



**Grade 8**  
**Science MCA-III Item Sampler**  
**Teacher Guide**

*Updated September 2, 2016*

## Purpose of the Item Samplers

Item Samplers are provided to help teachers and students become familiar with the format and type of content included in the MCAs. Item Samplers contain fewer items than an actual full-length test and are aligned to the Minnesota Academic Standards. They are not suitable for predicting how students will perform on the MCAs.

For more information on the proportions of items aligned to each standard and clarifications on how each standard will be assessed, [see the MCA-III Test Specifications for Science](#) (MDE > Districts, Schools and Educators > Statewide Testing > Test Specifications).

The [Item Samplers and other testing resources](#), like the Online MCA Tutorials, can be found on the Pearson Access Next site (<http://minnesota.pearsonaccessnext.com>).

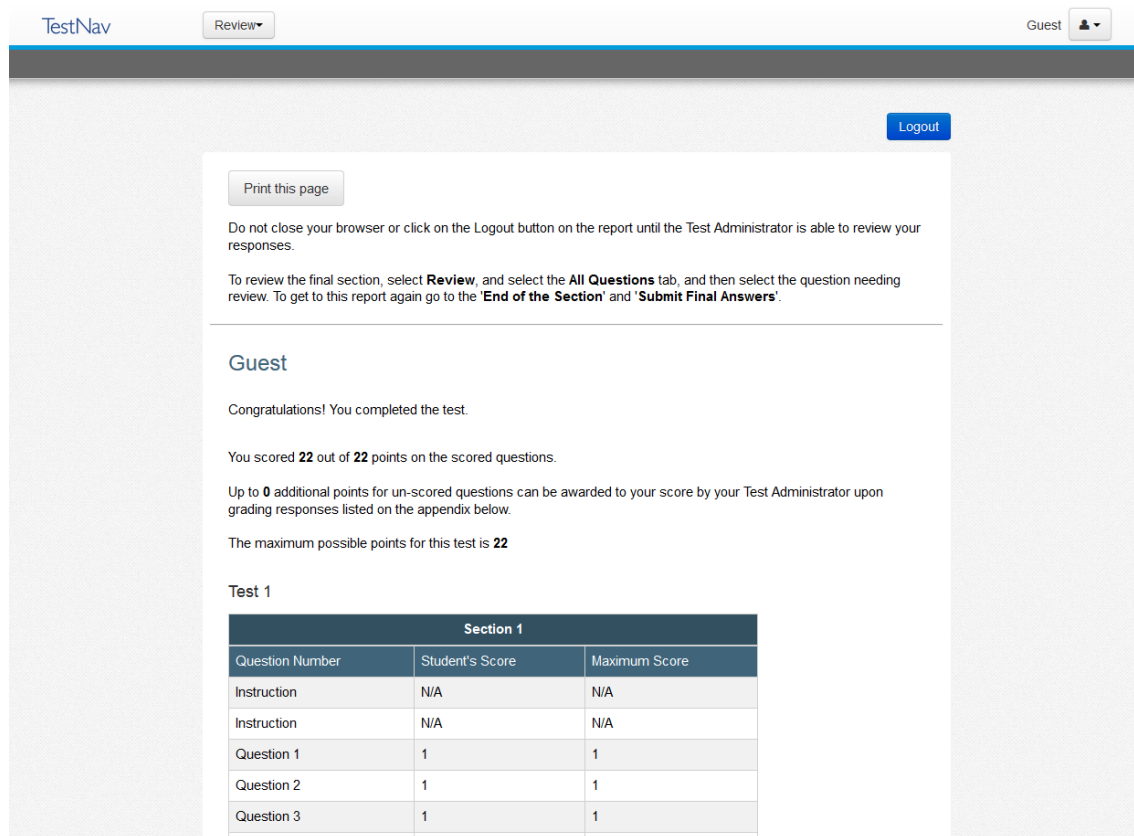
## Test Design and Navigation

- The screen is split vertically, with the scene on the left and questions on the right.
- Students are required to answer all questions in a section before they can proceed to the next section.
- A review screen at the end of a section reminds students about unanswered questions and questions they marked for review, and it provides an opportunity to review any questions in that section.
- Text-to-speech (TTS) is available on all items. Accommodated text is available for graphics and tables, but needs to be part of the student's IEP or EL designation
- Online tools include a highlighter, eliminate choice options, line reader, answer option masking, magnifier, notepad, screen contrast, and a calculator if needed.
- All items in the Item Samplers are worth one point.

The screenshot displays the Pearson Access Next interface for a science item sampler. The interface is split vertically. On the left side, there is a scene with a student in a garden. The text above the scene reads: "This student is growing a garden. In her garden, she is growing many types of fruits and vegetables, including bell peppers." On the right side, there is a question: "Which factor affecting the growth..." with four multiple-choice options: A. The temperature of the air, B. The kinds of bacteria living in the soil, C. The amount of water the plants receive, and D. The amount of sunlight the plants receive. Option D is crossed out with a red line. A dropdown menu is open over the question, listing accessibility options: "Change the background and foreground color", "Enable Magnifier", "Show Line Reader", "Enable Answer Masking", and "Sign out of TestNav". A text-to-speech control panel is visible in the bottom right corner, showing "Speed: Normal" and "Voice: Female".

## Score Report

Upon completion of the Item Samplers, a Score Report is displayed. This report can be printed.



