days in the sample with 2 mL of fertilizer.
- B. The sample with 0 mL of fertilizer showed an increase in algae after eight days.
- C. The smallest amount of algae was found in the sample with the darkest water.
- D. The samples with less fertilizer resulted in less growth of algae.

Item Information		
Answer	D	
Standard	Life Science	
Evidence Outcome	SC.MS.2.7.a	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. (MS-LS2-4) (Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.) |SEP 7 EAE|CCC 7 SC|
Disciplinary Core Idea	SC.MS.2.7	Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all of its populations.
Science and Engineering Practice	Engaging in Argument from Evidence	Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
Crosscutting Concept	Stability and Change	

Item Set 2 – Question 9 (Selected Response)

Based on the information, which statement **best** describes how the aquatic plants were affected by the algae bloom?

- A. Photosynthesis by the aquatic plants increased because the algae on the surface allowed sunlight to pass through the water.
- B. Respiration by the aquatic plants increased because the algae on the surface allowed sunlight to pass through the water.
- C. Photosynthesis by the underwater aquatic plants decreased because the algae on the surface blocked the sunlight.
- D. Respiration by the aquatic plants decreased because the algae on the surface blocked the sunlight.

Item Information		
Answer	C	
Standard	Life Science	
Evidence Outcome	SC.MS.2.3.a	Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. (MS-LS1-6) (Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.) (Boundary Statement: Does not include the biochemical mechanisms of photosynthesis.) |SEP 6 CEDS|CCC 5 EM|
Disciplinary Core Idea	SC.MS.2.3	Sustaining life requires substantial energy and matter inputs.
Science and Engineering Practice	Constructing Explanations and Designing Solutions	Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.
Crosscutting Concept	Energy and Matter	

Item Set 2 – Question 10 (TEI Multiple Select)

Based on the information in parts 2 and 3, determine how each component of the pond ecosystem changed between late August and late September.

Select **one** box per row.

Component	Increased	Decreased	Remained the Same
amount of carbon dioxide released by the fish	☐	☑	☐
amount of oxygen released by the algae	☑	☐	☐
amount of energy stored in sugars by the plants	☐	☑	☐

Item Information		
Answer	See Image	
Standard	Life Science	
Evidence Outcome	SC.MS.2.6.a	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. (MS-LS2-3) (Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.) (Boundary Statement: Assessment does not include the use of chemical reactions to describe the processes.) |SEP 2 DUM|CCC 5 EM|
Disciplinary Core Idea	SC.MS.2.6	Ecosystems are sustained by the continuous flow of energy, originating primarily from the sun, and the recycling of matter and nutrients within the system.
Science and Engineering Practice	SEP Not Assessed	N/A
Crosscutting Concept	Energy and Matter	

Item Set 2 – Question 11 (Constructed Response)

Based on the information in Part 2, explain why the water samples were placed next to the window. Your response should include an explanation of:

- why the water samples were placed next to the window
- how the water samples would look different if placed in a dark room throughout the investigation

Item Information		
Answer:	See Scoring Rubric and Sample Student Responses	
Standard:	Life Science	
Evidence Outcome:	SC.MS.2.3.a	Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. (MS-LS1-6) (Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.) (Boundary Statement: Does not include the biochemical mechanisms of photosynthesis.) |SEP 6 CEDS|CCC 5 EM|
Disciplinary Core Idea	SC.MS.2.3	Sustaining life requires substantial energy and matter inputs.
Science and Engineering Practice	Constructing Explanations and Designing Solutions	Construct an explanation using models or representations.
Crosscutting Concept	Energy and Matter	

Scoring Rubric	
Points	**Attributes**
2	**The student's response should include an explanation of:** • Why the water samples were placed next to the window. • How the water samples would look different if placed in a dark room throughout the investigation. **Student responses may include but are not limited to:** The water samples were placed next to the window because the algae need sunlight to perform photosynthesis. If the samples were placed in a dark room, the water samples would be less green (clearer). This is because the algae would be less able to perform photosynthesis and grow.
1	Student response demonstrates a partial understanding of the task.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response**
	Sample A The glasses needed to be near the window because the algae uses the sunlight to get energy to go through photosynthesis. Without the sunlight the algae would not be able to convert carbon dioxide into other molecules to help it grow. If you put it in a dark room it would grow very slowly and the water wouldn't look as dark. **Sample B** The algae needs the sunlight for energy. If it was in a dark room it would have less green stuff floating in it.
	Sample Annotation
	Sample A • The response explains why the water samples were placed next to the window (*the algae uses the sunlight to get energy to go through photosynthesis*). • The response explains how the water samples would look different if placed in a dark room throughout the investigation (*If you put it in a dark room it would grow very slowly and the water wouldn't look as dark*). **Sample B** • The response explains why the water samples were placed next to the window (*needs the sunlight for energy*). This is a minimal, but acceptable, response, since it does not connect the intake of energy to photosynthesis. • The response explains how the water samples would look different if placed in a dark room throughout the investigation (*would have less green stuff floating in it*). Any description of the glass that indicates a slower rate of increase of the algae is acceptable, including lighter in color, less murky, and less plant matter.
1	**Sample Response**
	Sample A The plant needs sunlight to turn CO_2 into O_2. **Sample B** The plant needs sunlight so if it was in a dark room it would sink to the bottom and die.
	Sample Annotation
	Sample A • The response explains why the water samples were placed next to the window (*The plant needs sunlight to turn CO_2 into O_2*). This is a simplified explanation of photosynthesis, which is a process by which the plant takes in carbon dioxide and water and releases oxygen as a by-product. • The response does not address how the water samples would look different if placed in a dark room. **Sample B** • The response explains how the water samples would look different if placed in a dark room throughout the investigation (*it would sink to the bottom and die*). This is acceptable, since it is referring to the picture in the simulation that shows decaying algae at the bottom of the pond. • The response does not explain why the water samples were placed next to the window. The statement given (*The plant needs sunlight*) is too vague and does not demonstrate any understanding of why plants need sunlight – for energy for photosynthesis.

