



Colorado Measures of Academic Success



Middle School Science



Paper Practice Resource for Students

1. 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.

2. 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

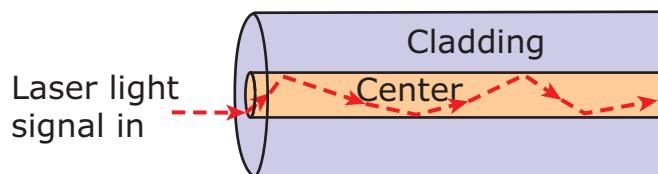
Direction: Use the information to answer questions 3 through 7.

Part 1

A seismograph is used to measure seismic waves traveling through Earth. Seismographs are difficult to use in deep water, so scientists have discovered how to use fiber-optic cables along the ocean floor as earthquake sensors.

A laser produces a light signal that moves through a central part of the cable, which is made of pure glass. A different type of glass, called cladding, surrounds the pure glass and keeps the light signal moving through the center, as shown in Figure 1.

Figure 1: Transmission End of Cable



When a seismic wave disturbs the cable, the light is distorted and scattered, as shown in Figure 2 and Figure 3. By comparing how the laser light signal changes as it moves through the cable, the scientists can determine the approximate location and identify the magnitude of the earthquake.

Figure 2: Cable along the Ocean Floor

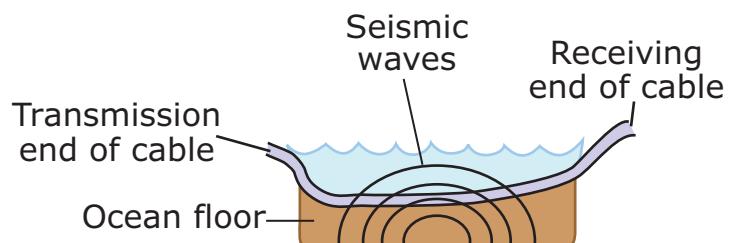
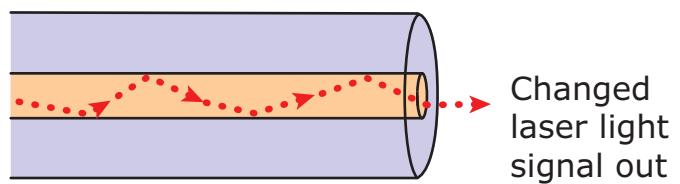


Figure 3: Receiving End of Cable



Part 2

Seismic waves are recorded by a network of seismographs. By comparing the arrival times of the seismic waves at the different seismographs, scientists can identify the magnitude and location of the earthquake's epicenter.

Figure 4 shows the epicenter of an earthquake and two seismograph locations that record the seismic waves from that earthquake. Seismograph 1 records a maximum amplitude of 75 microns, while a maximum amplitude of 37 microns is recorded at Seismograph 2.

Figure 4: Earthquake Epicenter and Seismograph Locations

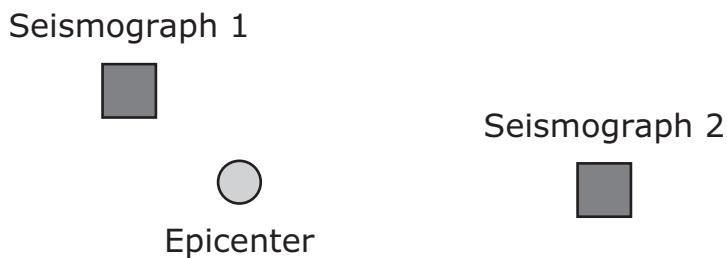


Figure 5 shows an analog seismograph. Ground movement causes the base of the seismograph to move while a pen attached to a weight remains still. A rotating paper drum beneath the pen captures the relative motion between the pen and the base.

Figure 5: Analog Seismograph

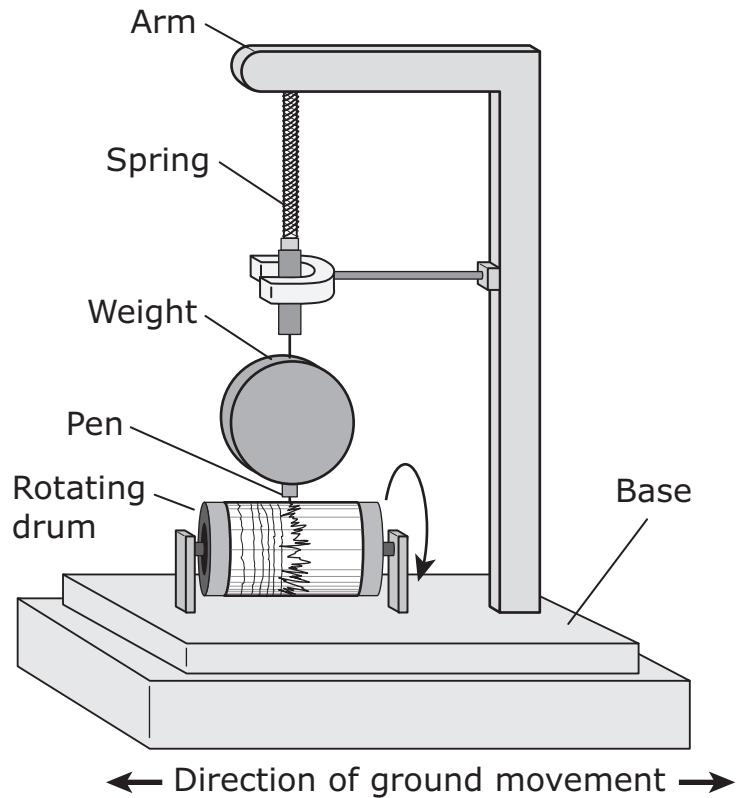


Figure 6 shows the output of the analog seismograph, called a seismogram. Lines with small disturbances result from strong winds or nearby cars vibrating the ground. Lines with much larger disturbances are caused by stronger ground movement or seismic waves.

Figure 6: Analog Seismogram

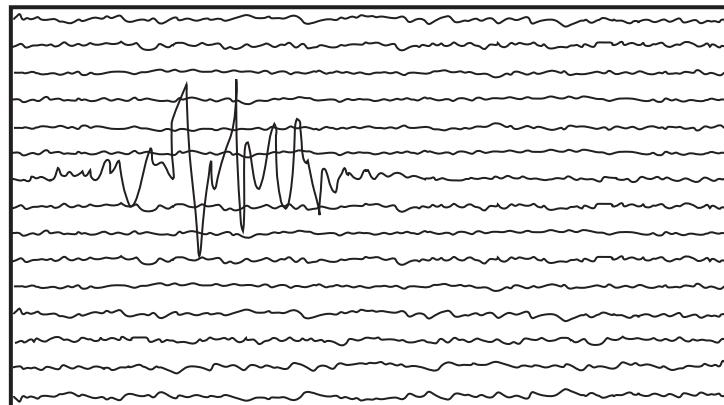
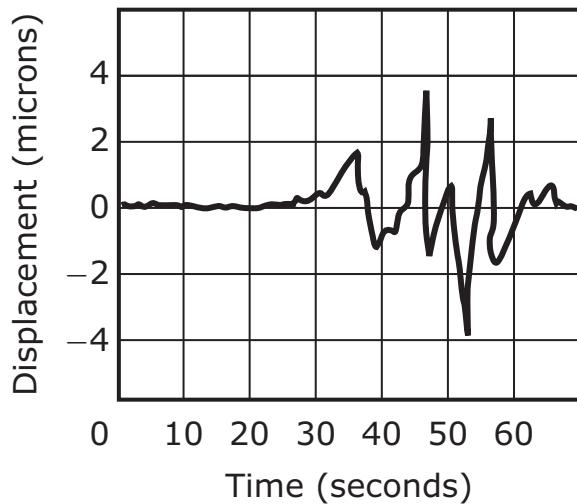


Figure 7 shows a digital seismogram, captured with electronic equipment and displayed by a computer. The displacement is how far the ground around the seismogram is moved by the seismic wave. A micron is equal to 0.0001 millimeters.

Figure 7: Digital Seismogram



- 3.** Based on the information in Part 2, identify the type of seismogram, analog or digital, that is more reliable and explain why.

Circle one correct response from each box to complete the sentence.

The _____ seismogram is easier to store, move, and compare

analog

digital

because it exists as _____.

electronically sampled data

a fixed physical structure

- 4.** 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.

Circle one correct response from each box to complete the sentence.

The energy at 47 seconds will be _____ as great because

four times

twice

the _____ is _____ as great.

amplitude

wavelength

four times

twice

5. 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.

6. 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.

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

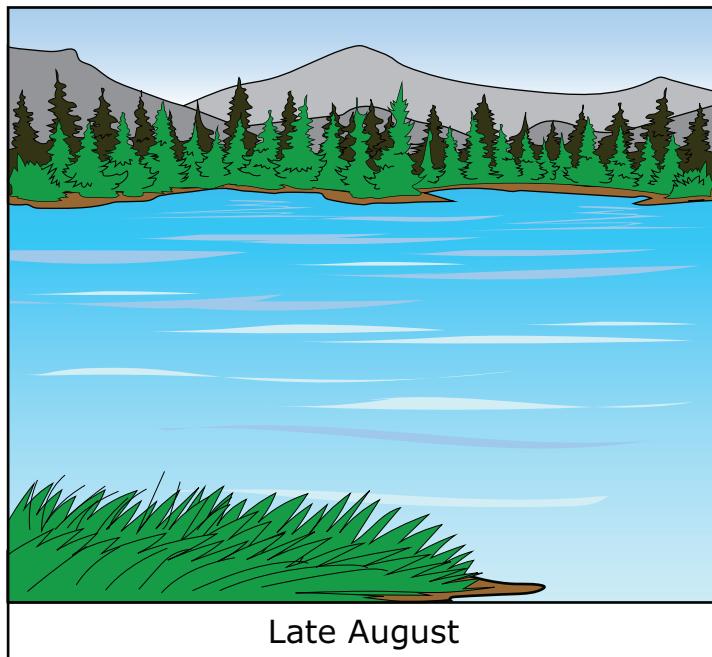
- why distance from the epicenter affects the amplitude of the seismic waves
- which seismograph would record a higher amplitude and how that amplitude is related to the energy in the wave