TestNav Review Guest Logout

Print this page

Do not close your browser or click on the Logout button on the report until the Test Administrator is able to review your responses.

To review the final section, select **Review**, and select the **All Questions** tab, and then select the question needing review. To get to this report again go to the **'End of the Section'** and **'Submit Final Answers'**.

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### Guest

Congratulations! You completed the test.

You scored **22** out of **22** points on the scored questions.

Up to **0** additional points for un-scored questions can be awarded to your score by your Test Administrator upon grading responses listed on the appendix below.

The maximum possible points for this test is **22**

Test 1

Section 1		
Question Number	Student's Score	Maximum Score
Instruction	N/A	N/A
Instruction	N/A	N/A
Question 1	1	1
Question 2	1	1
Question 3	1	1

## Teacher Guide

This guide includes the answer keys for all items in the sampler, along with rationales for the answer options. When student performance data is available for an item, the percentages of students answering correctly and incorrectly are shown. Item benchmark alignment and Depth of Knowledge (DOK) level are also provided for each item.

DOK refers to the cognitive demand associated with an item. The level of cognitive demand focuses on the type and level of thinking and reasoning required of the student on a particular item. MCA-III levels of cognitive complexity are based on Norman L. Webb's Depth of Knowledge<sup>1</sup> levels. Although certain verbs, such as "recall," "classify" or "reason," are commonly associated with specific cognitive levels, Webb's DOK levels are not determined by the verbs that describe them, but rather the contexts in which the verbs are used and the depth of thinking required.

DOK 1 (recall) items require the recall of information such as a fact, definition, term or simple science process or procedure.

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<sup>1</sup> Webb, N. L. Alignment of science and mathematics standards and assessments in four states (Research Monograph No. 18). Madison: University of Wisconsin – Madison, National Institute for Science Education, 1999.

DOK 2 (skill/concept) items call for the engagement of some mental processing beyond a habitual response, with students required to make some decisions as to how to approach a problem or activity.

DOK 3 (strategic thinking) items require students to reason, plan or use evidence to solve a problem.

The MCA-III Science Test Specifications give a more detailed explanation of DOK levels used in the MCA-III assessments.

If you have further questions concerning the MCA Science Assessments please contact the following MDE staff:

Dawn Cameron, [dawn.cameron@state.mn.us](mailto:dawn.cameron@state.mn.us), 651-582-8551

Jim Wood, [jim.wood@state.mn.us](mailto:jim.wood@state.mn.us), 651-582-8541

## Section 1

### Scenario: Lake Superior

#### Question 1

About 10,000 years ago, the last glaciers melted around the Lake Superior area and filled the lake with water. For the past few hundred years, agricultural and manufacturing developments have caused pollution in the lake.



Which observation suggests that Minnesota was covered by glaciers in the past?

- A. Rocks have fossils.
- B. Rocks show wind erosion.
- C. Rocks show chemical weathering.
- D. Rocks have scrapes and striations.

Benchmark: 8.3.1.2.2

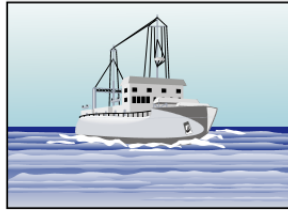
Explain the role of weathering, erosion, and glacial activity in shaping Minnesota's current landscape.

DOK: 2

Answer option	Rationale	Percent of student responses
A	Fossils can occur without glaciers.	13%
B	Wind erosion is not due to glaciers.	8%
C	Chemical weathering can occur without glaciers.	28%
<b>Correct: D</b>	Striations are a direct result of glaciers moving over exposed rock.	51%

## Question 2

To learn more about the pollution in Lake Superior, scientists travel in a boat to collect samples from different areas of the lake. Before going out on the lake, the scientists must study the local weather in order to safely travel on the lake.


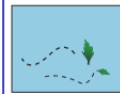

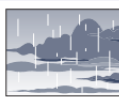



Based on the air pressure data, which 2 weather predictions will most likely be accurate?

Select the 2 weather predictions you want to choose.

Time of Day	Air Pressure (millibars)
6 a.m.	978
Noon	1,010
6 p.m.	1,010
Midnight	1,010

### Weather Predictions

 <b>Fair weather</b>	 <b>Strong winds</b>	 <b>Cirrus clouds</b>
 <b>Heavy rain</b>	 <b>Stratus clouds</b>	

Benchmark: 8.3.2.2.2

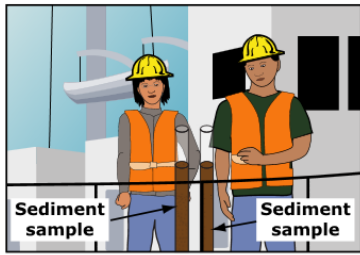
Analyze changes in wind direction, temperature, humidity and air pressure and relate them to fronts and pressure systems.

DOK: 2

Answer option	Rationale	Percent of student responses
<b>Correct:</b> Student selects <i>Fair weather</i> and <i>Cirrus clouds</i>	The student understands that high pressure systems are associated with cirrus clouds and fair weather.	20%
<b>Incorrect:</b> All other responses	Strong winds, stratus clouds, and heavy rains are not associated with an established high pressure system.	80%

### Question 3

The scientists on the boat discover many pollutants in the lake sediment.



Pollutants Found in Lake Superior Sediments
Arsenic
Cadmium
Chromium
Copper
Lead
Mercury
Pesticides
Zinc

Based on the data collected, which testable question are the scientists trying to answer?

