Grade 8 Science MCA
Item Sampler Teacher Guide

Overview of Item Samplers

Item samplers are one type of student resource provided to help students and educators prepare for test administration. While standardized tests are familiar to almost all students, each assessment has its own layout and ways students interact with it. The item samplers should be used to familiarize students and educators with how the content is assessed by providing examples of the format and item types students could encounter on the MCA.

Other Resources

While this Teacher Guide provides detailed information about the item samplers, the student tutorial is the resource that should be used to familiarize students and educators with the general functionality of the online test, including navigation, tools, and examples of all item types.

For further information about the student tutorial and using student resources, refer to the *Purposes of Student Resources* on the Item Samplers page of PearsonAccess Next (PearsonAccess Next > Preparing for Testing > Item Samplers). Please contact mde.testing@state.mn.us for any questions about the MCA or resources for testing.

Contents of this Teacher Guide

The Teacher Guides provide supplementary information for the items in the online item samplers, including:

- An answer key*
- Item images
- Rationales for correct and incorrect answer options
- Benchmarks the sample items align to from the test specifications
- Cognitive complexity (indicated as Depth of Knowledge or DOK) from the test specifications
- Data on the percentage of student response for each answer option, for science items that were previously administered on the MCA

For detailed information on benchmarks and cognitive complexity levels, see the test specifications on the MDE website (Districts, Schools and Educators > Statewide Testing > Test Specifications).

*All items in the paper item samplers (12-point, 18-point, 24-point, and braille test books) are also represented in this Teacher Guide. However, the simulation is not included in the paper accommodated samplers so item numbers in the key must be adjusted when used with these materials.

Student Responses

Upon completion of the online item samplers, a report is displayed, which provides student responses for some item types. This report can be printed for use in conjunction with the information in this Teacher's Guide on how the student responded to those items. The overall score on the report is **not** a predictor of performance on the MCA; it is simply a total of correct responses. Note: student responses for multiple-choice and multiple-response items will display the student's response followed by an underscore and additional text (e.g., A_A). Please ignore the information after the underscore.

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

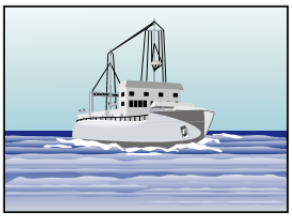
Explain the role of weathering, erosion, and glacial activity in shaping Minnesota's current landscape.

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%
Correct: D	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.

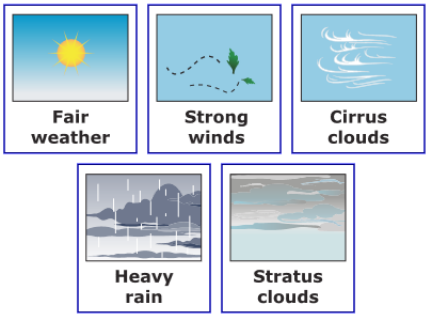


Based on the air pressure data, which 2 weather predictions will most likely be accurate?

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



Benchmark: 8.3.2.2.2

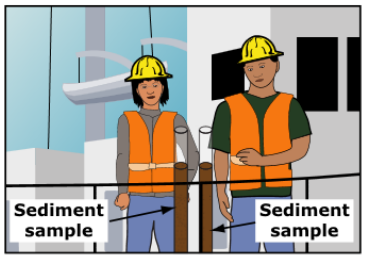
Analyze changes in wind direction, temperature, humidity and air pressure and relate them to fronts and pressure systems.

DOK: 2

Answer option	Rationale	Percent of student responses
Correct: Student selects *Fair weather* and *Cirrus clouds*	The student understands that high pressure systems are associated with cirrus clouds and fair weather.	20%
Incorrect: 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

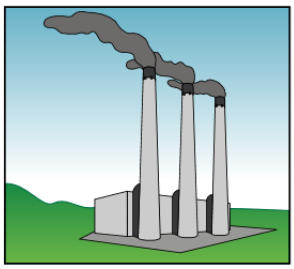
Generate and refine a variety of scientific questions and match them with appropriate methods of investigation, such as field studies, controlled experiments, reviews of existing work and development of models.