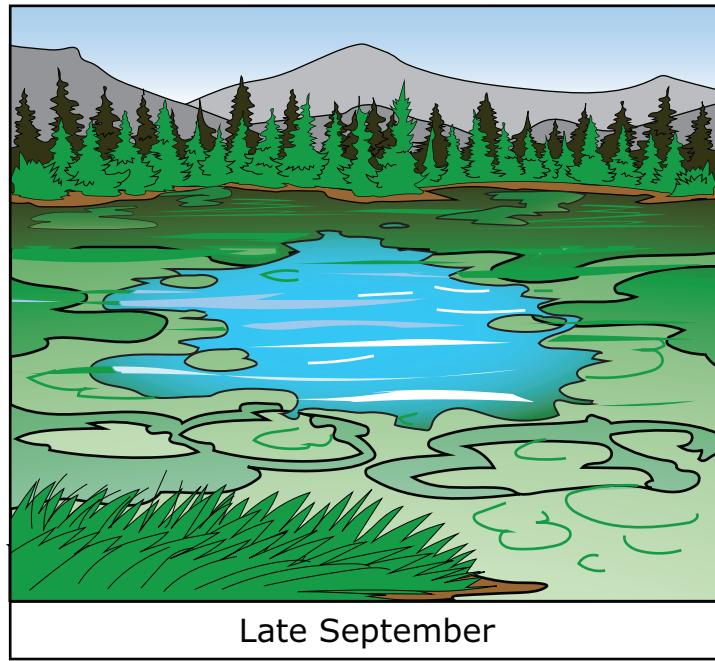
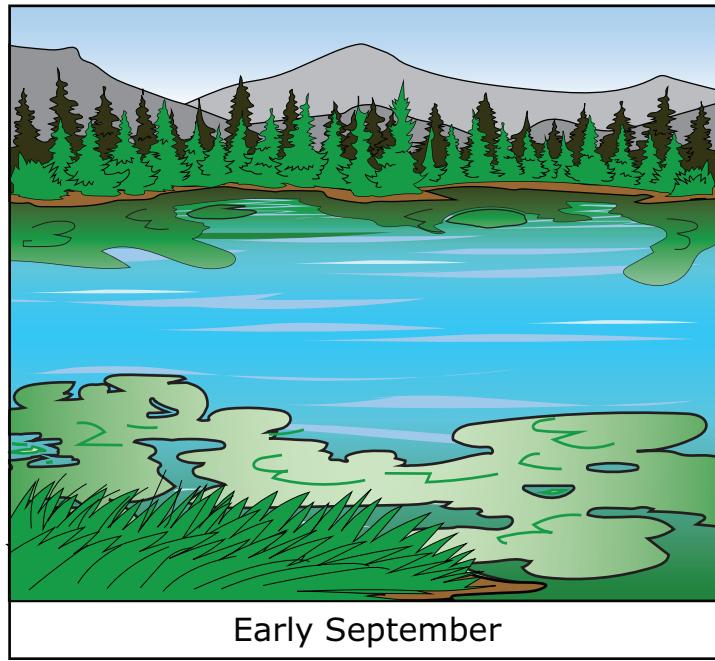
Directions: Use the information to answer questions 8 through 13.

Two students visit a nearby park and notice more and more algae covering a pond with every visit. The students wonder what is causing the growth of algae. They observe a worker applying fertilizer to plants near the pond and wonder whether the fertilizer causes the growth of algae.

Part 1

The students look at three pictures of the pond at different times of the year: late August, early September, and late September.



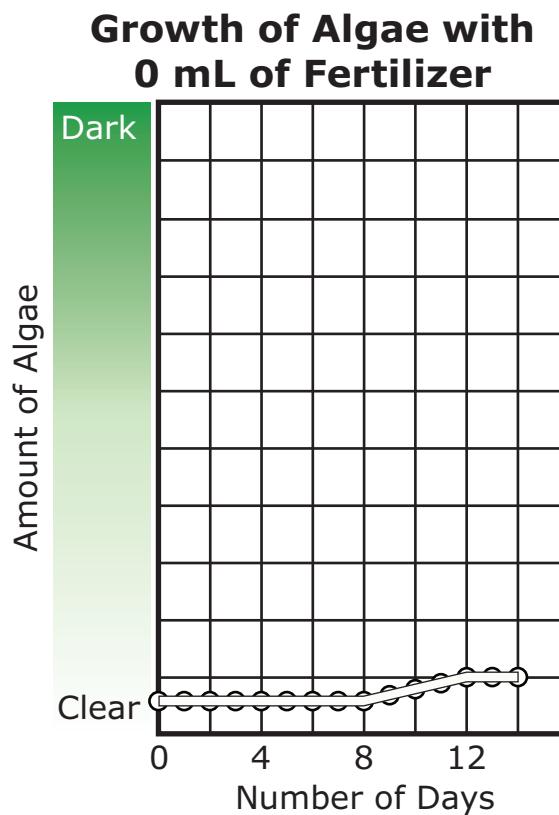
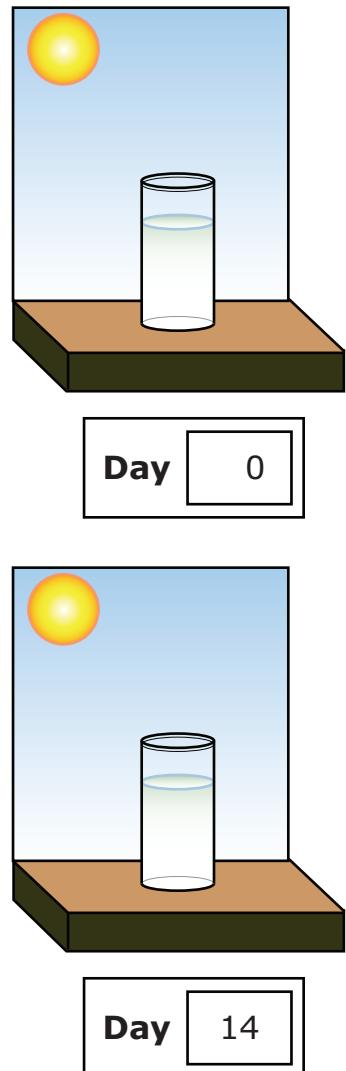


Part 2

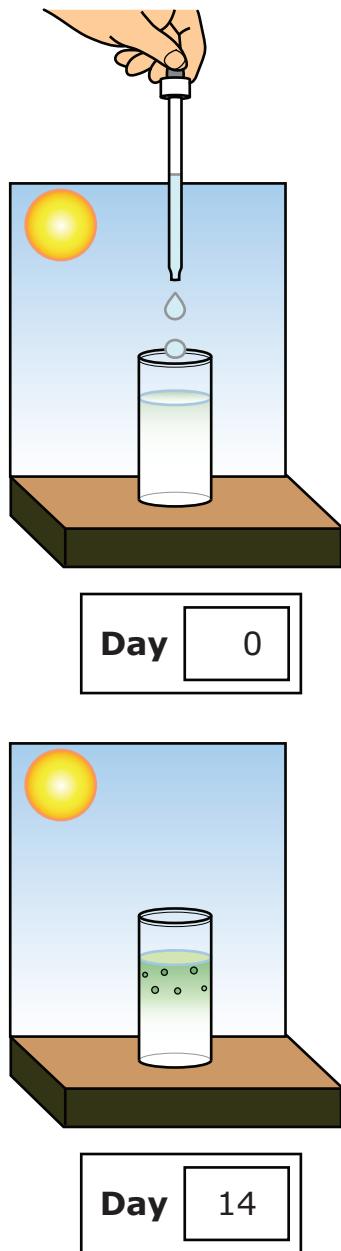
The students investigate how different amounts of fertilizer affect pond water. They add the same volume of pond water to three containers. They do not add any fertilizer to the first container. They add 2 milliliters (mL) of fertilizer to the second container and 4 mL of fertilizer to the third container. Then, they set all three containers on a windowsill for 14 days.

The pictures show the setup and results for three trials in the students' investigation.

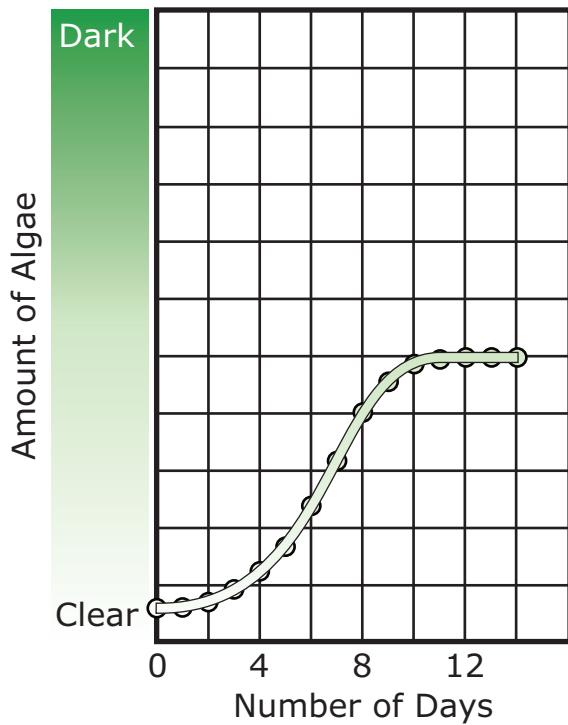
Pond Water with 0 mL of Fertilizer Added



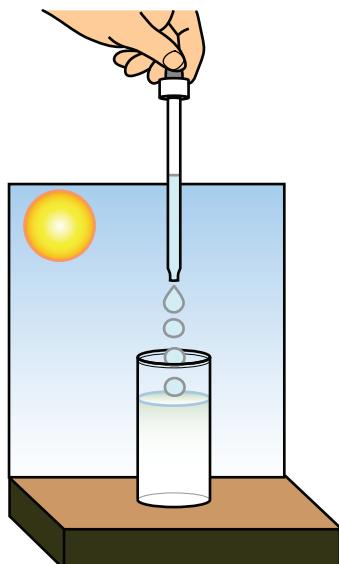
Pond Water with 2 mL of Fertilizer Added