- A. What is the source of the pollution?
- B. Which pollutants are found in the lake?
- C. Which pollutants have been in the water the longest?
- D. What effect does the pollution have on the lake ecosystem?

Benchmark: 7.1.1.2.1

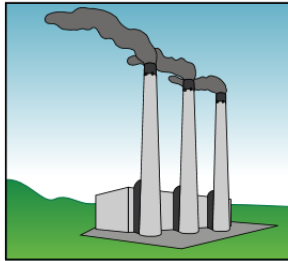
Generate and refine a variety of scientific questions and match them with appropriate methods of investigation, such as field studies, controlled experiments, reviews of existing work and development of models.

DOK: 2

Answer option	Rationale	Percent of student responses
A	Only the type of pollutant was measured. This gives no information about the source.	19%
<b>Correct: B</b>	Only the type of pollutant was measured.	46%
C	Only the type of pollutant was measured. This gives no information about the length of time the pollutants have been present.	9%
D	Only the type of pollutant was measured. This gives no information about the effect on the lake ecosystem.	25%

### Question 4

Mercury is 1 pollutant found in Lake Superior. The largest source of mercury pollution comes from burning coal in power plants. Data shows that air currents can carry pollutants from power plants that are hundreds of miles away.



Show how these factors would most likely change if people began to use less energy.

Drag a change into each box.

#### Changes When Less Energy Is Used

Amount of Coal Burned	Amount of Mercury Released	Condition of the Lake
<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="button" value="increases"/> <input type="button" value="decreases"/>	<input type="button" value="increases"/> <input type="button" value="decreases"/>	<input type="button" value="improves"/> <input type="button" value="declines"/>

Benchmark: 7.4.4.1.2

Describe ways that human activities can change the populations and communities in an ecosystem.

DOK: 2

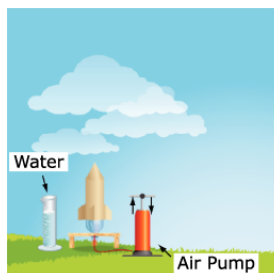
Answer option	Rationale	Percent of student responses
<p><b>Correct:</b> From left to right: <i>decreases, decreases, increases.</i></p>	<p>If people use less energy, the amount of coal burned to produce electricity would decrease, which would result in a decrease in the amount of mercury released. Less mercury in the environment will improve the condition of the lake.</p>	72%
<p><b>Incorrect:</b> All other responses</p>	<p>The student does not understand the relationship between burning coal and the release of mercury and that mercury is a source of pollution.</p>	28%



## Scenario: Water Bottle Rockets

### Question 5

Water bottle rockets are made by adding water to a bottle and pumping air into it. The flight time and height depend on the shape and the size of the water bottle rocket and the amounts of water and air you pump into the bottle.



Some of the air that is pumped into the bottle dissolves in the water. What type of change happens when air dissolves in water?

- A. Chemical
- B. Color
- C. Molecular
- D. Physical

**Benchmark:** 6.2.1.2.1

Identify evidence of physical changes, including changing phase or shape, and dissolving in other materials.

**DOK:** 1

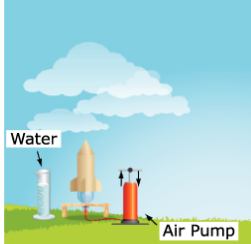
Answer option	Rationale	Percent of student responses
A	A chemical change can produce gases, temperature change, formation of a solid, or changes in color. Dissolving is not a chemical change.	No data available
B	The color of the water does not change during the physical change of dissolving air in water.	No data available
C	The molecular composition of the water does not change during the physical change of dissolving the air.	No data available
<b>Correct: D</b>	A physical change occurs when a substance dissolves.	No data available

## Question 6

← → Review Bookmark

Previous: MCA ITEM SAMPLER / SECTION 2 / 5 OF 12 Guest

Water bottle rockets are made by adding water to a bottle and pumping air into it. The flight time and height depend on the shape and the size of the water bottle rocket and the amounts of water and air you pump into the bottle.



650 milliliters of water is put into the water bottle. Convert 650 milliliters to liters.

You can use the calculator to help you answer this question.

Enter your answer in the box.

650 milliliters =  liters

**Benchmark:** 6.1.3.4.2

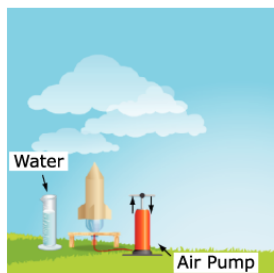
Demonstrate the conversion of units within the International System of Units (SI, or metric) and estimate the magnitude of common objects and quantities using metric units.

**DOK:** 1

Answer option	Rationale	Percent of student responses
<b>Correct:</b> 0.65	Using the conversion factor $1000 \text{ milliliters} = 1 \text{ liter}$ , solve $X$ $\text{liters} = 650 \text{ ml}/1000 \text{ ml}$ .	No data available
<b>Incorrect:</b> All other responses	The student does not convert milliliters to liters correctly.	No data available

### Question 7

Water bottle rockets are made by adding water to a bottle and pumping air into it. The flight time and height depend on the shape and the size of the water bottle rocket and the amounts of water and air you pump into the bottle.



Select the words that complete the sentence.