0	**Sample Response**
	Sample A Without sunlight the plant will die. **Sample B** I think they put it by the window because it is warmer there and the water won't freeze. If they put it in a dark room the plant would grow more, like mildew does.
	Sample Annotation
	Sample A • The response does not explain why the water samples were placed next to the window. To receive credit the student must explain why the plants need sunlight. • The response does not explain how the water samples would look different if placed in a dark room. The student must give a physical description of the sample, such as the water is clearer. **Sample B** • The response does not correctly explain why the water samples were placed next to the window. The sun does provide heat, which is a form of energy. However, this response does not demonstrate understanding that the plant is taking in the energy from the sun and using it. • The response does not explain how the water samples would look different if placed in a dark room. The statement that the algae would grow more is incorrect.

Item Set 2 – Question 12 (Constructed Response)

Based on the information, explain how resource availability affects populations in the pond between late August and late September. Your response should include an explanation of how during each of the two time periods:

- the plant population is affected by resource availability
- the fish population is affected by resource availability

Item Information		
Answer	See Scoring Rubric and Sample Student Responses	
Standard	Life Science	
Evidence Outcome	SC.MS.2.5.a	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. (MS-LS2-1) (Clarification Statement: Emphasis is on cause - and - effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.) |SEP 4 AID|CCC 2 CAE|
Disciplinary Core Idea	SC.MS.2.5	Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors.
Science and Engineering Practice	SEP Not Assessed	N/A
Crosscutting Concept	Cause and Effect	

Scoring Rubric	
Points	**Attributes**
2	**The student's response should include an explanation of how during each of the two time periods:** • The plant population is affected by resource availability. • The fish population is affected by resource availability. **Student responses may include but are not limited to:** Between late August and late September, the plant population receives less sunlight due to the growth of the algae on the surface of this pond. Because sunlight becomes more scarce, the plants are less able to perform photosynthesis and the plant population decreases. The fish depend on the plants to provide resources such as sugars and oxygen. As the plant population decreases, the resources available to the fish decrease and the fish population decreases.
1	Student response demonstrates a partial understanding of the task.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response** **Sample A** The resources the plants need are sunlight, carbon dioxide and water, so they can perform photosynthesis and make food for themselves. In early August they have all of those things, but by the end of September they are not getting enough sunlight so they start to die off because the algae is blocking the sun. The fish need to get their food from the plants. If the plants die, the herbivorous fish can't eat and they die and the whole food chain suffers. **Sample B** The sunlight isn't getting to the plants under the water in late September, so they stop growing and the fish eat all of the plants so they run out of food and their population can't grow.
	Sample Annotation
	Sample A • The response explains how during each of the two time periods the plant population is affected by resource availability (*In early August they have all of those things, but by the end of September they are not getting enough sunlight so they start to die off*). • The response explains how during each of the two time periods the fish population is affected by resource availability (*The fish need to get their food from the plants. If the plants die, the herbivorous fish can't eat and they die*). The response receives credit even though it does not mention oxygen. **Sample B** • The response explains how during each of the two time periods the plant population is affected by resource availability (*The sunlight isn't getting to the plants under the water in late September, so they stop growing*). The response is minimal, but acceptable. Although it doesn't explain how the resources change from August to September, it does acknowledge that the sunlight is the resource that is limited in the later time frame. • The response explains how during each of the two time periods the fish population is affected by resource availability (*fish eat all of the plants so they run out of food and their population can't grow*). The population dying out or not growing are equally acceptable response to how the population is affected.

1	**Sample Response**
	Sample A Because the plants are not getting sunlight, they are not making food so they don't grow. This has an effect on the fish and the snails and everything that lives in the pond. **Sample B** When the algae starts to expand and covers more of the pond, the fish have fewer plants to eat and it is colder and therefore they go into hibernation.
	Sample Annotation
	Sample A • The response explains how during each of the two time periods the plant population is affected by resource availability (*Because the plants are not getting sunlight, they are not making food so they don't grow*). • The response does not explain how during each of the two time periods the fish population is affected by resource availability. The statement given (*This has an effect on the fish*) is too vague and does not explain how the fish are affected. **Sample B** • The response explains how during each of the two time periods the fish population is affected by resource availability (*fish have fewer plants to eat and it is colder and therefore they go into hibernation*). This is a reasonable explanation of how the fish population could be affected by limited resource availability. • The response does not address how during each of the two time periods the plant population is affected by resource availability. Stating that there are fewer plants does not provide information on how the reduction in plants is related to the resources the plants need.
0	**Sample Response**
	Sample A The algae blocks the sun from getting to the pond. **Sample B** The algae makes oxygen for the fish.
	Sample Annotation
	Sample A • The response does not explain how during each of the two time periods either the plant population or the fish population is affected by resource availability. It is true that less of the resource is available, but the impact is not addressed. **Sample B** • The response does not address how during each of the two time periods the plant population is affected by resource availability. • The response does not correctly explain how during each of the two time periods the fish population is affected by resource availability. The algae does produce oxygen, but the response does not connect the resource to the effect on the population.

Item Set 2 – Question 13 (Constructed Response)

Based on the information, explain how populations in the pond could change during the following winter and spring. Your response should include an explanation of:

- how the amount of sunlight reaching the pond during the winter could change the algae population
- how this change in the algae population could affect the plant population during the spring

Item Information		
Answer	See Scoring Rubric and Sample Student Responses	
Standard	Life Science	
Evidence Outcome	SC.MS.2.7.a	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. (MS-LS2-4) (Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.) |SEP 7 EAE|CCC 7 SC|
Disciplinary Core Idea	SC.MS.2.7	Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all of its populations.
Science and Engineering Practice	Engaging in Argument from Evidence	Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
Crosscutting Concept	Stability and Change	