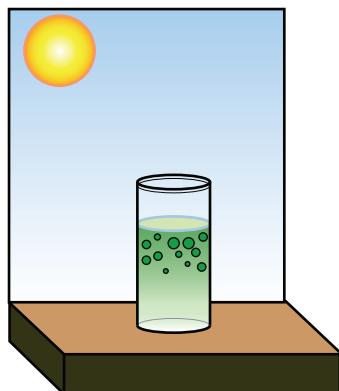
Growth of Algae with 2 mL of Fertilizer



Pond Water with 4 mL of Fertilizer Added

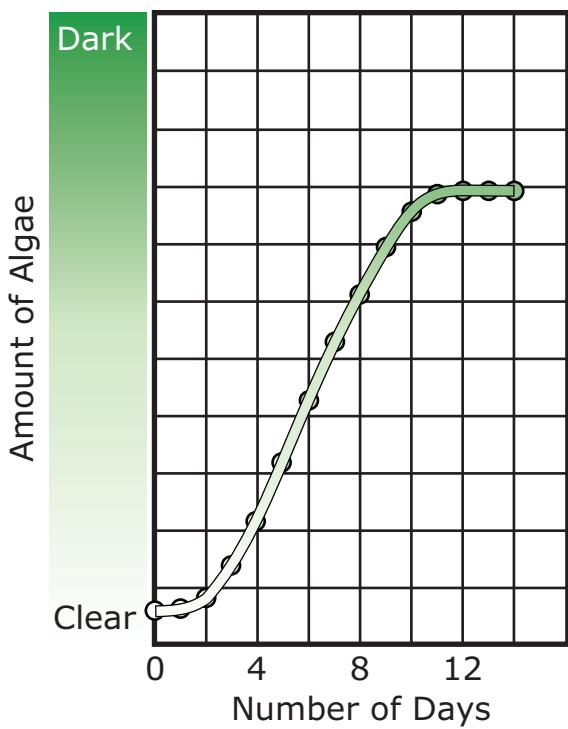


Day

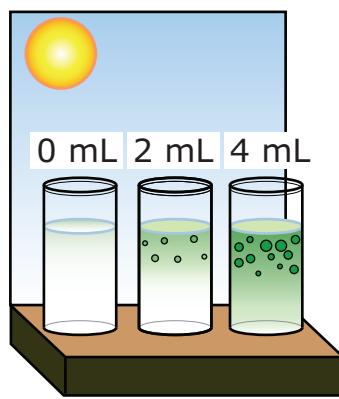


Day

Growth of Algae with 4 mL of Fertilizer

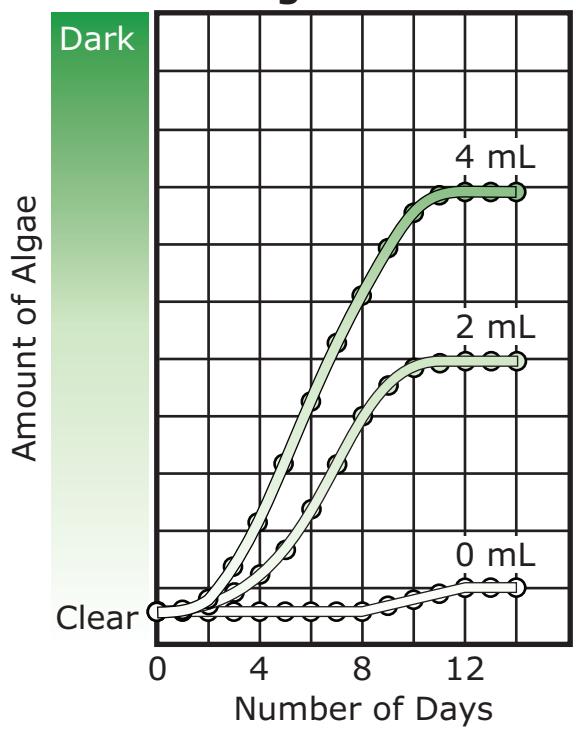


Comparison of All Trials



Day 14

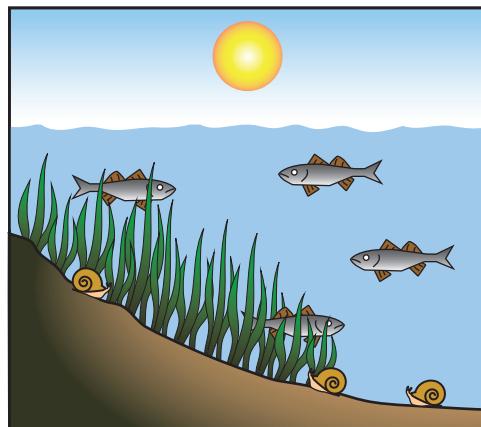
Growth of Algae in All Trials



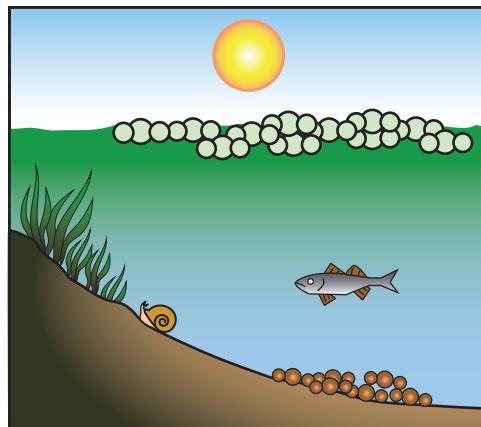
Part 3

The students create a model of the pond showing the ecosystem in late August and late September.

Underwater Ecosystem



Late August



Late September

KEY	
○○ = living algae	🐟 = fish
●● = decaying algae	eed = aquatic plants
蜗牛 = freshwater snail	

8. 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.

9. 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.

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

Place a check mark (✓) to select an answer in each row. Select **one** box per row.

Component	Increased	Decreased	Remained the Same
amount of carbon dioxide released by the fish	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
amount of oxygen released by the algae	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
amount of energy stored in sugars by the plants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11. 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

12. 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

- 13.** 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

- 14.** 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.

Circle one correct response from each box to complete the sentences.

During 2020, _____ was never positioned directly between the

the Moon
 the Sun
 Earth

two other celestial bodies. As a result, the shadow

of _____.

Earth never covered the Moon
 the Moon never fell on Earth

This is the end of Item Set 1.

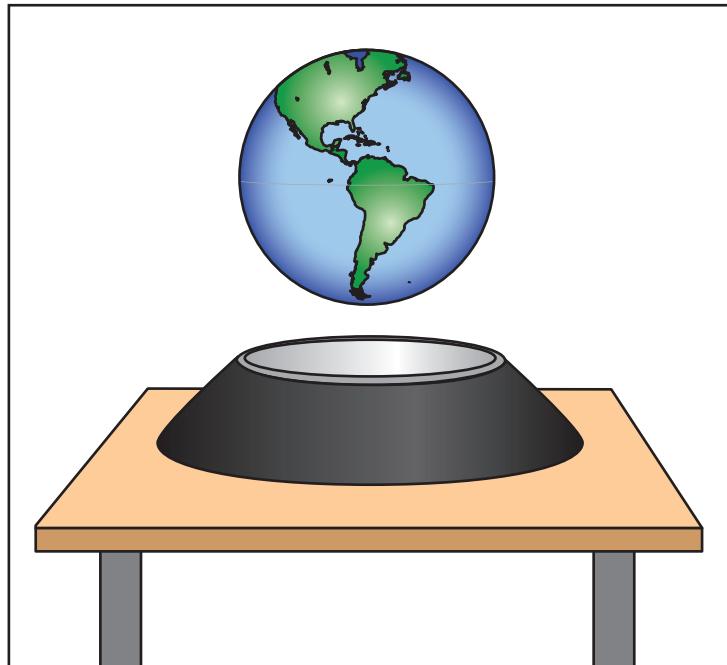
1. Curtains in theaters prevent sound waves from being reflected as echoes. Which model best explains why curtains prevent echoes?
- (A) A ball thrown toward a surface will come in contact faster with a soft surface than with a hard surface.
 - (B) A ball thrown at a surface will hit with a greater force 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.

Directions: Use the information to answer questions 2 through 6.

Part 1

A student is curious about a toy in the classroom. The toy is a small globe that floats in place over a special base. The globe does not rise, fall, or move from side to side. The student wonders what forces are needed to cause this effect.

Figure 1: Toy Globe



Part 2

The student investigates the forces that make the toy globe float. The student uses ring magnets and places a wooden rod through the hole in the magnets. The student drops different numbers of ring magnets down the rod from different heights, in centimeters (cm). The magnets fall close to another set of magnets at the bottom of the rod. Then the bottom magnets push the falling magnets back up.

Figure 2: Ring Magnets and Wooden Rod

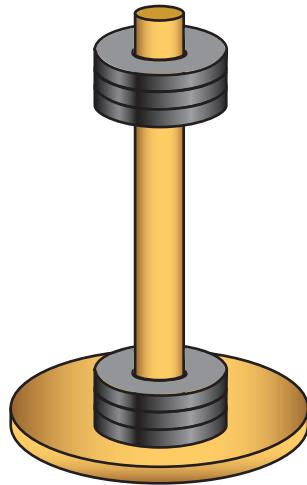
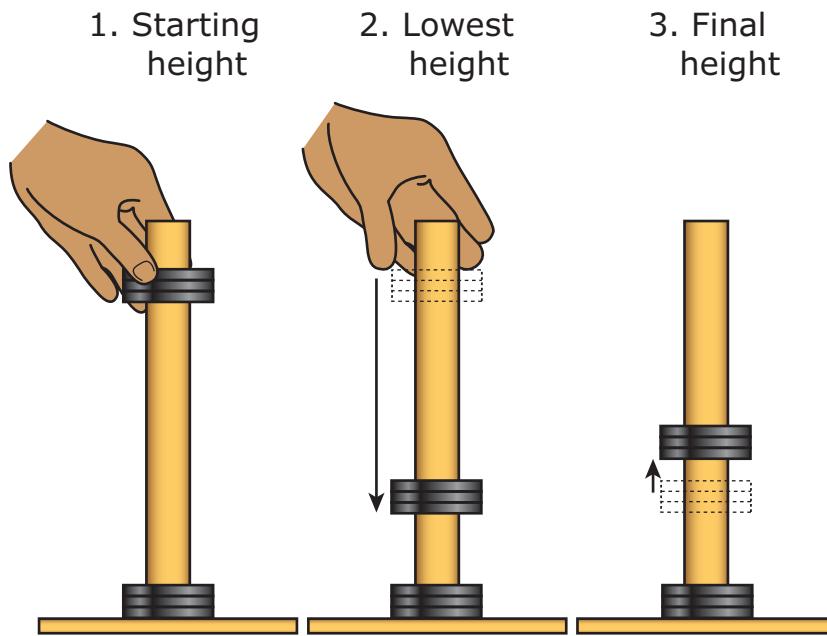


Figure 3: Movement of Dropped Magnets



The table shows the data the student collects.

Trial	Magnets Dropped	Height (cm)		
		Start	Lowest	Final
1	1	14.0	4.4	6.6
2	1	11.9	4.9	6.2
3	1	9.8	5.5	6.5
4	2	13.9	3.8	6.1
5	2	11.0	4.6	6.1
6	2	10.0	4.7	6.4
7	3	13.8	3.5	5.9
8	3	12.1	3.9	5.9
9	3	10.1	4.6	5.9

- 2.** 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.

Circle one correct response in each box to complete the sentence.

After the globe is let go, it will return to a stable position when the _____ force equals the _____ force.

frictional
magnetic

electrical
gravitational

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

Circle one correct response in each box to complete the sentences.

The investigation was designed to show that _____ exist

electrical currents
magnetic fields

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 _____ the lower set when it is dropped.

does not touch
collides with

- 4.** 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.

Circle one correct response from each box to complete the sentences.

The purpose of the investigation is to show that even when downward force is increased, the magnets continue to _____.

pull each other together
 push each other away

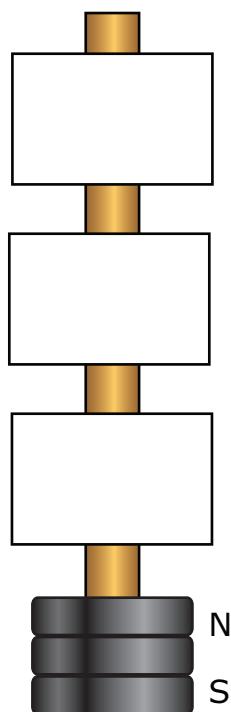
This shows that there is a field coming from _____.

the bottom set of magnets
 the top set of magnets
 both sets of magnets

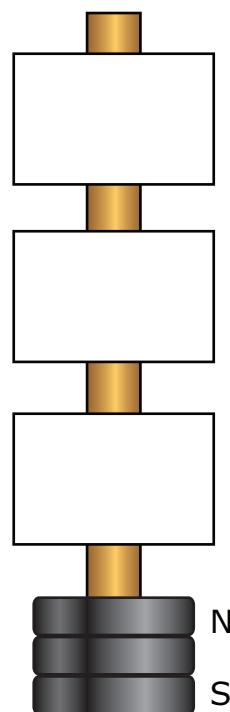
5. The sets of magnets described in the investigation in Part 2 demonstrate two kinds of potential energy, magnetic and gravitational. Based on the investigation, show where each kind of potential energy is greatest. The north (N) pole and south (S) pole of each magnet set are specified.