As the student pumps air into the bottle, the pressure

Choose...  
 Choose...  
 decreases  
 increases  
 stays the same

and the distance between particles

Benchmark: 6.2.1.1.1

Explain density, dissolving, compression, diffusion and thermal expansion using the particle model of matter.


DOK: 1

Answer option	Rationale	Percent of student responses
<b>Correct:</b> <i>Increases, decreases</i>	The student understands that in the particle model of matter as the pressure increases, the distance between particles decreases.	No data available
<b>Incorrect:</b> All other combinations of responses	The student does not understand the relationship between pressure and particle spacing.	No data available


### Question 8

To build and launch a water bottle rocket, select a bottle below. Select the amount of water in milliliters (mL) you want to add and the pressure of air in kilopascals (kPa) you want to pump into the bottle. Then select "Run." The water bottle rocket will launch, and data will be recorded in the table. Repeat as necessary.


**Step 1: Select a bottle.**



2 L




1 L




1 L, Wide

**Step 2: Add water.**



mL

**Step 3: Pump air.**



kPa

RUN

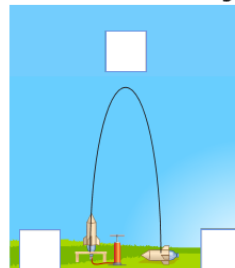
Trial	Bottle	Water (mL)	Air (kPa)	Height (m)	Flight Time (sec.)

Clear All

Gravity acts on the water bottle rocket. Identify the direction in which gravity acts on the water bottle rocket during flight.

Drag the arrows into the diagram.

**Water Bottle Rocket Flight**



**Arrows**



**Benchmark:** 6.2.2.2.2

Identify the forces acting on an object and describe how the sum of the forces affects the motion of the object. For example: Forces acting on a book on a table or a car on the road.

**DOK:** 2

Answer option	Rationale	Percent of student responses
<p><b>Correct:</b> All 3 arrows pointing down.</p>	<p>The student understands that the force of gravity acts to pull an object towards the Earth's surface.</p>	<p>No data available</p>
<p><b>Incorrect:</b> All other responses</p>	<p>The student thinks the force of gravity acts to pull an object in various directions or in a single direction not towards Earth's surface.</p>	<p>No data available</p>

### Question 9

To build and launch a water bottle rocket, select a bottle below. Select the amount of water in milliliters (mL) you want to add and the pressure of air in kilopascals (kPa) you want to pump into the bottle. Then select "Run." The water bottle rocket will launch, and data will be recorded in the table. Repeat as necessary.

Step 1: Select a bottle.

2 L   
  1 L   
  1 L, Wide

Step 2: Add water.

100 mL

Step 3: Pump air.

300 kPa

**RUN**

Trial	Bottle	Water (mL)	Air (kPa)	Height (m)	Flight Time (sec.)

Clear All

What is the average speed of the water bottle rocket when it travels 20 meters in 5 seconds?

You can use the calculator to help you answer this question.

- A. 4 meters per second
- B. 15 meters per second
- C. 25 meters per second
- D. 100 meters per second

Benchmark: 6.2.2.1.1

Measure and calculate the speed of an object that is traveling in a straight line.


DOK 1

Answer option	Rationale	Percent of student responses
<b>Correct: A</b>	The rocket would have a speed of 20 meters/5 seconds or 4m/s.	No data available
B	This answer was obtained by students if they subtract the time from the distance.	No data available
C	This answer was obtained by students if they add the time and the distance.	No data available
D	This answer was obtained by students if they multiply the time with the distance.	No data available


### Question 10

To build and launch a water bottle rocket, select a bottle below. Select the amount of water in milliliters (mL) you want to add and the pressure of air in kilopascals (kPa) you want to pump into the bottle. Then select "Run." The water bottle rocket will launch, and data will be recorded in the table. Repeat as necessary.


**Step 1: Select a bottle.**



2 L




1 L




1 L, Wide

**Step 2: Add water.**



mL

**Step 3: Pump air.**



kPa

**RUN**

Trial	Bottle	Water (mL)	Air (kPa)	Height (m)	Flight Time (sec.)

Select the 1 liter (L) water bottle and an air pressure of 300 kPa. Run several trials with different amounts of water.

Which statement is supported by the results of this experiment?

- A. As the volume of water increases, the maximum height of the rocket decreases.
- B. As the volume of water increases, the maximum height of the rocket stays constant.
- C. As the volume of water increases, the maximum height of the rocket increases and then decreases.
- D. As the volume of water increases, the maximum height of the rocket decreases and then increases.

Benchmark: 7.1.1.2.3

Generate a scientific conclusion from an investigation, clearly distinguishing between results (evidence) and conclusions (explanation).


DOK: 3

Answer option	Rationale	Percent of student responses
A	At the lower ranges of water volume, the height the rocket flies increases.	No data available
B	As the water volume increases, the height the rocket flies continues to change.	No data available
<b>Correct: C</b>	At the lower ranges of water volume, the rocket increases in height. At the higher ranges of volume, the height decreases.	No data available
D	This is opposite of the results from performing the simulation.	No data available


### Question 11

To build and launch a water bottle rocket, select a bottle below. Select the amount of water in milliliters (mL) you want to add and the pressure of air in kilopascals (kPa) you want to pump into the bottle. Then select "Run." The water bottle rocket will launch, and data will be recorded in the table. Repeat as necessary.