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%
Correct: 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

increases	increases	improves
decreases	decreases	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
Correct: From left to right: *decreases, decreases, improves*.	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**.**	72%
Incorrect: All other responses	The student does not understand the relationship between burning coal and the release of mercury and that mercury is a source of pollution.	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

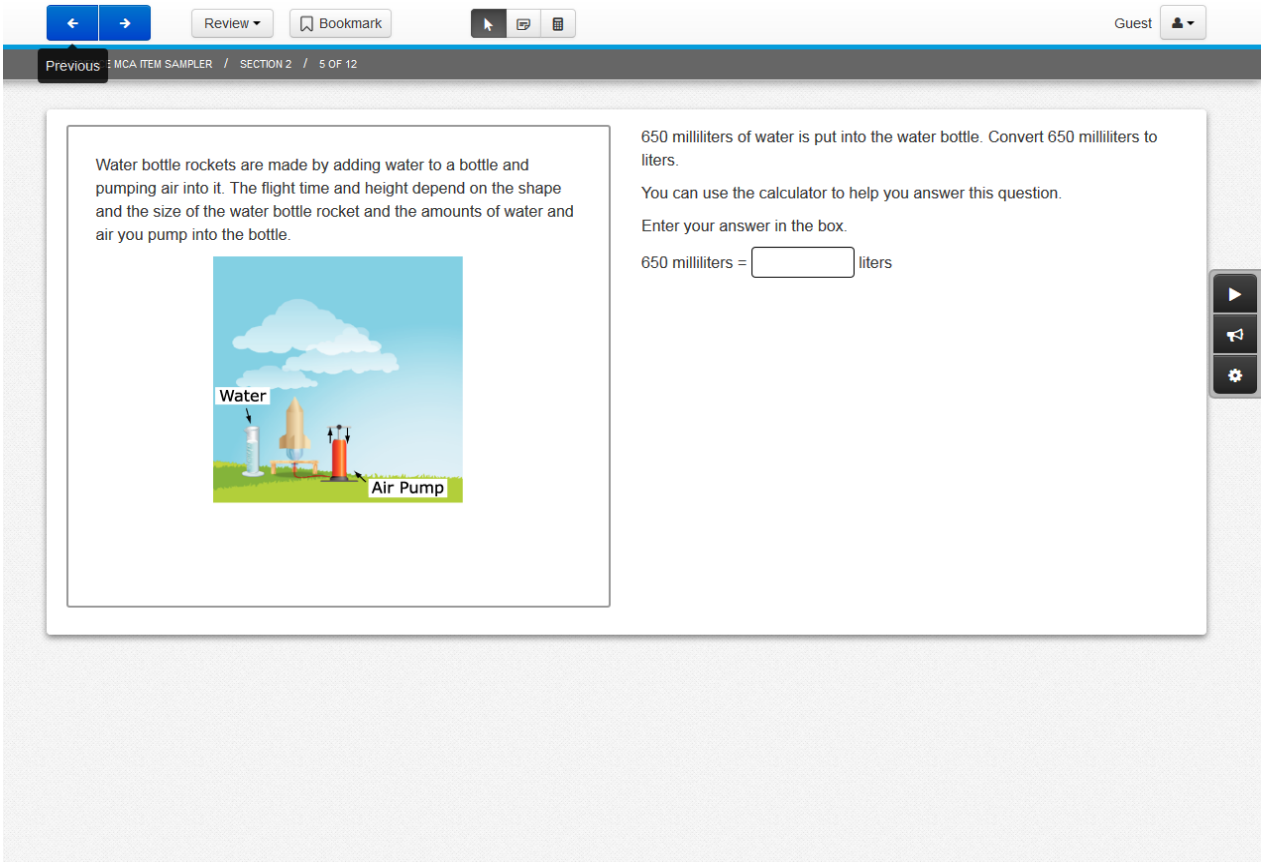
Benchmark: 6.2.1.2.1

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
Correct: D	A physical change occurs when a substance dissolves.	No data available