Draw an X in the box that shows the location of the greatest amount of each kind of potential energy. Draw only one X in the location for the greatest amount of magnetic potential energy, and draw another X in the location for the greatest amount of gravitational potential energy. Only one X should be drawn for each type of potential energy.

**Greatest
Magnetic
Potential Energy**



**Greatest
Gravitational
Potential Energy**



- 6.** 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

Directions: Use the information to answer questions 7 through 12.

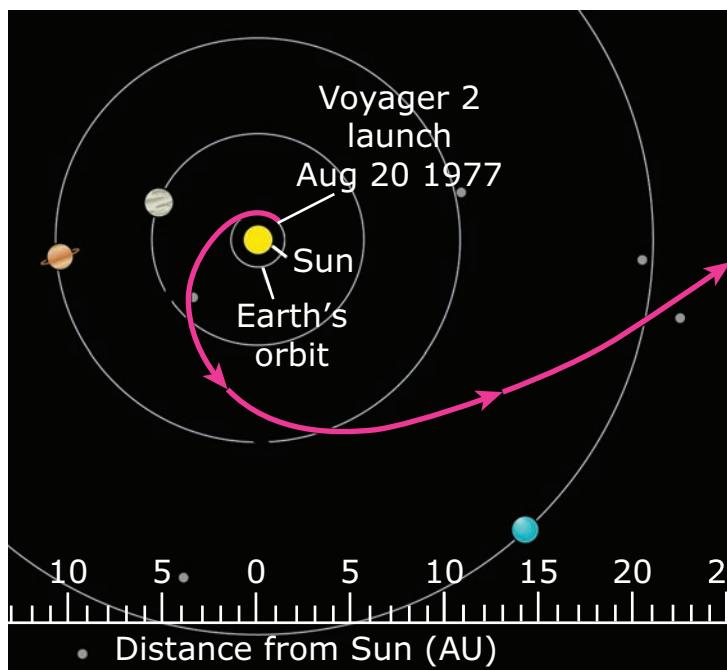
In 1977, NASA launched a robotic spacecraft from Earth called Voyager 2. This spacecraft was sent to gather data on Jupiter, Saturn, Uranus, and Neptune, and those planets' moons. Voyager 2's trip was timed to take place when Jupiter, Saturn, Uranus, and Neptune were positioned near each other in their orbits, an arrangement that only occurs every 176 years.

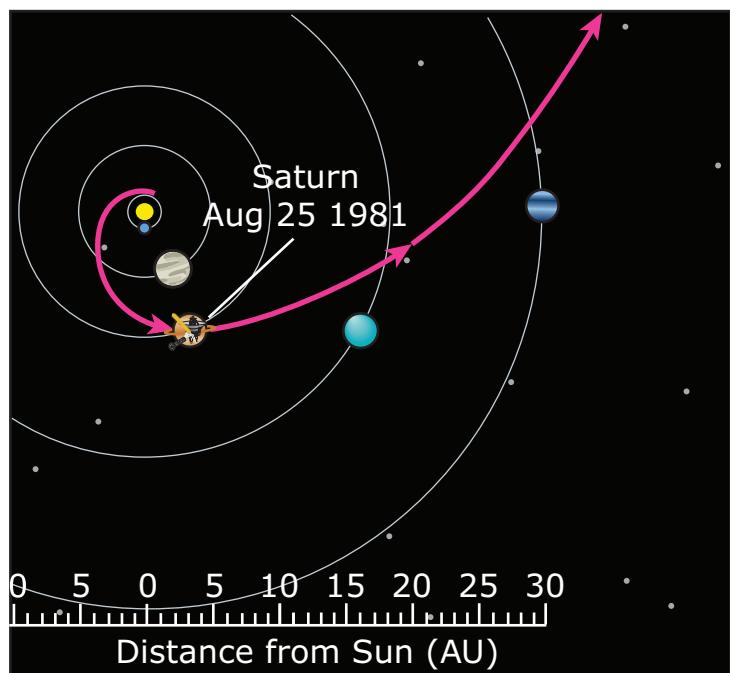
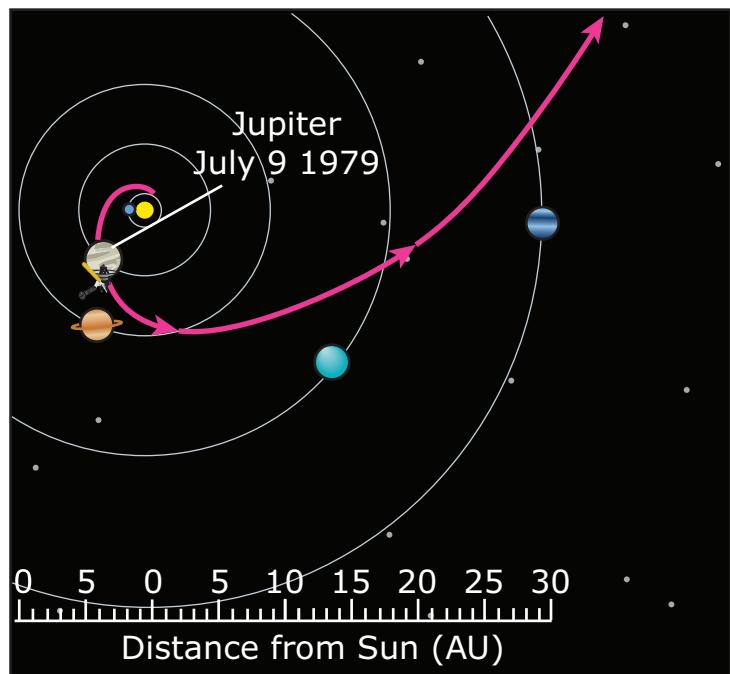
Solar system distances are measured in astronomical units (AU). One AU is the average distance between Earth and the Sun, about 150 million kilometers.

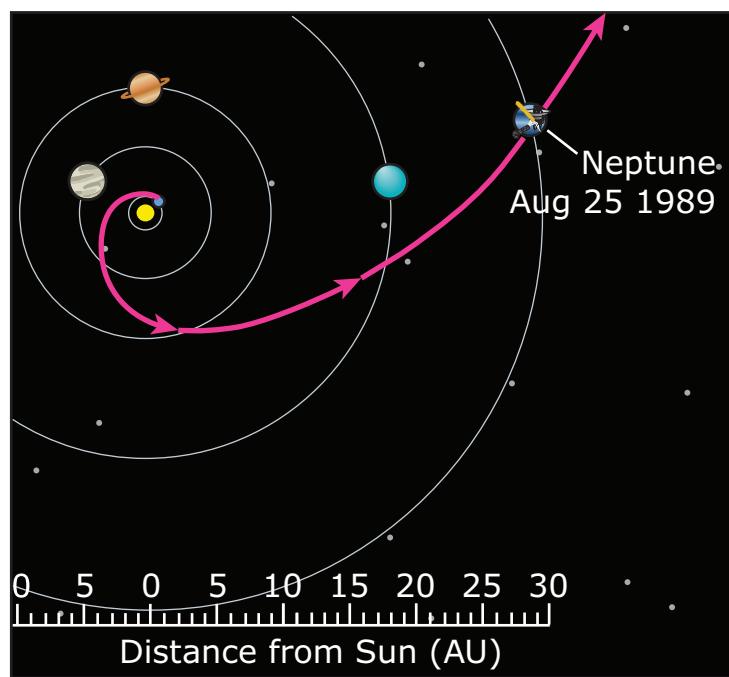
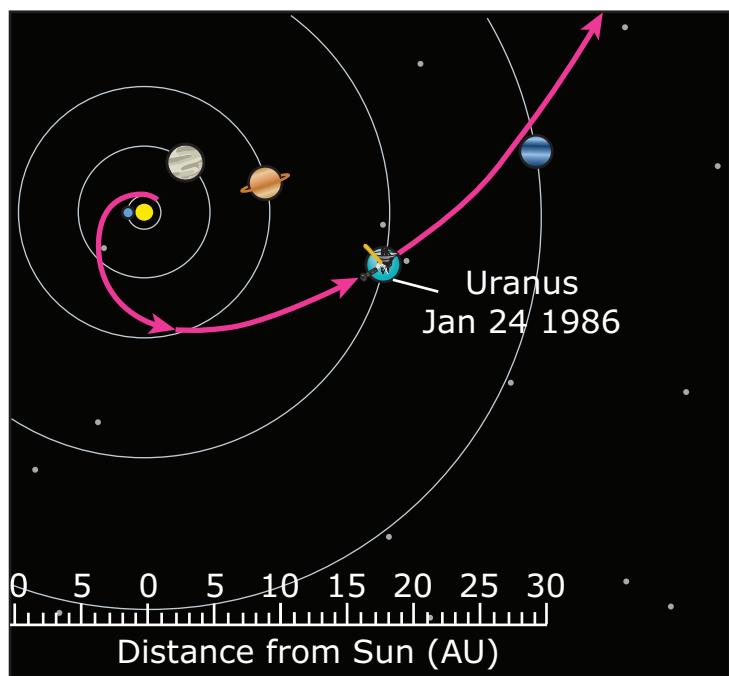
The planets Mercury, Venus, and Mars are not included in the drawings of this model.

Part 1

These drawings show the path that Voyager 2 took through the solar system and the movements of the planets as the spacecraft traveled around the Sun.







Part 2

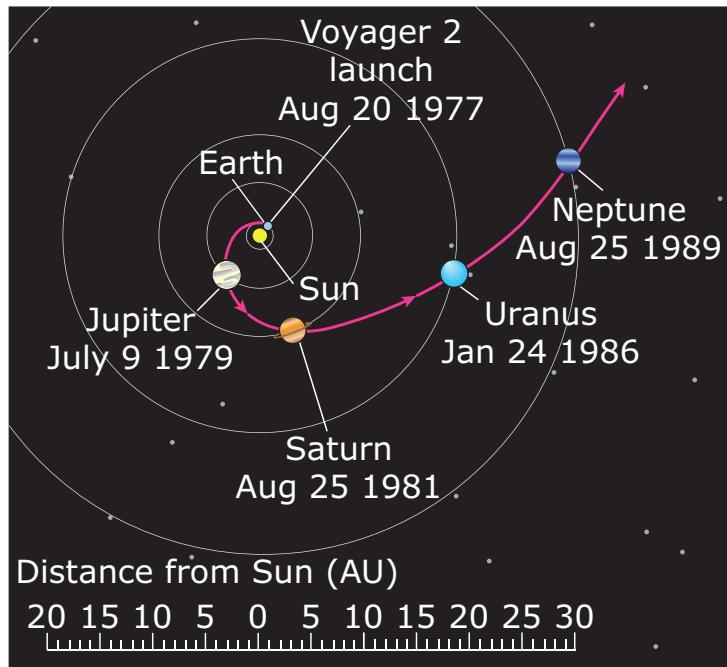
Observe the number of revolutions around the Sun each planet made during the time Voyager 2 traveled through our solar system. The planets closer to Earth orbit more quickly around the Sun than the planets farther away do.