**Step 1: Select a bottle.**



2 L




1 L




1 L, Wide

**Step 2: Add water.**



mL

**Step 3: Pump air.**



kPa

**RUN**

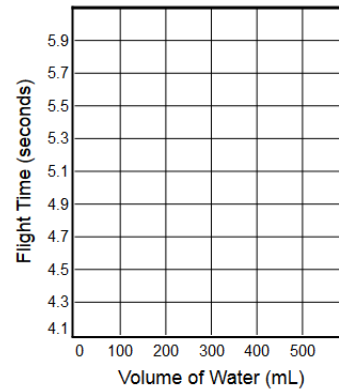
Trial	Bottle	Water (mL)	Air (kPa)	Height (m)	Flight Time (sec.)

Use the simulation to determine the relationship between the amount of water and flight time in water bottle rockets. Use a 2-liter bottle and set the air pressure to 300 kPa for 100, 200, 300, 400, and 500 mL of water.

Graph the flight time data for each trial.

Select the location on the graph to plot each point.

**Flight Time versus Volume of Water**



**Benchmark:** 8.1.3.4.2

Determine and use appropriate safety procedures, tools, measurements, graphs and mathematical analyses to describe and investigate natural and designed systems in Earth and physical science contexts.

**DOK:** 2

Answer option	Rationale	Percent of student responses
<p><b>Correct:</b> The student plots the points 100,4.3; 200,4.8; 300,5.1; 400,5.3; 500,5.4.</p>	<p>The student correctly runs the simulation with the variables given and plots the results.</p>	<p>No data available</p>
<p><b>Incorrect:</b> All other responses</p>	<p>The student does not plot the data correctly and/or run the simulation with the correct variables selected.</p>	<p>No data available</p>


## Question 12

To build and launch a water bottle rocket, select a bottle below. Select the amount of water in milliliters (mL) you want to add and the pressure of air in kilopascals (kPa) you want to pump into the bottle. Then select "Run." The water bottle rocket will launch, and data will be recorded in the table. Repeat as necessary.


Perform 3 trials in a controlled experiment to test how the amount of water added to the bottle affects the height of the flight.

After you perform the 3 trials, go on to the next question.


**Step 1: Select a bottle.**



2 L




1 L




1 L, Wide

**Step 2: Add water.**



mL

**Step 3: Pump air.**



kPa

**RUN**

Trial	Bottle	Water (mL)	Air (kPa)	Height (m)	Flight Time (sec.)

Clear All

**Benchmark:** 7.1.1.2.2

Plan and conduct a controlled experiment to test a hypothesis about a relationship between two variables, ensuring that one variable is systematically manipulated, the other is measured and recorded, and any other variables are kept the same (controlled). For example: The effect of various factors on the production of carbon dioxide by plants.

**DOK:** 3

Answer option	Rationale	Percent of student responses
<p><b>Correct:</b> Any combination of trials where only the amount of water is changed in all 3 trials</p>	<p>The student understands that in a controlled experiment, only 1 variable should be changed. In this simulation, the student can select any size water bottle and pressure and vary only the amount of water for each trial.</p>	<p>No data available</p>
<p><b>Incorrect:</b> All other responses</p>	<p>The student does not set up a controlled experiment correctly, changing only the amount of water in each trial or runs fewer than 3 trials.</p>	<p>No data available</p>

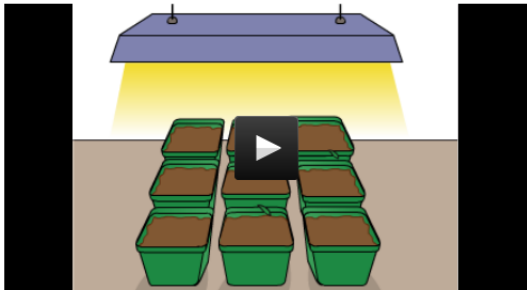


## Section 2

### Scenario: Pea Plant Experiment

#### Question 13

A student plants pea seeds in containers. Each container has the same type of soil and receives the same amounts of water and light. The pea seeds grow into mature plants.



What 2 substances do plants take in to make sugars during photosynthesis?

- A. Soil and light
- B. Water and oxygen
- C. Soil and carbon dioxide
- D. Water and carbon dioxide

*Benchmark: 7.4.2.2.1*



Recognize that producers use the energy from sunlight to make sugars from carbon dioxide and water through a process called photosynthesis. This food can be used immediately, stored for later use, or used by other organisms.

*DOK: 1*

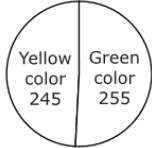
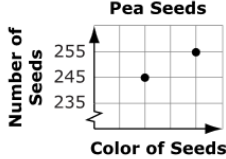
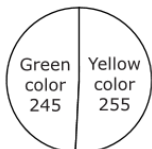
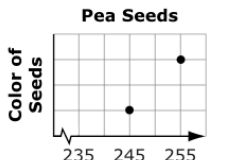
Answer option	Rationale	Percent of student responses
A	While plants use light energy, they do not use soil in the process of photosynthesis.	22%
B	While water is used during photosynthesis, plants produce oxygen, not use it to make sugars.	19%
C	While plants do take in carbon dioxide, they do not use soil in the process of photosynthesis.	6%
<b>Correct: D</b>	Plants take in water and carbon dioxide to produce sugars during photosynthesis.	53%

**Question 14**

The student collects the seeds from the mature pea plants. Some of the seeds are green and some are yellow. The student records the data about seed color in a table.