Scoring Rubric	
Points	**Attributes**
2	**The student's response should include an explanation of:** • How the amount of sunlight reaching the pond during the winter could change the algae population. • How this change in the algae population could affect the plant population during the spring. **Student responses may include but are not limited to:** Less sunlight will reach the pond during the winter. So, the algae will be less able to perform photosynthesis and grow, and the algae population will likely decrease during the winter. In the spring, more sunlight will be able to pass through the water. So, the plants will be more able to perform photosynthesis and grow, and the plant population will likely increase during the spring.
1	Student response demonstrates a partial understanding of the task.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response** **Sample A** I think that the algae would grow less in the winter because the sunlight is less direct and the sunlight gives the algae energy to grow. If the algae stops growing and some of it dies out, there will be clearer water and the sunlight can reach the plants at the bottom of the pond better when spring comes. This will be good for the plants because they are starting to grow again and can use the sunlight to produce food and grow. **Sample B** In the winter the sun does not shine directly on that part of the Earth, so the pond will freeze and the algae will die. This allows the plants to start growing again in the spring when everything thaws out, because the sunlight can reach the plants.
	Sample Annotation **Sample A** • The response explains how the amount of sunlight reaching the pond during the winter could change the algae population (*I think that the algae would grow less in the winter because the sunlight is less direct and the sunlight gives the algae energy to grow*). • The response explains how this change in the algae population could affect the plant population during the spring (*If the algae stops growing and some of it dies out, there will be clearer water and the sunlight can reach the plants at the bottom of the pond better when spring comes. This will be good for the plants because they are starting to grow again and can use the sunlight to produce food and grow*). The response does not state that the population will increase, but indicating that the plants can grow is sufficient. **Sample B** • The response explains how the amount of sunlight reaching the pond during the winter could change the algae population (*the sun does not shine directly on that part of the Earth, so the pond will freeze and the algae will die*). • The response explains how this change in the algae population could affect the plant population during the spring (*This allows the plants to start growing again in the spring when everything thaws out, because the sunlight can reach the plants*).

1	**Sample Response** **Sample A** I predict that the algae would still get some sunlight during the winter because it is at the top of the pond, so it could still grow and do photosynthesis, so it wouldn't all die. People would have to remove it from the pond in the spring because it will affect the plants and fish. **Sample B** If there is less algae, there is more plants and more fish and snails.
	Sample Annotation **Sample A** • The response explains how the amount of sunlight reaching the pond during the winter could change the algae population (*algae would still get some sunlight during the winter because it is at the top of the pond, so it could still grow and do photosynthesis, so it wouldn't all die*). Since the prompt does not specify how harsh the winter at this pond is, this is a reasonable prediction for the population [no change], correctly supported by the influence of the sun. • The response provides only a partial explanation of how this change in the algae population could affect the plant population during the spring (*People would have to remove it from the pond in the spring because it will make the plants sick*), since it does not specify how the algae makes the plants "sick." **Sample B** • The response explains how this change in the algae population could affect the plant population during the spring (*If there is less algae, there is more plants and more fish and snails*). • The response does not explain how the amount of sunlight reaching the pond during the winter could change the algae population.
0	**Sample Response** **Sample A** The plants and the algae both grow when it is spring because that is when it starts to warm up. **Sample B** They are fertilizing the grass and the fertilizer gets into the pond and makes the algae grow.
	Sample Annotation **Sample A** • The response does not explain how the amount of sunlight could change the algae population or how the amount of algae affects the plants. Saying that the algae grows when it is warmer does not sufficiently address the relationship between the amount of growth and the amount of sunlight. **Sample B** • The response does not explain how the amount of sunlight reaching the pond during the winter could change the algae population. The algae in the simulation does grow better when it has more fertilizer, but this does not show understanding of how the algae population will change in the winter and does not relate the population change to sunshine. • The response does not address how this change in the algae population could affect the plant population during the spring.

Item Set 2 – Question 14 (TEI Inline Choice)

A student learns that total lunar eclipses occur in some years and not in others. The student remembers that there was no total lunar eclipse in the year 2020.

Select one correct response from each drop-down menu to complete the sentences.

During 2020, Earth was never positioned directly between the two other celestial bodies.

As a result, the shadow of Earth never covered the Moon .

Item Information		
Answer	See Image	
Standard	Earth and Space Science	
Evidence Outcome	SC.MS.3.2.c	Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. **(MS-ESS1-1) (Clarification Statement: Examples of models can be physical, graphical, or conceptual.) |SEP 2 DUM|CCC 1 P |**Also assessed as SC.MS.3.1.a under GLE SC.MS.3.1.
Disciplinary Core Idea	SC.MS.3.2	The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.
Science and Engineering Practice	Developing and Using Models	Develop and/or use a model to predict and/or describe phenomena.
Crosscutting Concept	CCC Not Assessed	
P Value	0.17	

ANSWER KEY: ITEM SET 3

Item Set 3 – Question 1 (Selected Response)

Curtains in theaters prevent sound waves from being reflected as echoes. Which model best explains why curtains prevent echoes?

- ○ A. A ball thrown toward a surface will come in contact faster with a soft surface than with a hard surface.
- ○ B. A ball thrown at a surface will hit with a greater force on a soft surface than on a hard surface.
- ○ C. A ball rolled across a surface will roll more quickly on a hard surface than on a soft surface.
- ◉ D. A ball dropped on a surface will bounce more on a hard surface than on a soft surface.

Item Information		
Answer	D	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.8.b	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
Disciplinary Core Idea	SC.MS.1.8	A simple wave model has a repeating pattern with specific wavelength, frequency, and amplitude and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena which include light and sound.
Science and Engineering Practice	Developing and Using Models	Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.
Crosscutting Concept	CCC Not Assessed	

Item Set 3 – Question 2 (TEI Inline Choice)

In the scenario described in Part 1, the student pushes down on the globe and lets it go. Then the globe returns to its original stable position.

Select one correct response from each drop-down menu to complete the sentence.

After the globe is let go, it will return to a stable position when the [magnetic] force equals the [gravitational] force.

Item Information		
Answer	See Image	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.3.b	Plan an investigation to provide evidence that the change in an objects motion depends on the sum of the forces on the object and the mass of the object
Disciplinary Core Idea	SC.MS.1.3	Motion is described relative to a reference frame that must be shared with others and is determined by the sum of the forces acting on it. The greater the mass of the object, the greater the force needed to achieve the same change in motion.
Science and Engineering Practice	Planning and Carrying Out Investigations	Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
Crosscutting Concept	Stability and Change	

Item Set 3 – Question 3 (TEI Inline Choice)

The student completed the ring magnet investigation to help explain the interaction between the two sets of magnets described in Part 2.

Select one correct response from each drop-down menu to complete the sentences.

The investigation was designed to show that [magnetic fields] exist between the upper and lower sets of magnets. The results provide evidence that the magnets exert forces on each other because the upper magnet set [does not touch] the lower set when it is dropped.