Planetary Revolutions: 1977–1989

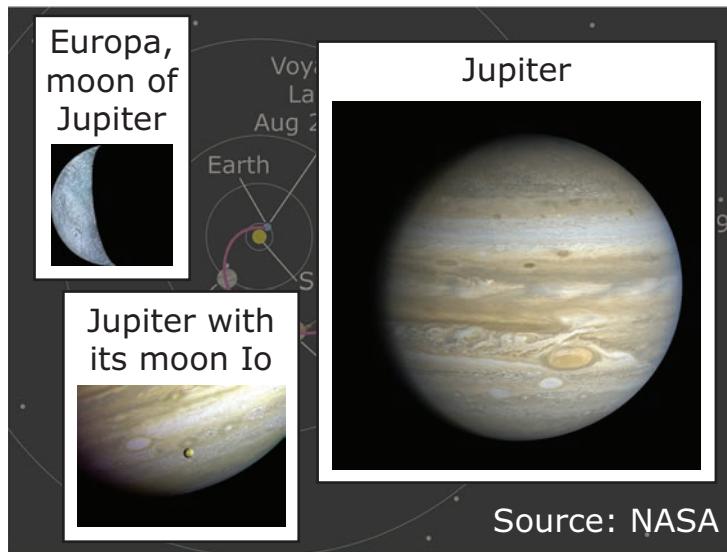
Planet	Number of Revolutions around the Sun
Earth	12
Jupiter	1
Saturn	$\frac{1}{2}$
Uranus	$\frac{1}{7}$
Neptune	$\frac{1}{13}$

Part 3

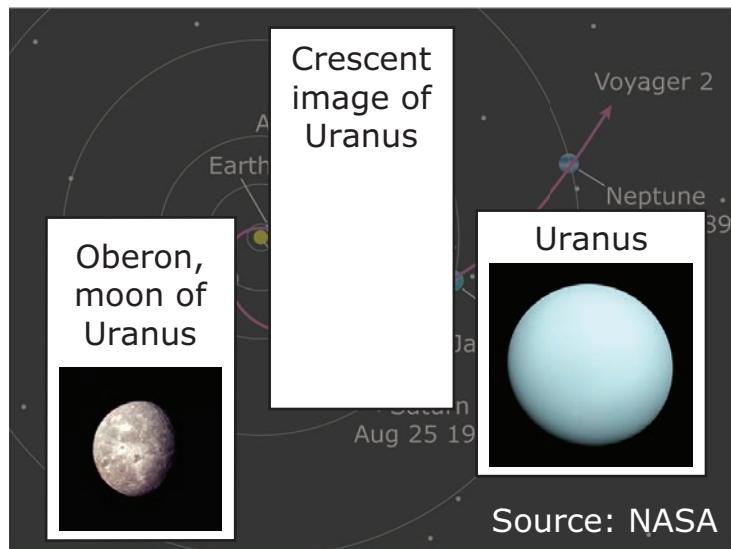
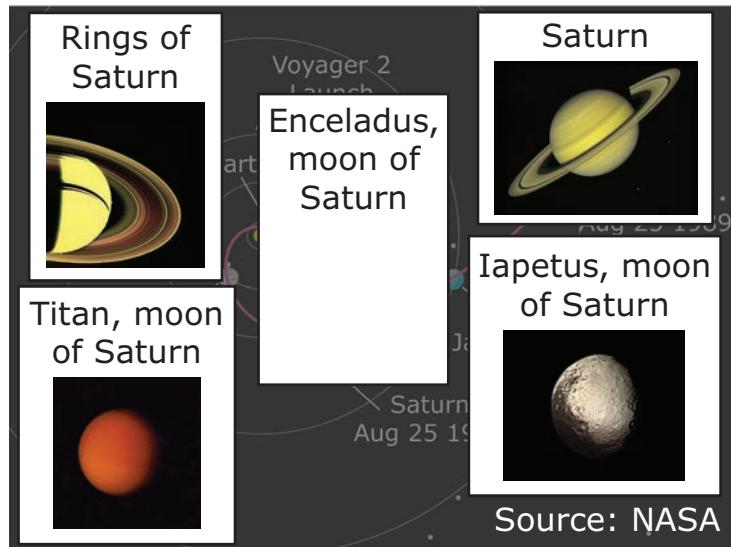
This drawing shows the path Voyager 2 took through the solar system.

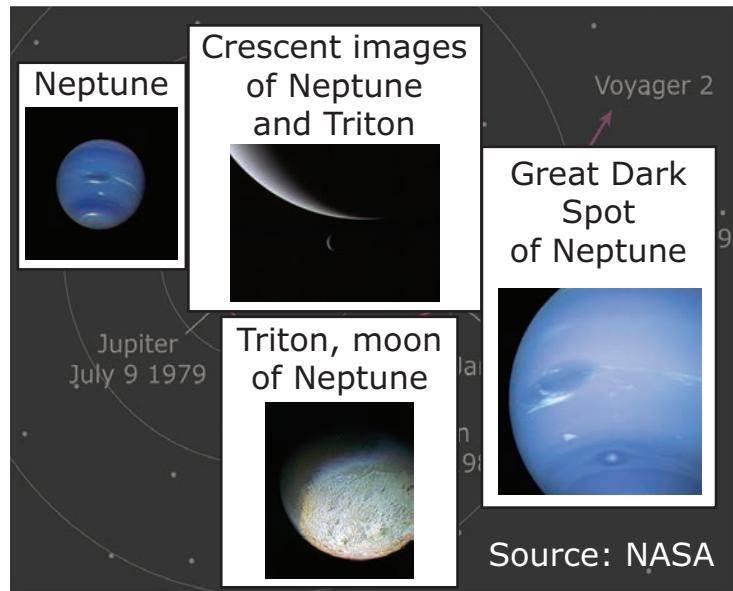


The images show information sent back to Earth by Voyager 2 as it encountered Jupiter.



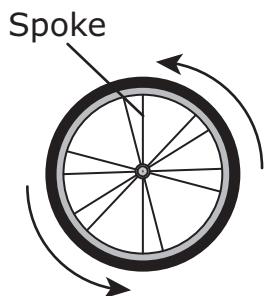
The images show information sent back to Earth by Voyager 2 as it encountered Saturn, Uranus, and Neptune.



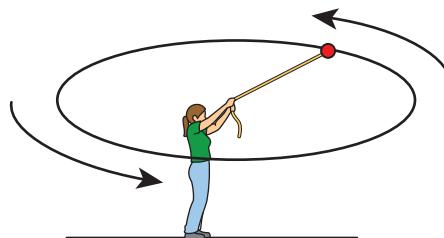


7. A student wants to demonstrate the movement of the planets shown in Part 1.

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.



Spinning wheel



Spinning a ball
on a string

Circle one correct response in each box to complete the sentence.

A planet stays in orbit because the

Sun's _____ acts like a

gravitational force
rotational motion

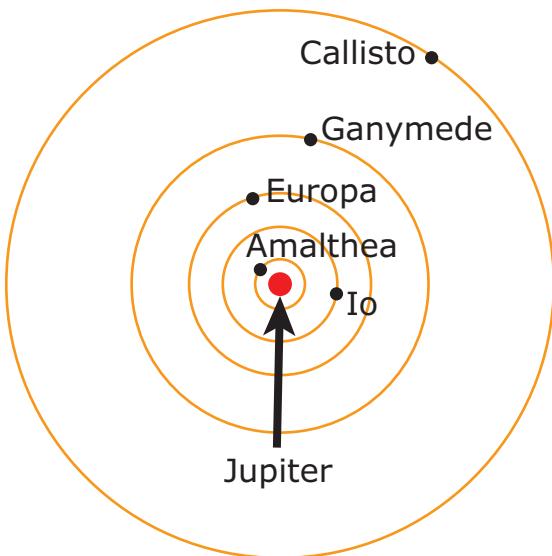
spoke that is used to spin a wheel

string that is used to swing a ball

in a circle.

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

Moons of Jupiter



Circle one correct response in each box to complete the sentence.

The moon Io travels _____ than

faster
slower

Europa because the gravitational force is stronger between Jupiter and moons that are _____ the planet.

farther away from
closer to

- 9.** A student wants to compare the distance between orbital paths of each planet shown using the scale along the bottom in Part 3.

Circle one correct response in each box to complete the sentences.

The distance between the orbital paths of Earth and _____

Jupiter
Neptune
Saturn
Uranus

is almost the same as the distance between the orbital paths of _____.

Uranus and Neptune
Saturn and Uranus
Jupiter and Saturn

This shows the orbital radius increases by a _____.

greater and greater
constant

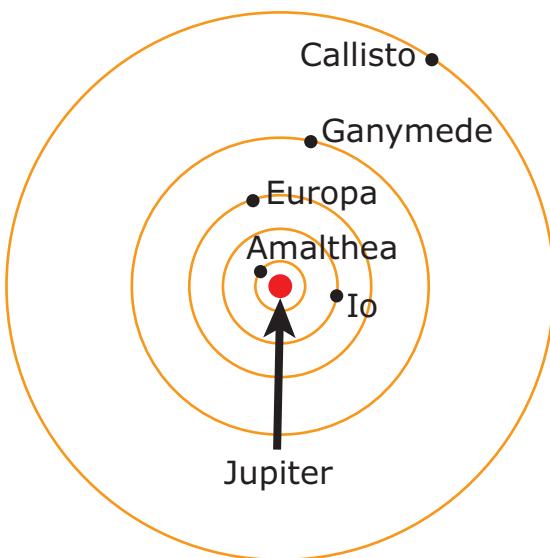
amount for each of the outer planets.

10. Explain how the planetary motion shown in the model 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 model demonstrates 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

- 11.** 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

12. 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 Part 3
- an explanation of how evidence from Part 3 supports your selection of those planets

Directions: Use the information to answer questions 13 through 17.

Part 1

The ecosystems of western Canada include mountainous terrain covered in forests that usually receive snowfall five to eight months a year. Two animals that live in these forests are the Canada lynx and the snowshoe hare.

Information about Canada Lynx and Snowshoe Hares

Animal	Main Food Source	Other Food Sources	Adaptations for Cold Weather Conditions
Canada lynx	snowshoe hares	small mammals, birds, caribou	large, furry paws to walk on snow
snowshoe hare	plants with soft stems, grasses	tree seedlings, leaves from shrubs	fur turns white in winter

Part 2

Scientists gathered data about the populations of Canada lynx and snowshoe hares. These graphs show how populations of lynx and hares changed over time.