Number of Pea Seeds	
 Green	245
 Yellow	255

Which graph best shows the information from the table?

- A. **Pea Seeds**  

- B. **Pea Seeds**  

- C. **Pea Seeds**  

- D. **Pea Seeds**  


**Benchmark:** 7.1.3.4.2



Determine and use appropriate safety procedures, tools, measurements, graphs and mathematical analyses to describe and investigate natural and designed systems in a life science context.

**DOK:** 1

Answer option	Rationale	Percent of student responses
A	The values on the circle graph do not match the data in the table.	5%
B	Line graphs are used to track changes over a short or long period of time.	14%
<b>Correct: C</b>	A circle graph can be used to convey proportional data.	76%
D	Line graphs are used to track changes over a short or long period of time. The axis's do not convey the appropriate information.	5%

### Question 15

The student collects the seeds from the mature pea plants. Some of the seeds are green and some are yellow. The student records the data about seed color in a table.

Number of Pea Seeds	
 Green	245
 Yellow	255

Reproduction is important for a species to survive. Select one factor that might affect a species. Then select the most likely outcome of that factor.

Drag the factor and the outcome into the box.

Factor	→	Outcome
<input type="text"/>		<input type="text"/>
large amount of genetic diversity		decreased chance of species survival
small number of organisms		increased chance of species survival
negative change in environment		no chance of species survival

Benchmark: 7.4.3.2.3

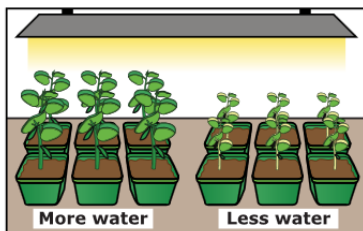
Recognize that variation exists in every population and describe how a variation can help or hinder an organism's ability to survive.

DOK: 2

Answer option	Rationale	Percent of student responses
<p><b>Correct:</b> The student must select one of the following pairs: <i>large amount of genetic diversity, increased chance of species survival; small number of organisms, decreased chance of species survival; negative change in environment, decreased chance of species survival</i></p>	<p>The student understands how genetic diversity, the number of organisms, or changes in the environment factors might affect the chance of survival for a species.</p>	78%
<p><b>Incorrect:</b> All other responses</p>	<p>The student does not understand the relationship between certain factors and the chance of survival for a species.</p>	22%

**Question 16**

The student uses yellow pea seeds for a different experiment. The student divides these seeds into 2 groups. One group of yellow pea seeds receives half as much water as the other group. After 1 month, the group of plants that received less water is shorter than the other group of plants.



Several types of variables are found in this experiment. Identify each of the 4 variables shown as changed, measured, or kept the same.

Drag the variables into the diagram.

<b>Variable(s) Changed</b>	
<b>Variable(s) Measured</b>	
<b>Variable(s) Kept the Same</b>	

**Pea Plant Experiment**

Amount of water

Amount of light

Height of plant

Size of container

**Benchmark: 7.1.1.2.2**

Plan and conduct a controlled experiment to test a hypothesis about a relationship between two variables, ensuring that one variable is systematically manipulated, the other is measured and recorded, and any other variables are kept the same (controlled). For example: The effect of various factors on the production of carbon dioxide by plants.

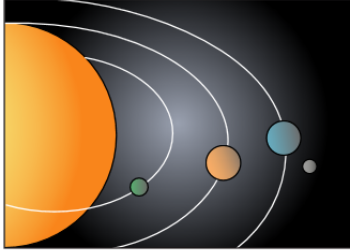
**DOK: 2**

Answer option	Rationale	Percent of student responses
<p><b>Correct:</b>                      Variable(s) Changed: <i>Amount of water</i>                      Variable(s) Measured: <i>Height of plant</i>                      Variable(s) Kept the Same: <i>Size of container and Amount of light</i></p>	<p>The student understands that in this controlled experiment, only the amount of water was changed, and the height of the plant was measured. All other variables were kept the same.</p>	50%
<p><b>Incorrect:</b>                      All other responses</p>	<p>The student does not understand which variables are changed, measured or kept the same in this controlled experiment.</p>	50%

## Scenario: Satellites

### Question 17

Satellites are natural or artificial objects that orbit a planet or star. The Moon and Earth are both natural satellites. For thousands of years, humans have used natural satellites and stars to determine the time of day and predict the change of the seasons.



Satellites move in regular, predictable patterns. Identify which 2 properties keep satellites moving in regular, predictable patterns.

Select 2 properties you want to choose.

#### Properties

- Density
- Friction
- Gravity
- Inertia
- Magnetism
- Speed

**Benchmark:** 8.3.3.1.2

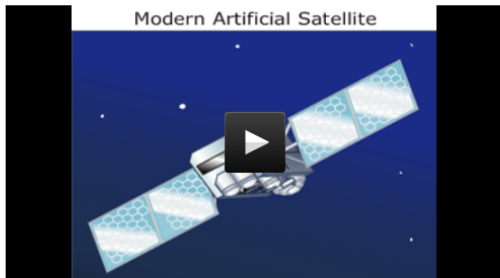
Describe how gravity and inertia keep most objects in the solar system in regular and predictable motion.