Item Information		
Answer	See Image	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.4.c	Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
Disciplinary Core Idea	SC.MS.1.4	Forces that act a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object.
Science and Engineering Practice	Planning and Carrying Out Investigations	Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
Crosscutting Concept	Cause and Effect	

Item Set 3 – Question 4 (TEI Inline Choice)

The data from the investigation in Part 2 show that the final height of three magnets dropped is lower than when one magnet or two magnets are dropped.

Select one correct response from each drop-down menu to complete the sentences.

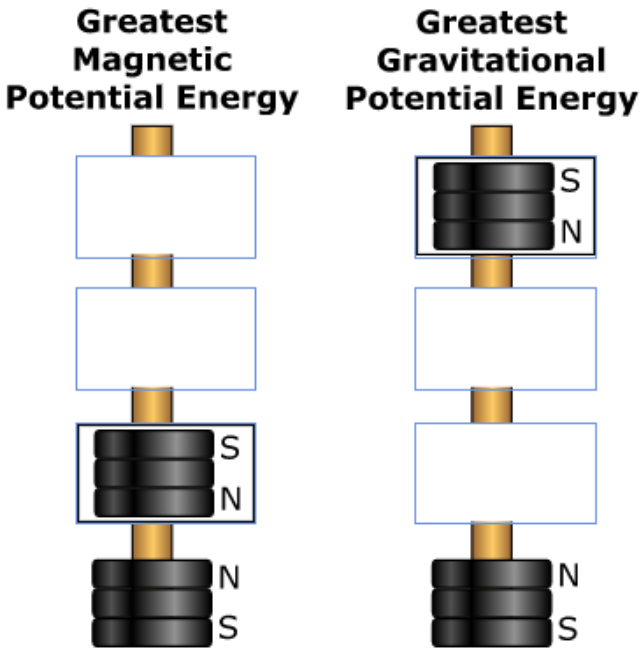
The purpose of the investigation is to show that even when downward force is increased, the magnets continue to [push each other away] . This shows that there is a field coming from [both sets of magnets] .

Item Information		
Answer	See Image	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.4.c	Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
Disciplinary Core Idea	SC.MS.1.4	Forces that act a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object.
Science and Engineering Practice	Planning and Carrying Out Investigations	Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
Crosscutting Concept	Cause and Effect	

Item Set 3 – Question 5 (TEI Drag and Drop)

The sets of magnets described in the investigation in Part 2 demonstrate two kinds of potential energy, magnetic and gravitational. Based on the investigation, show where each kind of potential energy is greatest. The north (N) pole and south (S) pole of each magnet set are specified.

Drag and drop a set of magnets to show the location of the greatest amount of each kind of potential energy. Drag only one set of magnets to the location for the greatest amount of magnetic potential energy, and drag another set to the location for the greatest amount of gravitational potential energy. Fill only one box for each type of potential energy.



Item Information		
Answer	See Image	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.5.b	Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
Disciplinary Core Idea	SC.MS.1.5	Kinetic energy can be distinguished from the various forms of potential energy.
Science and Engineering Practice	Developing and Using Models	Develop and/or use a model to predict and/or describe phenomena.
Crosscutting Concept	Systems and System Models	

Item Set 3 – Question 6 (Constructed Response)

In the scenario described in Part 1, the student plans to change the setup by adding mass to make the globe heavier. Explain what effect the additional mass will have on the globe. Your response should include:

- an explanation of the changed position of the heavier globe
- a description of two different forces acting on the heavier globe

Item Information		
Answer	See Scoring Rubric and Sample Student Responses	
Standard	Physical Science	
Evidence Outcome	SC.MS.1.3.b	Plan an investigation to provide evidence that the change in an objects motion depends on the sum of the forces on the object and the mass of the object.
Disciplinary Core Idea	SC.MS.1.3	Motion is described relative to a reference frame that must be shared with others and is determined by the sum of the forces acting on it. The greater the mass of the object, the greater the force needed to achieve the same change in motion.
Science and Engineering Practice	Planning and Carrying Out Investigations	Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
Crosscutting Concept	Stability and Change	

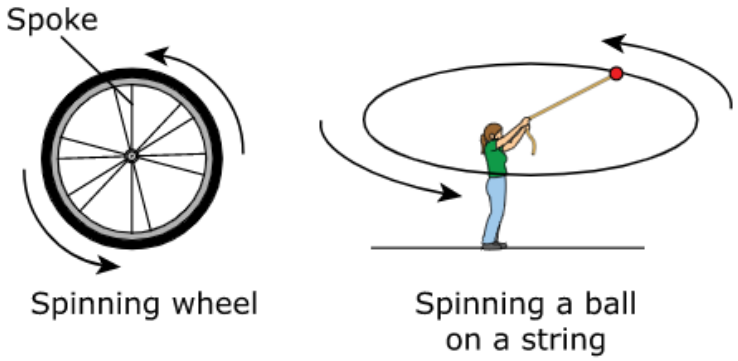
Scoring Rubric	
Points	**Attributes**
2	**The student's response should include:** • An explanation of the changed position of the heavier globe. • A description of two different forces acting on the heavier globe. **Student responses may include but are not limited to:** Mass added to the globe will cause the globe to drop closer to the base. The gravitational force increases when the mass is greater. This brings the globe closer to the base, but the repulsive force of the magnetic base increases when the distance decreases.
1	Student response demonstrates a partial understanding of the task.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response**
	Mass added to the globe will cause the globe to drop closer to the base. The gravitational force increases when the mass is greater. This brings the globe closer to the base, but the repulsive force of the magnetic base increases when the distance decreases.
	Sample Annotation
	This response demonstrates a complete understanding of the task. The student describes both forces acting on the globe (*The gravitational force increases when the mass is greater … but the repulsive force of the magnetic base increases when the distance decreases*) and explains the changed position of the heavier globe (*closer to the base*).
1	**Sample Response**
	If it is heavier, it will be lower than it was before because of its weight and gravity.
	Sample Annotation
	This response demonstrates a partial understanding of the task. The student does not describe the forces acting on the globe but does correctly explain the changed position of the heavier globe (*it will be lower than it was before*).
0	**Sample Response**
	The mass will make it heavier.
	Sample Annotation
	The response does not demonstrate an understanding of the task. There is no description of forces acting on the globe and no explanation of the changed position of the heavier globe.

Item Set 3 – Question 7 (TEI Inline Choice)

A student wants to demonstrate the movement of the planets shown in Part 1.