Figure 1: Lynx Population over Time

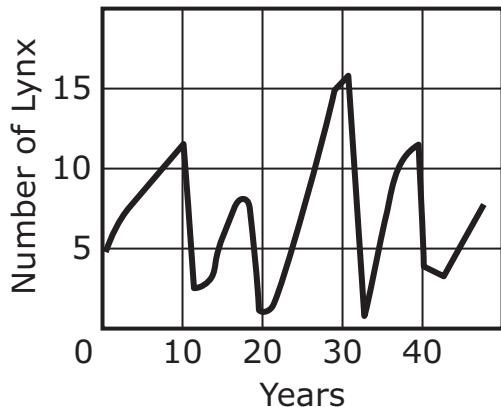


Figure 2: Hare Population over Time

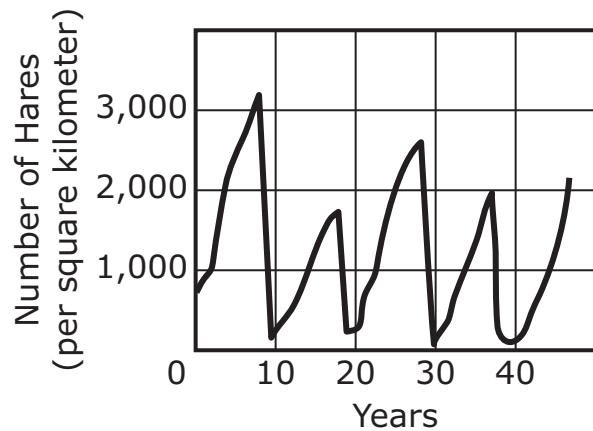
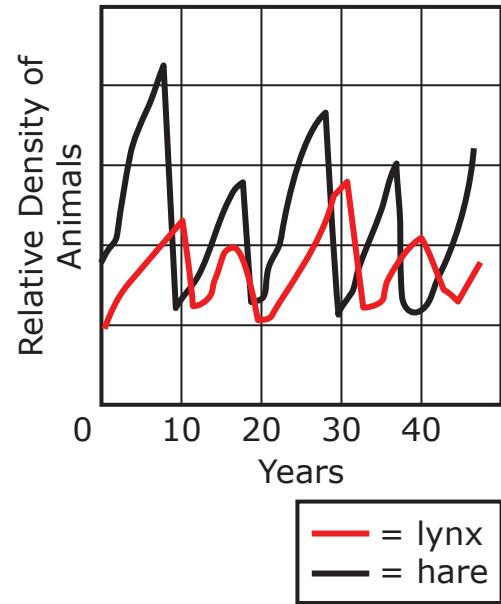


Figure 3: Lynx and Hare Populations over Time



Part 3

These maps show the ranges of Canada lynx and snowshoe hares.

Figure 4: Range of Canada Lynx



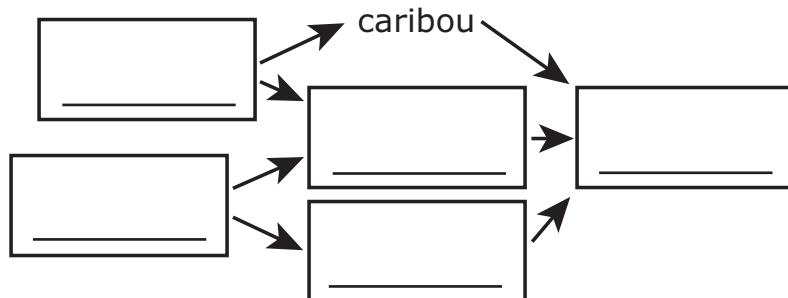
Figure 5: Range of Snowshoe Hares



- 13.** A student creates a food web for the organisms listed in the table from Part 1. The student learns that caribou eat shrubs, and birds eat grass seeds.

Based on this information, write the letters for the organisms in the boxes to create a model that shows how matter and energy move through this forest ecosystem. Each letter may be used once.

- | | |
|----------------|------------------|
| A. birds | D. shrubs |
| B. Canada lynx | E. snowshoe hare |
| C. grasses | |



- 14.** 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

15. 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.

- 16.** 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.

Circle one correct response in each box 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 5
Year 15
Year 30
Year 35

because the main food source for the Canada lynx was _____ during this year.

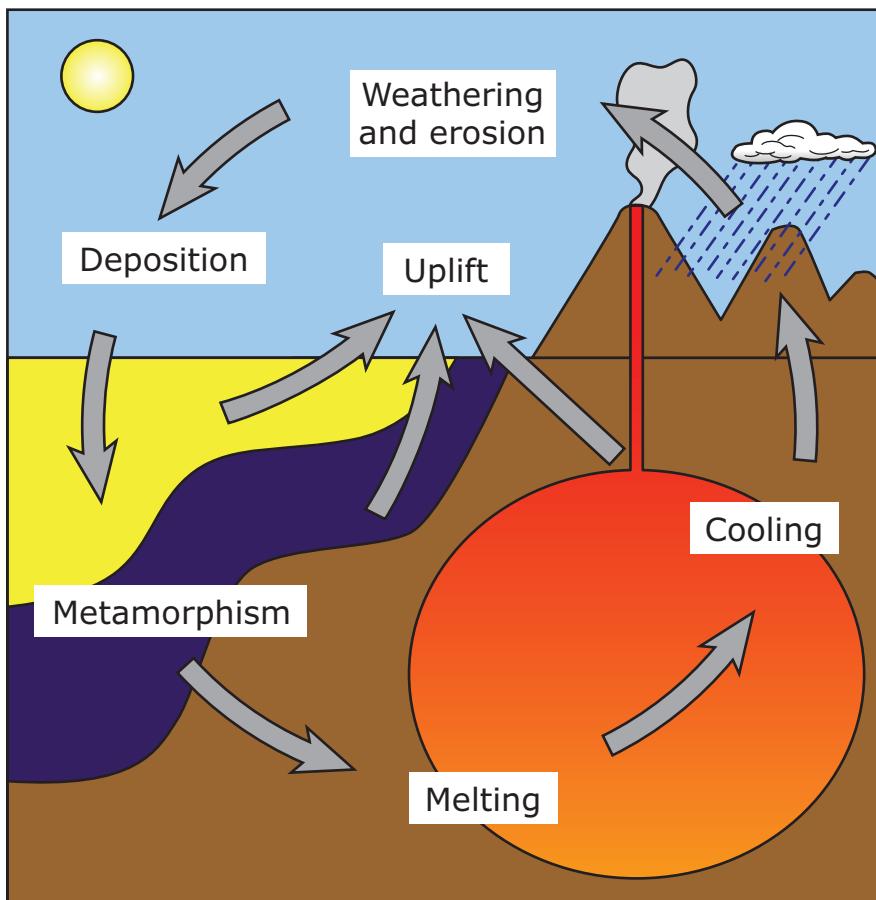
more abundant
less abundant
stable

- 17.** 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

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

The Rock Cycle



KEY	
	= sedimentary rock
	= metamorphic rock
	= igneous rock

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.

This is the end of Item Set 2.



Colorado Measures of Academic Success



Middle School Science

**Answer Key with
Scoring Rubrics, Sample
Responses & Annotations**

Practice Resource for Students

ANSWER KEY: ITEM SET 1

Item Set 1 – 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	
Grade Level Expectation:	SC.MS.2.2	Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.
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
Standard:	Life Science	

Item Set 1 – 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 Sample Student Responses	
Grade Level Expectation:	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.
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
Standard:	Life Science	

Scoring Rubric

Points	Attributes
2	<p>The student's response should include an explanation of:</p> <ul style="list-style-type: none">• 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. <p>Student responses may include but are not limited to:</p> <p>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.</p>
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	
	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.
2	Sample Annotation Sample A <ul style="list-style-type: none">The response explains how information is transferred as the student bites into the lemon slice (<i>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</i>).The response explains why the muscles in the student's face contract after seeing a lemon (<i>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</i>). Sample B <ul style="list-style-type: none">The response explains how information is transferred as the student bites into the lemon slice (<i>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</i>).The response explains why the muscles in the student's face contract after seeing a lemon (<i>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</i>).

	<p>Sample Response</p> <p>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.</p> <p>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.</p>
1	<p>Sample Annotation</p> <p>Sample A</p> <ul style="list-style-type: none"> The response explains how information is transferred as the student bites into the lemon slice (<i>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</i>). The response gives an incorrect reason why the muscles contract (<i>his tongue sends signals to the brain to be prepared</i>). It is the memory of the taste, not the receptors in the tongue, that are causing the muscle contractions in the later scenario. <p>Sample B</p> <ul style="list-style-type: none"> The response explains why the muscles in the student's face contract after seeing a lemon (<i>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</i>). 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	<p>Sample Response</p> <p>Sample A The student may be thinking of how the lemon already tastes so they make a certain face.</p> <p>Sample B Information is transferred as the student bites into the lemon slice</p> <p>Sample Annotation</p> <p>Sample A</p> <ul style="list-style-type: none"> The response does not explain how information is transferred as the student bites into the lemon slice. The information given (<i>The student may be thinking of how the lemon already tastes</i>) 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. <p>Sample B</p> <ul style="list-style-type: none"> 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 1 – Question 3 (TEI Inline Choice)

Based on the information in Part 2, identify the type of seismogram, analog or digital, that is more reliable and explain why.

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

The seismogram is easier to store, move, and compare because it exists as .

Item Information

Answer:	See Image	
Grade Level Expectation:	SC.MS.1.10	Designed technologies can transmit digital information as wave pulses.
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
Standard:	Physical Science	

Item Set 1 – 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 as great because the
 is as great.

Item Information

Answer:	See Image	
Grade Level Expectation:	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.
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
Standard:	Physical Science	

Item Set 1 – 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	
Grade Level Expectation:	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.
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.
Standard:	Physical Science	

Item Set 1 – 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	
Grade Level Expectation:	SC.MS.1.9	A wave model of light is useful to explain how light interacts with objects through a variety of properties.
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.
Standard:	Physical Science	

Item Set 1 – 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 Sample Student Responses	
Grade Level Expectation:	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.
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
Standard:	Physical Science	

Scoring Rubric	
Points	Attributes
2	<p>The student's response should include an explanation of:</p> <ul style="list-style-type: none"> • 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. <p>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.</p>
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	
	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.
2	Sample Annotation Sample A <ul style="list-style-type: none">The response explains why distance from the epicenter affects the amplitude of the seismic waves (<i>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</i>).The response explains which seismograph would record a higher amplitude and how that amplitude is related to the energy in the wave (<i>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</i>). Sample B <ul style="list-style-type: none">The response explains why distance from the epicenter affects the amplitude of the seismic waves (<i>The waves would be taller when they had more energy, right after the earthquake...they would have lost some energy and would be shorter</i>). “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 (<i>So, by the time they travelled to the further seismograph, #2, they would have lost some energy and would be shorter</i>). It is equally acceptable to say that seismograph 1 would measure higher amplitudes or that seismograph 2 would measure shorter amplitudes.