**DOK 2**

Answer option	Rationale	Percent of student responses
<b>Correct:</b> <i>Gravity, Inertia</i>	The student understands the two properties that keep objects in orbit are gravity and inertia.	31%
<b>Incorrect:</b> All other responses	While objects in orbit have a density and speed and experience some friction, these properties are not what keep them in orbit.	69%

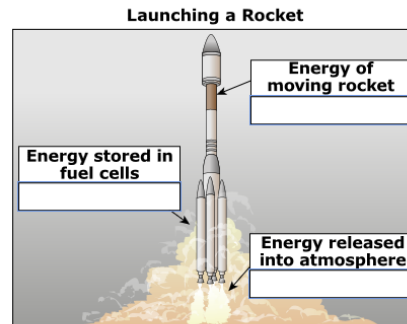
### Question 18

The first artificial satellite, Sputnik, was launched in 1957. Since then, many other countries, including the United States, have launched artificial satellites. These satellites are powered by an energy source such as batteries or the Sun.



Scientists use rockets to launch satellites from Earth. Identify which energy types are involved in launching a rocket.

Drag an energy type into each box.



#### Energy Types

- 
- 
- 
- 

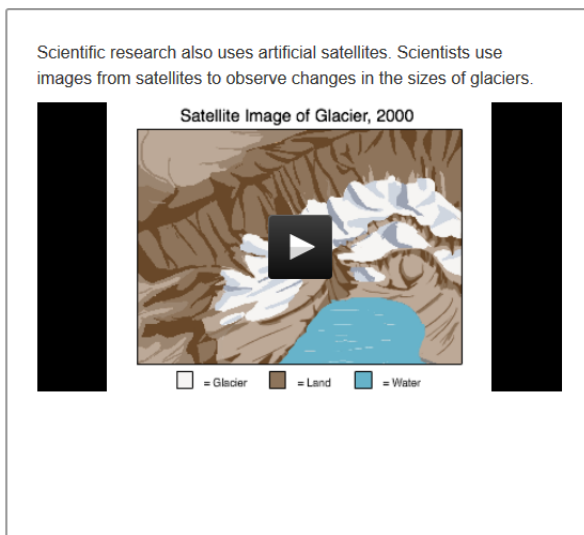
**Benchmark:** 6.2.3.2.2

Trace the changes of energy forms, including thermal, electrical, chemical, mechanical or others as energy is used in devices. For example: A bicycle, lightbulb or automobile.

DOK: 2

<b>Answer option</b>	<b>Rationale</b>	<b>Percent of student responses</b>
<b>Correct:</b> Energy stored in fuel cells: <i>chemical</i> Energy of moving rocket: <i>mechanical</i> Energy released into atmosphere: <i>heat</i>	The student understands the 3 energy types that occur when a rocket is launched. Chemical energy is stored in fuel cells, the energy of motion is a form of mechanical energy, and heat is released into the atmosphere.	38%
<b>Incorrect:</b> All other responses	The student incorrectly matches the energy types that occur when a rocket is launched.	62%

**Question 19**



The glacier in the satellite image appears white and the land appears brown. Which statement explains why objects appear to be different colors?

- A. Objects reflect all wavelengths of light.
- B. Objects refract all wavelengths of light.
- C. Objects reflect some wavelengths of light and absorb others.
- D. Objects refract some wavelengths of light and absorb others.

**Benchmark:** 6.2.3.1.3

Use wave properties of light to explain reflection, refraction and the color spectrum.

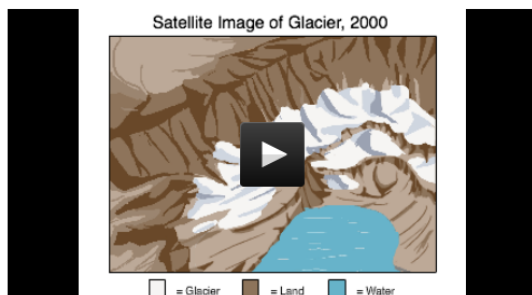
**DOK:** 1

Answer option	Rationale	Percent of student responses
A	In a white object, all wavelengths of light are reflected into the eye, but what causes us to perceive objects as different colors is that only certain wavelengths are reflected from the object into our eyes.	11%
B	Refraction does occur to some extent when the light hits an object, but it is the reflecting light that makes the objects appear different colors.	8%
<b>Correct: C</b>	People perceive color by wavelengths of light that are reflected off the object.	67%
D	Some wavelengths of light are refracted and some are absorbed, but it is the reflected light that makes an object appear a particular color.	14%



## Question 20

Scientific research also uses artificial satellites. Scientists use images from satellites to observe changes in the sizes of glaciers.



As the glacier melts, the volume of water in the lake near the glacier increases. Every 3 square kilometers of ice that melts adds 1,000,000 liters of water to the lake.

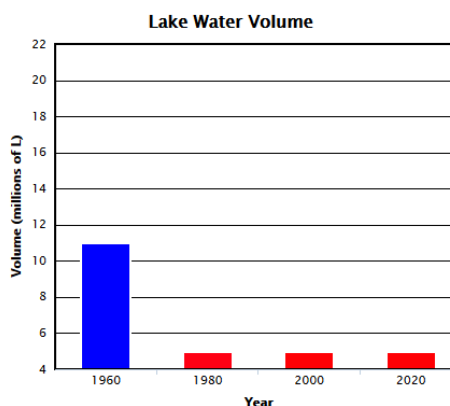
Glacier Size over Time

Year	1960	1980	2000
Area (km <sup>2</sup> )	9	6	3

Assume the glacier melts at the same rate through 2020. Graph the volume of water in the lake from 1980 to 2020.