The student will use one of two different models. On the wheel, the spokes are permanently attached to the center, and the wheel stays round. The person spinning the ball on the string has to continue applying force to the string and ball to keep the ball moving in a circular path.



Select one correct response from each drop-down menu to complete the sentence.

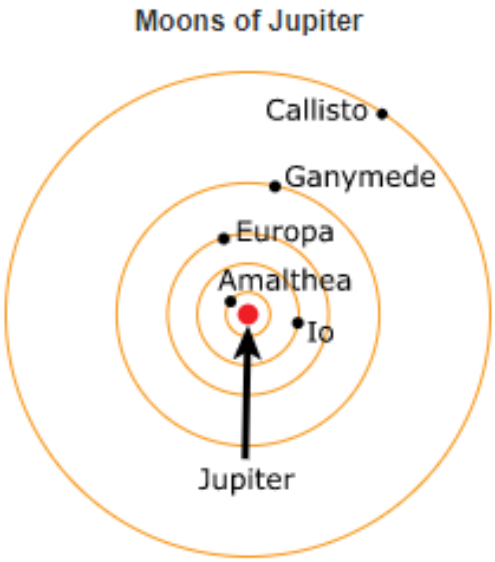
A planet stays in orbit because the Sun's [gravitational force ▾]

acts like a [string that is used to swing a ball ▾] in a circle.

Item Information		
Answer	See Image	
Standard	Earth and Space Science	
Evidence Outcome	SC.MS.3.2.a	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
Disciplinary Core Idea	SC.MS.3.2	The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.
Science and Engineering Practice	Developing and Using Models	Develop and/or use a model to predict and/or describe phenomena.
Crosscutting Concept	Systems and System Models	

Item Set 3 – Question 8 (TEI Inline Choice)

Use the Moons of Jupiter diagram shown, the planetary movement in Part 1, and the table in Part 2 to answer this question.

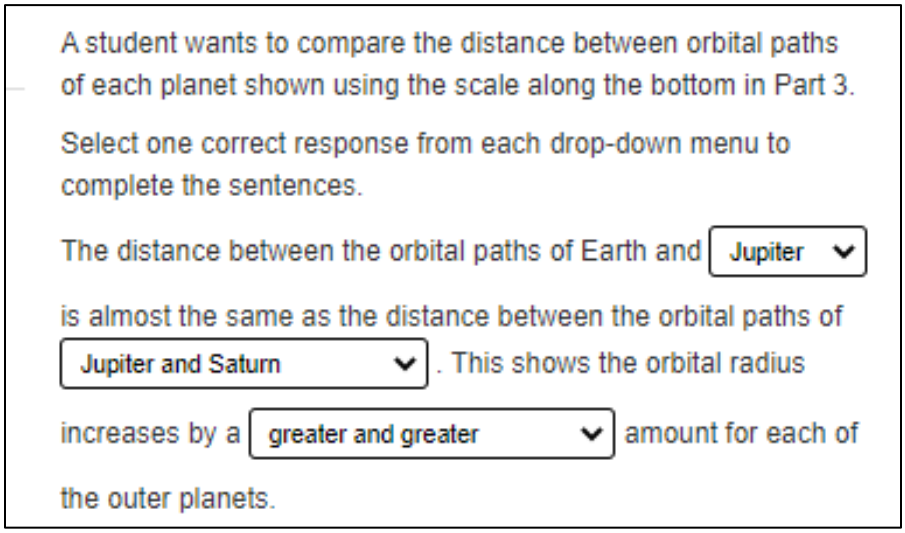


Select one correct response from each drop-down menu to complete the sentence.

The moon Io travels [faster ▾] than Europa because the gravitational force is stronger between Jupiter and moons that are [closer to ▾] the planet.

Item Information		
Answer	See Image	
Standard	Earth and Space Science	
Evidence Outcome	SC.MS.3.2.a	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
Disciplinary Core Idea	SC.MS.3.2	The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.
Science and Engineering Practice	Developing and Using Models	Develop and/or use a model to predict and/or describe phenomena.
Crosscutting Concept	Systems and System Models	

Item Set 3 – Question 9 (TEI Inline Choice)



Item Information		
Answer	See Image	
Standard	Earth and Space Science	
Evidence Outcome	SC.MS.3.2.b	Analyze and interpret data to determine scale properties of objects in the solar system.
Disciplinary Core Idea	SC.MS.3.2	The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.
Science and Engineering Practice	Analyzing and Interpreting Data	Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.
Crosscutting Concept	Scale, Proportion, and Quantity	

Item Set 3 – Question 10 (Constructed Response)

Explain how the planetary motion shown in the simulation in Part 1 and described in the table in Part 2 can be used to describe the effects of gravity on the motions of the solar system, and why designers had to consider the entire system of planets when planning Voyager 2's path. Your response should include explanations of:

- how the simulation models the effect of gravity on planetary motions over time given the planets' locations in the solar system
- why understanding planetary motion was needed to plan Voyager 2's path

Item Information		
Answer	See Scoring Rubric and Sample Student Responses	
Standard	Earth and Space Science	
Evidence Outcome	SC.MS.3.2.a	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
Disciplinary Core Idea	SC.MS.3.2	The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.
Science and Engineering Practice	Developing and Using Models	Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.
Crosscutting Concept	Systems and System Models	