	<p>Sample Response</p> <p>Sample A The waves start out really big when they are produced by the earthquake, but they lose amplitude as they travel farther away.</p> <p>Sample B The waves would have the most amount of energy when they hit seismograph 1.</p>
1	<p>Sample Annotation</p> <p>Sample A</p> <ul style="list-style-type: none"> 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. <p>Sample B</p> <ul style="list-style-type: none"> 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	<p>Sample Response</p> <p>Sample A Seismograph 1 because it says 75 microns.</p> <p>Sample B Seismograph 2 because that location is using fiber optic cables.</p> <p>Sample Annotation</p> <p>Sample A</p> <ul style="list-style-type: none"> 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. <p>Sample B</p> <ul style="list-style-type: none"> 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 1 – 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	
Grade Level Expectation:	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.
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
Standard:	Life Science	

Item Set 1 – 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	
Grade Level Expectation:	SC.MS.2.3	Sustaining life requires substantial energy and matter inputs.
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
Standard:	Life Science	

Item Set 1 – 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	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
amount of oxygen released by the algae	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
amount of energy stored in sugars by the plants	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Item Information

Answer:	See Image	
Grade Level Expectation:	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.
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
Standard:	Life Science	

Item Set 1 – 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 Sample Student Responses	
Grade Level Expectation:	SC.MS.2.3	Sustaining life requires substantial energy and matter inputs.
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
Standard:	Life Science	

Scoring Rubric

Points	Attributes
2	<p>The student's response should include an explanation of:</p> <ul style="list-style-type: none">• 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. <p>Student responses may include but are not limited to:</p> <p>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.</p>
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	
	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.
2	Sample Annotation Sample A <ul style="list-style-type: none">• The response explains why the water samples were placed next to the window (<i>the algae uses the sunlight to get energy to go through photosynthesis</i>).• The response explains how the water samples would look different if placed in a dark room throughout the investigation (<i>If you put it in a dark room it would grow very slowly and the water wouldn't look as dark</i>). Sample B <ul style="list-style-type: none">• The response explains why the water samples were placed next to the window (<i>needs the sunlight for energy</i>). 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 (<i>would have less green stuff floating in it</i>). 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 <ul style="list-style-type: none">• The response explains why the water samples were placed next to the window (<i>The plant needs sunlight to turn CO₂ into O₂</i>). 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 <ul style="list-style-type: none">• The response explains how the water samples would look different if placed in a dark room throughout the investigation (<i>it would sink to the bottom and die</i>). 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 (<i>The plant needs sunlight</i>) is too vague and does not demonstrate any understanding of why plants need sunlight – for energy for photosynthesis.

	<p>Sample Response</p> <p>Sample A Without sunlight the plant will die.</p> <p>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.</p>
0	<p>Sample Annotation</p> <p>Sample A</p> <ul style="list-style-type: none">• 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. <p>Sample B</p> <ul style="list-style-type: none">• 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 1 – 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 Sample Student Responses	
Grade Level Expectation:	SC.MS.2.5	Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors.
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
Standard:	Life Science	

Scoring Rubric

Points	Attributes
2	<p>The student's response should include an explanation of how during each of the two time periods:</p> <ul style="list-style-type: none"> • The plant population is affected by resource availability. • The fish population is affected by resource availability. <p>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.</p>
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	
	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.
2	Sample Annotation Sample A <ul style="list-style-type: none">The response explains how during each of the two time periods the plant population is affected by resource availability (<i>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</i>).The response explains how during each of the two time periods the fish population is affected by resource availability (<i>The fish need to get their food from the plants. If the plants die, the herbivorous fish can't eat and they die</i>). The response receives credit even though it does not mention oxygen. Sample B <ul style="list-style-type: none">The response explains how during each of the two time periods the plant population is affected by resource availability (<i>The sunlight isn't getting to the plants under the water in late September, so they stop growing</i>). 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 (<i>fish eat all of the plants so they run out of food and their population can't grow</i>). The population dying out or not growing are equally acceptable response to how the population is affected.

	<p>Sample Response</p> <p>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.</p> <p>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.</p>
1	<p>Sample Annotation</p> <p>Sample A</p> <ul style="list-style-type: none"> The response explains how during each of the two time periods the plant population is affected by resource availability (<i>Because the plants are not getting sunlight, they are not making food so they don't grow</i>). The response does not explain how during each of the two time periods the fish population is affected by resource availability. The statement given (<i>This has an effect on the fish</i>) is too vague and does not explain how the fish are affected. <p>Sample B</p> <ul style="list-style-type: none"> The response explains how during each of the two time periods the fish population is affected by resource availability (<i>fish have fewer plants to eat and it is colder and therefore they go into hibernation</i>). 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.
	<p>Sample Response</p> <p>Sample A The algae blocks the sun from getting to the pond.</p> <p>Sample B The algae makes oxygen for the fish.</p>
0	<p>Sample Annotation</p> <p>Sample A</p> <ul style="list-style-type: none"> 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. <p>Sample B</p> <ul style="list-style-type: none"> 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 1 – 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 Sample Student Responses	
Grade Level Expectation:	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.
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
Standard:	Life Science	

Scoring Rubric	
Points	Attributes
2	<p>The student's response should include an explanation of:</p> <ul style="list-style-type: none">• 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. <p>Student responses may include but are not limited to:</p> <p>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.</p>
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	
	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.
2	Sample Annotation Sample A <ul style="list-style-type: none">The response explains how the amount of sunlight reaching the pond during the winter could change the algae population (<i>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</i>).The response explains how this change in the algae population could affect the plant population during the spring (<i>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</i>). The response does not state that the population will increase, but indicating that the plants can grow is sufficient. Sample B <ul style="list-style-type: none">The response explains how the amount of sunlight reaching the pond during the winter could change the algae population (<i>the sun does not shine directly on that part of the Earth, so the pond will freeze and the algae will die</i>).The response explains how this change in the algae population could affect the plant population during the spring (<i>This allows the plants to start growing again in the spring when everything thaws out, because the sunlight can reach the plants</i>).

	<p>Sample Response</p> <p>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.</p> <p>Sample B If there is less algae, there is more plants and more fish and snails.</p>
1	<p>Sample Annotation</p> <p>Sample A</p> <ul style="list-style-type: none"> The response explains how the amount of sunlight reaching the pond during the winter could change the algae population (<i>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</i>). 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 (<i>People would have to remove it from the pond in the spring because it will make the plants sick</i>), since it does not specify how the algae makes the plants "sick." <p>Sample B</p> <ul style="list-style-type: none"> The response explains how this change in the algae population could affect the plant population during the spring (<i>If there is less algae, there is more plants and more fish and snails</i>). The response does not explain how the amount of sunlight reaching the pond during the winter could change the algae population.
	<p>Sample Response</p> <p>Sample A The plants and the algae both grow when it is spring because that is when it starts to warm up.</p> <p>Sample B They are fertilizing the grass and the fertilizer gets into the pond and makes the algae grow.</p>
0	<p>Sample Annotation</p> <p>Sample A</p> <ul style="list-style-type: none"> 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. <p>Sample B</p> <ul style="list-style-type: none"> 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 1 – 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	
Grade Level Expectation:	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.
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.
Standard:	Earth and Space Science	

ANSWER KEY: ITEM SET 2

Item Set 2 – 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	
Grade Level Expectation:	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.
Evidence Outcome:	SC.MS.1.8.b	Develop and use a model to describe that waves are reflected, absorbed or transmitted through various materials.
Standard:	Physical Science	

Item Set 2 – 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

force equals the force.

Item Information

Answer:	See Image	
Grade Level Expectation:	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.
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
Standard:	Physical Science	

Item Set 2 – 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 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

the lower set when it is dropped.

Item Information

Answer:	See Image	
Grade Level Expectation:	SC.MS.1.4	Forces that act at 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.
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.
Standard:	Physical Science	

Item Set 2 – 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 . This

shows that there is a field coming from .

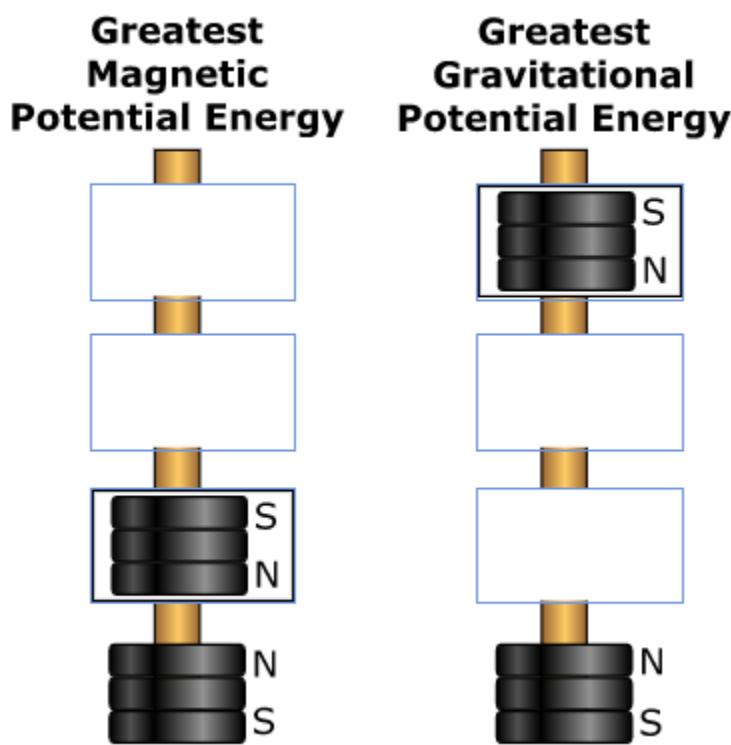
Item Information

Answer:	See Image	
Grade Level Expectation:	SC.MS.1.4	Forces that act at 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.
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.
Standard:	Physical Science	

Item Set 2 – 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	
Grade Level Expectation:	SC.MS.1.5	Kinetic energy can be distinguished from the various forms of potential energy.
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.
Standard:	Physical Science	

Item Set 2 – 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 Sample Student Responses	
Grade Level Expectation:	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.
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.
Standard:	Physical Science	

Scoring Rubric	
Points	Attributes
2	<p>The student's response should include:</p> <ul style="list-style-type: none">• An explanation of the changed position of the heavier globe.• A description of two different forces acting on the heavier globe. <p>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.</p>
1	Student response demonstrates a partial understanding of the task.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses

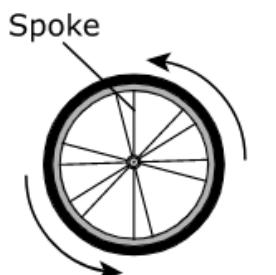
Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.

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 (<i>The gravitational force increases when the mass is greater ... but the repulsive force of the magnetic base increases when the distance decreases</i>) and explains the changed position of the heavier globe (<i>closer to the base</i>).
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 (<i>it will be lower than it was before</i>).
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.

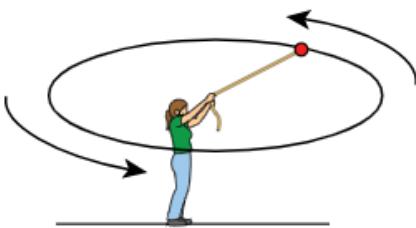
Item Set 2 – Question 7 (TEI Inline Choice)

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.