You can use the calculator to help you answer this question.

Drag the top of each bar to the correct height.



**Benchmark:** 8.1.3.4.1

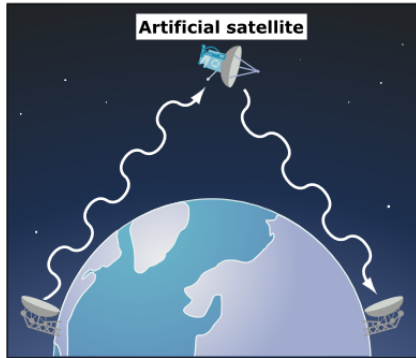
Use maps, satellite images and other data sets to describe patterns and make predictions about local and global systems in Earth science contexts. For example: Use data or satellite images to identify locations of earthquakes and volcanoes, ocean surface temperatures, or weather patterns.

**DOK:** 3

Answer option	Rationale	Percent of student responses
<p><b>Correct:</b> Bar for 1980 goes to 12 Bar for 2000 goes to 13 Bar for 2020 goes to 14</p>	<p>The student understands the relationship between the added volume of water in the lake from the ice melt and the how the trend continues at a constant rate.</p>	21%
<p><b>Incorrect:</b> All other responses</p>	<p>The student does not graph the information correctly or misunderstands how the melting ice increases the lake water volume.</p>	79%

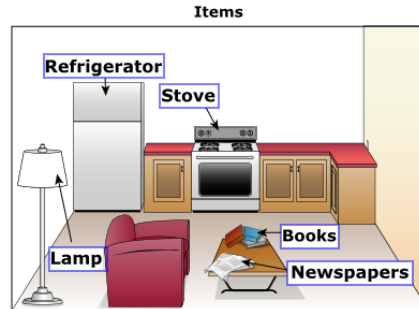
**Question 21**

Communication is a common use of artificial satellites. They receive and send electromagnetic waves to transmit radio, telephone, and television signals.



Internet services use satellite signals. People can use the Internet in homes to replace some older technologies. Identify which items people can replace by using the Internet.

Select the items you want to choose.



**Benchmark:** 6.1.2.1.1

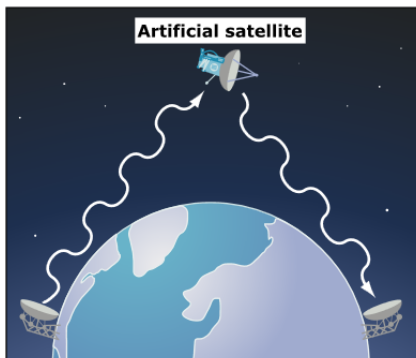
Identify a common engineered system and evaluate its impact on the daily life of humans. For example: Refrigeration, cell phone or automobile.

**DOK:** 2

Answer option	Rationale	Percent of student responses
<b>Correct:</b> <i>Books and Newspapers</i>	The student correctly chooses the 2 items for which the Internet can provide the same service for humans.	81%
<b>Incorrect:</b> All other responses	The student incorrectly chooses only 1 item or selects more than 2 items.	19%

## Question 22

Communication is a common use of artificial satellites. They receive and send electromagnetic waves to transmit radio, telephone, and television signals.



Which statement describes why sound waves cannot travel beyond Earth's atmosphere to the satellites?

- A. Sound waves need light to move.
- B. Sound waves cannot travel in air.
- C. Sound waves need particles to move.
- D. Sound waves cannot travel fast enough.

**Benchmark:** 6.2.3.1.2

Explain how the vibration of particles in air and other materials results in the transfer of energy through sound waves.

**DOK:** 1

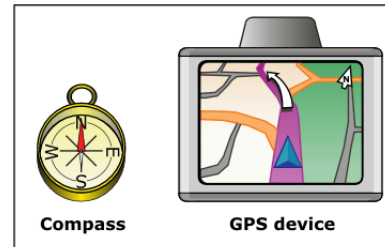
Answer option	Rationale	Percent of student responses
A	Light is also a wave and can move through outer space, but sound does not rely on light.	7%
B	Sound waves can travel in the air, but there is no air outside of the atmosphere.	5%
<b>Correct: C</b>	The vibration of particles is what results in the transfer of energy through sound waves.	60%
D	Sound waves are slower than some other types of waves, but sound does not travel at all in outer space.	28%

**Question 23**

The global positioning system, known as GPS, uses artificial satellites. People can use a GPS device to get directions to a location.



A compass and a GPS device have similar features and different features. Identify which features are similar and which are different.



Drag each feature into the correct box.

Shows which direction is north      Cost      Number of functions      Includes a map

Similar      Different

**Benchmark:** 6.1.2.1.3

Describe the trade-offs in using manufactured products in terms of features, performance, durability and cost.

**DOK:** 2

Answer option	Rationale	Percent of student responses
<p><b>Correct:</b>                      Similar: <i>Shows which direction is north</i>                      Different: <i>Cost, Number of functions, Includes a map</i></p>	<p>The student understands that a compass has a limited but useful purpose in displaying direction. A GPS device is an engineered device that in addition to showing direction, performs many more functions than a compass but costs more money.</p>	71%
<p><b>Incorrect:</b>                      All other responses</p>	<p>The student does not understand the similarities and differences between a compass and a GPS device.</p>	29%