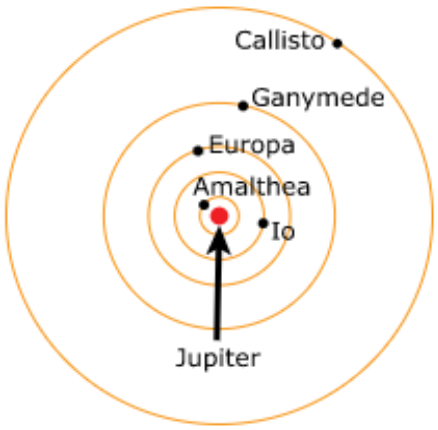
Scoring Rubric	
Points	**Attributes**
2	**The student's response should include an explanation of:** • How the simulation models the effect of gravity on planetary motions over time given the planets' locations in the solar system. • Why understanding planetary motion was needed to plan Voyager 2's path. **Student responses may include but are not limited to:** The planets that are closer to the Sun move faster than planets that are farther away, showing that the gravitational force between the planets and the Sun is much stronger with closer planets. The designers needed to know each planet's movements to design a path to make sure Voyager 2 would fly close enough to observe the planets.
1	Student response demonstrates a partial understanding of the task.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response**
	The planets that are closer to the Sun move faster than planets that are farther away, showing that the gravitational force between the planets and the Sun is much stronger with closer planets. The designers needed to know each planet's movements to design a path to make sure Voyager 2 would fly close enough to observe the planets.
	Sample Annotation
	The response demonstrates a complete understanding of the task. The explanation of how the simulation models the effect of gravity on planetary motions over time is correct *(The planets that are closer to the Sun move faster than planets that are farther away, showing that the gravitational force between planets and the Sun is much stronger with closer planets)*, and the explanation of the necessity to understand planetary motion to plan Voyager 2's path is correct *(needed to know each planet's movements to design a path to make sure Voyager 2 would fly close enough to observe)*.
1	**Sample Response**
	The closer planets have more gravitational force than the farther away ones, so they move faster. The farther away planets move slower because of less force. Voyager started on earth and followed a curving path to visit the other planets.
	Sample Annotation
	The response demonstrates a partial understanding of the task. The explanation of how gravitational force affects planetary motion is correct *(The closer planets have more gravitational force than the farther away ones, so they move faster);* the inverse statement that is also given would also earn credit for the first bullet point on its own *(The farther away planets move slower because of less force)*. The attempted explanation of the necessity to understand planetary motion to plan Voyager 2's path only describes the shape of the path and does not answer the question *(followed a curving path to visit the other planets)*.
0	**Sample Response**
	The smaller the planet, the faster it goes. Earth is small, compared to Jupiter, and it goes much faster.
	Sample Annotation
	This response does not demonstrate an understanding of the task. The explanation of how gravitational force affects planetary motion is incorrect, the speed of the planets in orbit is related mainly to their proximity to the sun due to gravitational forces, not to their sizes. The effect of the varying masses of the planets is negligible compared to the much larger mass of the sun.

Item Set 3 – Question 11 (Constructed Response)

Study the Moons of Jupiter diagram, which shows Jupiter and the orbital paths of its moons.

Moons of Jupiter



Compare the Sun and planets system in Part 3 with the Jupiter and moons system shown in the diagram. Your response should include:

- a comparison of how the two systems are similar
- an explanation of the role of gravity in both systems

Item Information		
Answer	See Scoring Rubric and Sample Student Responses	
Standard	Earth and Space Science	
Evidence Outcome	SC.MS.3.2.a	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
Disciplinary Core Idea	SC.MS.3.2	The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.
Science and Engineering Practice	Developing and Using Models	Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.
Crosscutting Concept	Systems and System Models	

Scoring Rubric	
Points	**Attributes**
2	**The student's response should include:** • A comparison of how the two systems are similar. • An explanation of the role of gravity in both systems. **Student responses may include but are not limited to:** The Sun is at the center of the solar system, while the planets are revolving around it in their orbits. Similarly, Jupiter is at the center of its system, while its moons are revolving around it in their own orbits. The gravitational force of the Sun makes its planets revolve around it, while the gravitational force of Jupiter makes its moons revolve around it.[Student may also mention that the Sun is very large or massive compared to the planets, and that Jupiter is very large or massive compared to its moons.]

1	Student response demonstrates a partial understanding of the task.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response**
	The Sun is at the center of the solar system, while the planets are revolving around it in their orbits. Similarly, Jupiter is at the center of its system, while its moons are revolving around it in their own orbits. The gravitational force of the Sun makes its planets revolve around it, while the gravitational force of Jupiter makes its moons revolve around it.
	Sample Annotation
	The student demonstrates a complete understanding of the task. The response compares how the systems are similar, noting that the Sun and Jupiter are at the centers of their respective systems *(The Sun is at the center of the solar system, while the planets are revolving around it in their orbits. Similarly, Jupiter is at the center of its system, while its moons are revolving around it in their own orbits).* The response also explains the role of gravity in both systems *(The gravitational force of the Sun makes its planets revolve around it, while the gravitational force of Jupiter makes its moons revolve around it).* [Student may also mention that the Sun is very large or massive compared to the planets, and that Jupiter is very large or massive compared to its moons.]
1	**Sample Response**
	Part 3 shows the Sun and planets and the Jupiter diagram shows Jupiter and its moons. Without the gravitational forces of the Sun and Jupiter, the planets and moons would just go flying off into space.
	Sample Annotation
	The response demonstrates a partial understanding of the task. The comparison is too general because it does not indicate that both systems have satellites orbiting a larger central body, the Sun in one and Jupiter in the other *(Part 3 shows the Sun and planets and the Jupiter diagram shows Jupiter and its moons).* The explanation of the role of gravitational forces, even though it is stated in the negative, is correct and complete *(Without the gravitational forces of the Sun and Jupiter, the planets and moons would just go flying off into space).*
0	**Sample Response**
	Both of the diagrams have things in the center with circles going around them. Gravity keeps us on the ground so we don't go floating off into space.
	Sample Annotation
	This response does not demonstrate an understanding of the task. The comparison is a description of the diagrams only, not what is represented in the diagrams *(things in the center with circles going around them).* The statement about gravity addresses the role of gravity on Earth *(Gravity keeps us on the ground)* not the role of gravitational forces causing the planets to orbit the Sun or the moons to orbit Jupiter.

Item Set 3 – Question 12 (Constructed Response)

Use the AU scale across the bottom of Part 3 to compare the relative distances of the different planets' orbits from one another. With this information, identify three planets where the distance between the orbits of the first two planets is almost the same distance between the orbits of the second and third planets. Your response should include:

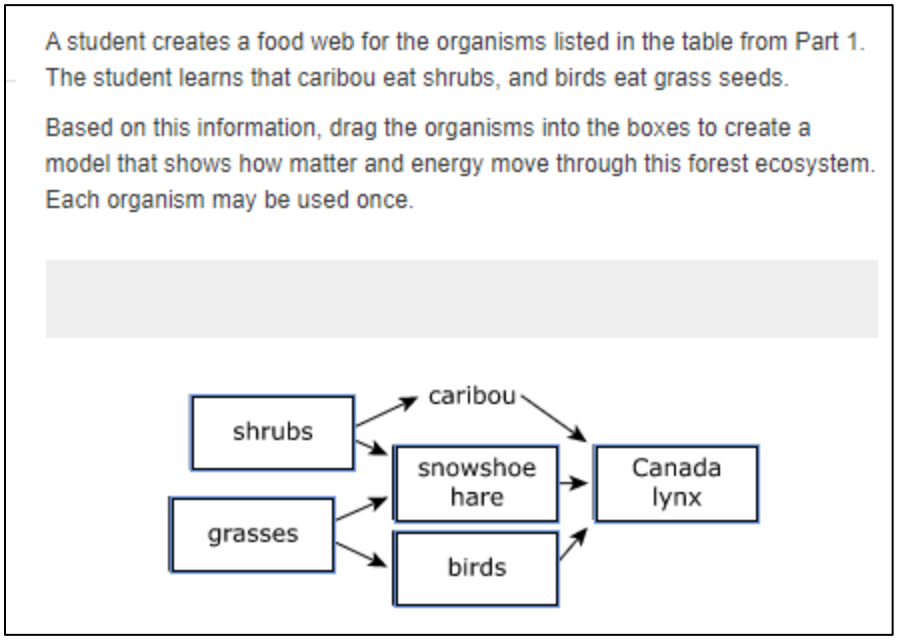
- the distances between orbits of the **three** particular planets from the simulation
- an explanation of how evidence from Part 3 supports your selection of those planets

Item Information		
Answer	See Scoring Rubric and Sample Student Responses	
Standard	Earth and Space Science	
Evidence Outcome	SC.MS.3.2.b	Analyze and interpret data to determine scale properties of objects in the solar system.
Disciplinary Core Idea	SC.MS.3.2	The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.
Science and Engineering Practice	Analyzing and Interpreting Data	Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.
Crosscutting Concept	Scale, Proportion, and Quantity	

Scoring Rubric	
Points	**Attributes**
2	**The student's response should include:** • The distances between orbits of the three particular planets from the simulation. • An explanation of how evidence from Part 3 supports your selection of those planets. **Student responses may include but are not limited to:** The distance between Earth and Jupiter is 4 AU, while the distance from Jupiter to Saturn is 5 AU. Those numbers are very similar, more similar than the distances between other orbits. OR The distance between the orbits of Saturn and Uranus and the distance between the orbits of Uranus and Neptune are about the same. The AU scale showing the distance of the planets from the Sun shows that Saturn is 10 AU distant, Uranus is 19 AU distant, and Neptune is 30 AU distant. So the distance between Saturn and Uranus is 9 AU, while the distance from Uranus to Neptune is 11 AU.
1	Student response demonstrates a partial understanding of the task.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response**
	The distance between the orbits of Saturn and Uranus and the distance between the orbits of Uranus and Neptune are about the same. The AU scale showing the distance of the planets from the Sun shows that Saturn is 10 AU distant, Uranus is 19 AU distant, and Neptune is 30 AU distant. So the distance between Saturn and Uranus is 9 AU, while the distance from Uranus to Neptune is 11 AU.
	Sample Annotation
	This response demonstrates a complete understanding of the task. The appropriate distances are given *(the distance between Saturn and Uranus is 9 AU, while the distance from Uranus to Neptune is 11 AU),* and the explanation of evidence from Part 3 is correct *(AU scale … shows that Saturn is 10 AU distant, Uranus is 19 AU distant, and Neptune is 30)*. **Note:** The planets Earth, Jupiter, and Saturn could also be used. The distance between the orbits of Earth and Jupiter is 4 AU; the distance between the orbits of Jupiter and Saturn is 5 AU.
1	**Sample Response**
	I chose Saturn, Uranus, and Neptune for my planets. Saturn and Uranus look to be just under 10 AU apart and Uranus and Neptune look just over 10 AU apart.
	Sample Annotation
	This response demonstrates a partial understanding of the task. A group of three acceptable planets have been selected and the approximate distances between their orbits have been given *(Saturn and Uranus look to be just under 10 AU apart and Uranus and Neptune look just over 10 AU apart).* However, there is no use of data from the AU scale in Part 3 to give the total sizes of the planets' orbits, which would justify the distances given *(just under 10 AU apart … just over 10 AU apart)*.
0	**Sample Response**
	I think Mercury, Venus and Earth are the planets to use. Mercury and Venus are all closer to the Sun than the Earth, so their orbits would be less than 1, so they are closer together than the other planets shown in part 3.
	Sample Annotation
	This response does not demonstrate an understanding of the task. Two of the three planets chosen do not appear in Part 3 *(Mercury, Venus)*. The determination of orbit size follows correct logic, but since the planets do not appear in Part 3, measurement of their orbits cannot be made, so no credit is given.

Item Set 3 – Question 13 (TEI Drag and Drop)



Item Information		
Answer	See Image	
Standard	Life Science	
Evidence Outcome	SC.MS.2.6.a	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
Disciplinary Core Idea	SC.MS.2.6	Ecosystems are sustained by the continuous flow of energy, originating primarily from the sun, and the recycling of matter and nutrients within the system.
Science and Engineering Practice	Developing and Using Models	Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.
Crosscutting Concept	Energy and Matter	

Item Set 3 – Question 14 (Selected Response)

Based on the information in Part 2, which year in the study was **most likely** associated with a decrease in available energy from plants?

- (●) A. Year 9
- ( ) B. Year 15
- ( ) C. Year 27
- ( ) D. Year 45

Item Information		
Answer	A	
Standard	Life Science	
Evidence Outcome	SC.MS.2.5.a	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
Disciplinary Core Idea	SC.MS.2.5	Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors.
Science and Engineering Practice	Analyzing and Interpreting Data	Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
Crosscutting Concept	Cause and Effect	

Item Set 3 – Question 15 (Selected Response)

Based on the information in Part 1 and Part 2, which statement **most likely** explains the conditions between Year 15 and Year 20?

- A. A decrease in caribou population in Year 17 led to a decrease in the Canada lynx population and an increase in the snowshoe hare population in Year 20.
- B. A disease slowed the population growth of Canada lynx in Year 17, but the disease did not affect the snowshoe hare population in that same year.
- C. A new predator of snowshoe hares migrated to the area in Year 17, which led to an increase in the Canada lynx population in Year 20.
- D. A severe drought in Year 17 caused a sharp reduction in both the Canada lynx population and the snowshoe hare population.