Spinning wheel



Spinning a ball
on a string

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.

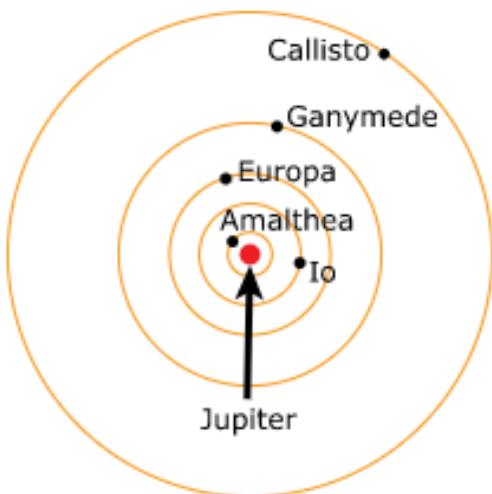
Item Information

Answer:	See Image	
Grade Level Expectation:	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.
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.
Standard:	Earth and Space Science	

Item Set 2 – 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.

Moons of Jupiter



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

The moon Io travels than Europa because the gravitational force is stronger between Jupiter and moons that are the planet.

Item Information

Answer:	See Image	
Grade Level Expectation:	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.
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.
Standard:	Earth and Space Science	

Item Set 2 – Question 9 (TEI Inline Choice)

A student wants to compare the distance between orbital paths of each planet shown using the scale along the bottom in Part 3.

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

The distance between the orbital paths of Earth and .

is almost the same as the distance between the orbital paths of

. This shows the orbital radius

increases by a amount for each of

the outer planets.

Item Information

Answer:	See Image	
Grade Level Expectation:	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.
Evidence Outcome:	SC.MS.3.2.b	Analyze and interpret data to determine scale properties of objects in the solar system.
Standard:	Earth and Space Science	

Item Set 2 – 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 Sample Student Responses	
Grade Level Expectation:	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.
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.
Standard:	Earth and Space Science	

Scoring Rubric

Points	Attributes
2	The student's response should include an explanation of: <ul style="list-style-type: none">• 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.

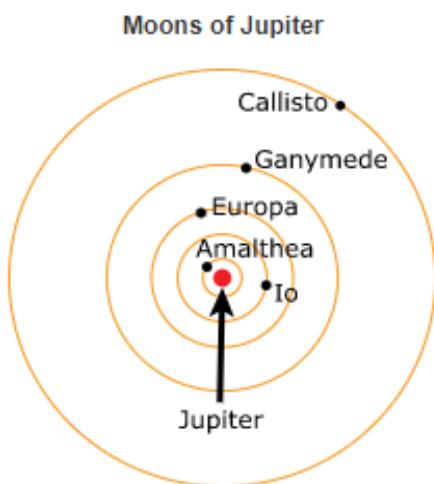
Sample Student Responses

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 (<i>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</i>), and the explanation of the necessity to understand planetary motion to plan Voyager 2's path is correct (<i>needed to know each planet's movements to design a path to make sure Voyager 2 would fly close enough to observe</i>).
	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 (<i>The closer planets have more gravitational force than the farther away ones, so they move faster</i>); the inverse statement that is also given would also earn credit for the first bullet point on its own (<i>The farther away planets move slower because of less force</i>). 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 (<i>followed a curving path to visit the other planets</i>).
1	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.
0	

Item Set 2 – Question 11 (Constructed Response)

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



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 Sample Student Responses	
Grade Level Expectation:	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.
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.
Standard:	Earth and Space Science	

Scoring Rubric

Points	Attributes
2	<p>The student's response should include:</p> <ul style="list-style-type: none"> • A comparison of how the two systems are similar. • An explanation of the role of gravity in both systems. <p>Student responses may include but are not limited to:</p> <p>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.]</p>
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	
	<p>Sample Response</p> <p>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.</p> <p>Sample Annotation</p> <p>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 (<i>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</i>). The response also explains the role of gravity in both systems (<i>The gravitational force of the Sun makes its planets revolve around it, while the gravitational force of Jupiter makes its moons revolve around it</i>).</p> <p>[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.]</p>
2	<p>Sample Response</p> <p>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.</p> <p>Sample Annotation</p> <p>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 (<i>Part 3 shows the Sun and planets and the Jupiter diagram shows Jupiter and its moons</i>). The explanation of the role of gravitational forces, even though it is stated in the negative, is correct and complete (<i>Without the gravitational forces of the Sun and Jupiter, the planets and moons would just go flying off into space</i>).</p>
1	<p>Sample Response</p> <p>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.</p> <p>Sample Annotation</p> <p>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 (<i>things in the center with circles going around them</i>). The statement about gravity addresses the role of gravity on Earth (<i>Gravity keeps us on the ground</i>) not the role of gravitational forces causing the planets to orbit the Sun or the moons to orbit Jupiter.</p>
0	

Item Set 2 – 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 Sample Student Responses	
Grade Level Expectation:	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.
Evidence Outcome:	SC.MS.3.2.b	Analyze and interpret data to determine scale properties of objects in the solar system.
Standard:	Earth and Space Science	

Scoring Rubric

Points	Attributes
2	<p>The student's response should include:</p> <ul style="list-style-type: none">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. <p>Student responses may include but are not limited to:</p> <p>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.</p>
1	Student response demonstrates a partial understanding of the task.
0	Student response does not demonstrate an understanding of the task.

Sample Student Responses

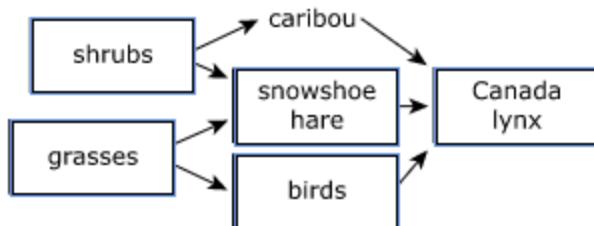
Sample student responses are not representative of all correct answers for an item and are provided only as a guide to assist teachers with scoring.

Points	
	<p>Sample Response</p> <p>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.</p> <p>Sample Annotation</p> <p>This response demonstrates a complete understanding of the task. The appropriate distances are given (<i>the distance between Saturn and Uranus is 9 AU, while the distance from Uranus to Neptune is 11 AU</i>), and the explanation of evidence from Part 3 is correct (<i>AU scale ... shows that Saturn is 10 AU distant, Uranus is 19 AU distant, and Neptune is 30</i>).</p> <p>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.</p>
1	<p>Sample Response</p> <p>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.</p> <p>Sample Annotation</p> <p>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 (<i>Saturn and Uranus look to be just under 10 AU apart and Uranus and Neptune look just over 10 AU apart</i>). 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 (<i>just under 10 AU apart ... just over 10 AU apart</i>).</p>
0	<p>Sample Response</p> <p>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.</p> <p>Sample Annotation</p> <p>This response does not demonstrate an understanding of the task. Two of the three planets chosen do not appear in Part 3 (<i>Mercury, Venus</i>). 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.</p>

Item Set 2 – Question 13 (TEI Drag and Drop)

A student creates a food web for the organisms listed in the table from Part 1. The student learns that caribou eat shrubs, and birds eat grass seeds.

Based on this information, drag the organisms into the boxes to create a model that shows how matter and energy move through this forest ecosystem. Each organism may be used once.



Item Information

Answer:	See Image	
Grade Level Expectation:	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.
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.
Standard:	Life Science	

Item Set 2 – 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	
Grade Level Expectation:	SC.MS.2.5	Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors.
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.
Standard:	Life Science	

Item Set 2 – 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	
Grade Level Expectation:	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.
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.
Standard:	Life Science	

Item Set 2 – 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

because the main food source for the Canada lynx was during this year.

Item Information

Answer:	See Image	
Grade Level Expectation:	SC.MS.2.5	Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors.
Evidence Outcome:	SC.MS.2.5.b	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
Standard:	Life Science	

Item Set 2 – 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 Sample Student Responses	
Grade Level Expectation:	SC.MS.2.5	Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors.
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.
Standard:	Life Science	

Scoring Rubric

Points	Attributes
2	<p>The student's response should include:</p> <ul style="list-style-type: none">• 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. <p>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.)</p>
1	Student response demonstrates a partial understanding of the task.
0	Student response does not demonstrate an understanding of the task.

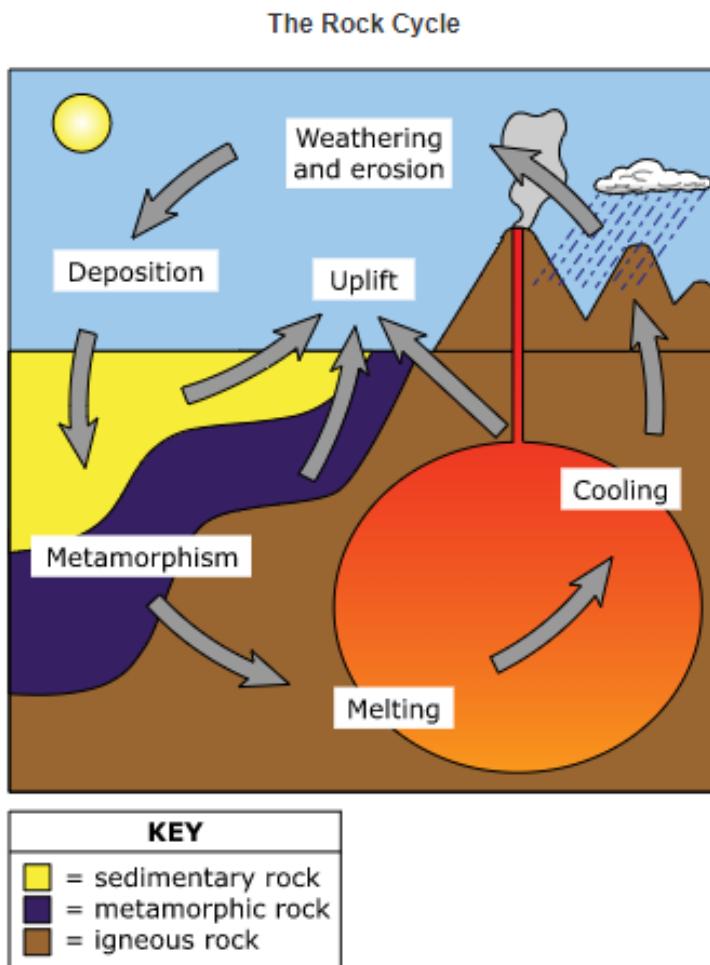
Sample Student Responses

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 (<i>a decrease in the number of birds because the Canada lynx would need to increase the amount of other food sources</i>) and how a population would increase (<i>an increase in the grasses because the grasses are one of the snowshoe hare's main food sources</i>).
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 (<i>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</i>). 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 2 – Question 18 (Selected Response)

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



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	
Grade Level Expectation:	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.
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.
Standard:	Earth and Space Science	