Item Information		
Answer	D	
Standard	Life Science	
Evidence Outcome	SC.MS.2.7.a	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
Disciplinary Core Idea	SC.MS.2.7	Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all of its populations.
Science and Engineering Practice	Engaging in Argument from Evidence	Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
Crosscutting Concept	Stability and Change	

Item Set 3 – Question 16 (TEI Inline Choice)

The maps in Part 3 show the ranges for the Canada lynx and the snowshoe hare. The scientists collected data on sightings of these animals during the study. They observed that the Canada lynx traveled outside their normal range at certain times.

Select one correct response from each drop-down menu to complete the sentence.

Based on the information in Part 1 and Part 2, the **most likely** year during the study when Canada lynx were observed outside their range is [Year 30 ▾]

because the main food source for the Canada lynx was [less abundant ▾]

during this year.

Item Information		
Answer	See Image	
Standard	Life Science	
Evidence Outcome	SC.MS.2.5.b	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
Disciplinary Core Idea	SC.MS.2.5	Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors.
Science and Engineering Practice	Constructing Explanations and Designing Solutions	Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.
Crosscutting Concept	Patterns	

Item Set 3 – Question 17 (Constructed Response)

A disease that affects snowshoe hares may also have an effect on the ecosystem. Based on the information in Part 1, explain how a disease affecting the snowshoe hare population would affect the overall ecosystem. Your response should include:

- how the disease would cause a decrease in population of some organisms in the ecosystem
- how the disease would cause an increase in population of other organisms in the ecosystem

Item Information		
Answer	See Scoring Rubric and Sample Student Responses	
Standard	Life Science	
Evidence Outcome	SC.MS.2.5.a	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
Disciplinary Core Idea	SC.MS.2.5	Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors.
Science and Engineering Practice	Analyzing and Interpreting Data	Analyze and interpret data to provide evidence for phenomena.
Crosscutting Concept	Cause and Effect	

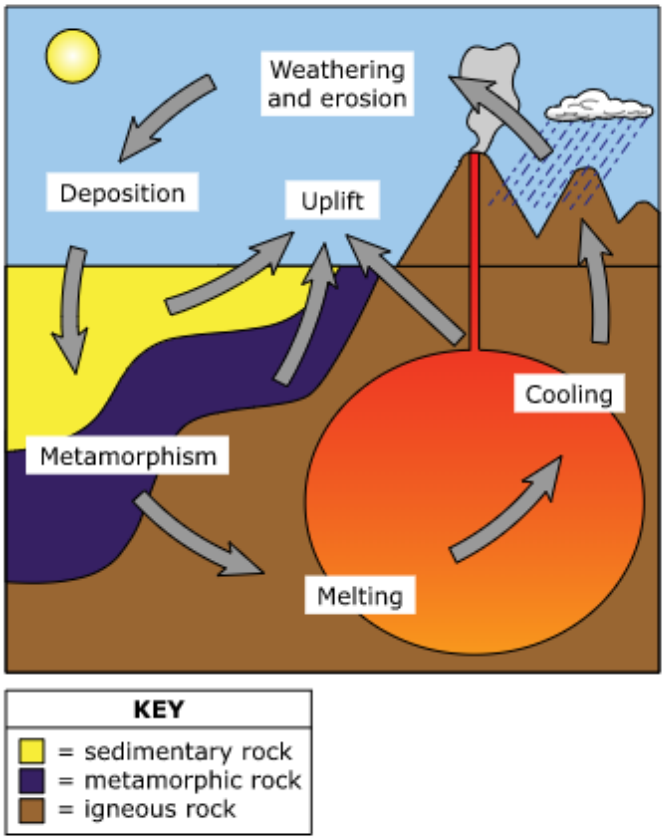
Scoring Rubric	
Points	**Attributes**
2	**The student's response should include:** • How the disease would cause a decrease in population of some organisms in the ecosystem. • How the disease would cause an increase in population of other organisms in the ecosystem. **Student responses may include but are not limited to:** Fewer snowshoe hares would cause a decrease in the number of birds because the Canada lynx would need to increase the amount of other food sources to replace their main source of prey. A decrease in snowshoe hares would cause an increase in the grasses because the grasses are one of the snowshoe hare's main food sources. (Note: Other valid approaches using organisms not in the scenario are acceptable.)
1	Student response demonstrates a partial understanding of the task.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses *Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.*	
Points	
2	**Sample Response**
	Fewer snowshoe hares would cause a decrease in the number of birds because the Canada lynx would need to increase the amount of other food sources to replace their main source of prey. A decrease in snowshoe hares would cause an increase in the grasses because the grasses are one of the snowshoe hare's main food sources.
	Sample Annotation
	This response demonstrates a complete understanding of the task. The student correctly describes how a population would decrease (*a decrease in the number of birds because the Canada lynx would need to increase the amount of other food sources*) and how a population would increase (*an increase in the grasses because the grasses are one of the snowshoe hare's main food sources*).
1	**Sample Response**
	The lynx population would increase because they would start catching caribou and caribou are way bigger than hares. The hare eats plants with soft stems and grass so if the hare is not there to eat them because it died of a disease there would be more of those.
	Sample Annotation
	This response demonstrates a partial understanding of the task. The student correctly describes how a population would increase (*The hare eats plants with soft stems and grass so if the hare is not there to eat them because it died of a disease there would be more of those*). However, the student provides flawed logic about the connection between the lynx and the caribou populations and does not attempt to explain a decrease in any of the populations.
0	**Sample Response**
	The lynx eats the hare.
	Sample Annotation
	This response does not demonstrate an understanding of the task. No population increase or decrease is described.

Item Set 3 – Question 18 (Selected Response)

This model shows interactions in one of Earth's systems.

The Rock Cycle



How does energy from the Sun affect this cycle?

- A. It causes heating of water that results in weathering and erosion.
- B. It causes heating of rocks that results in metamorphism.
- C. It causes heating of Earth that results in melting.
- D. It causes heating of the air that results in uplift.

Item Information		
Answer	A	
Standard	Earth and Space Science	
Evidence Outcome	SC.MS.3.4.a	Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
Disciplinary Core Idea	SC.MS.3.4	Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes.
Science and Engineering Practice	Developing and Using Models	Develop and/or use a model to predict and/or describe phenomena.
Crosscutting Concept	Stability and Change	