Question 6



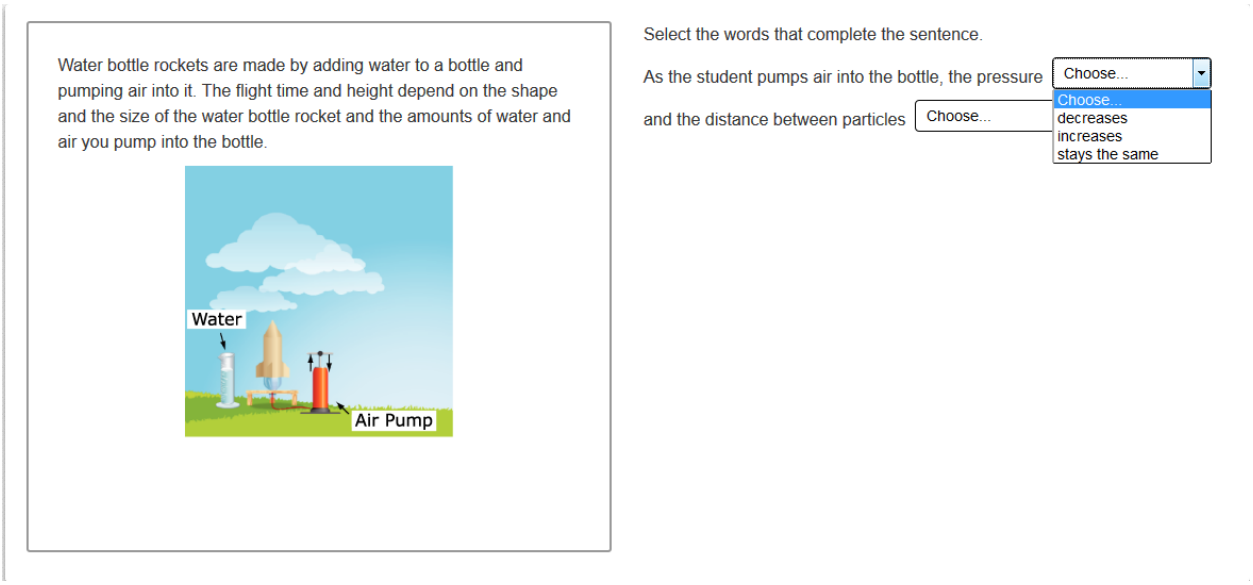
Benchmark: 6.1.3.4.2

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
Correct: 0.65	Using the conversion factor 1000 milliliters = 1 liter, solve X liters = 650 ml/1000 ml.	No data available
Incorrect: All other responses	The student does not convert milliliters to liters correctly.	No data available

Question 7



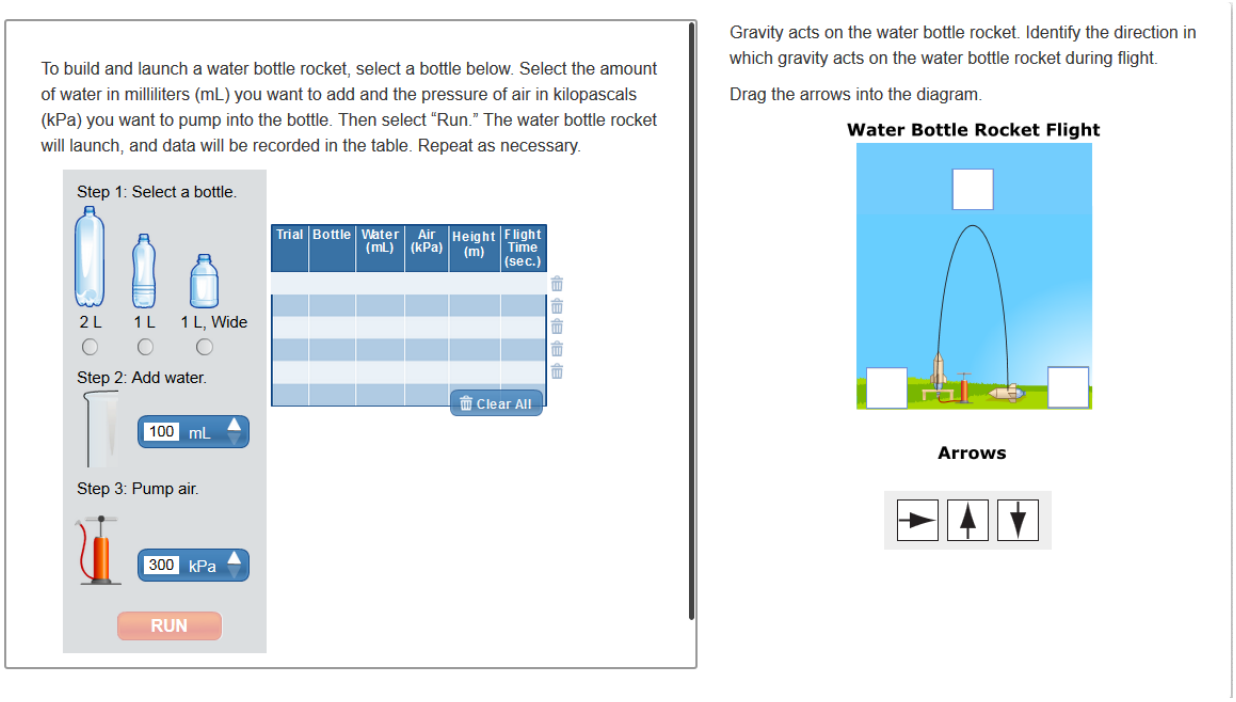
Benchmark: 6.2.1.1.1

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

DOK: 1

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

Question 8



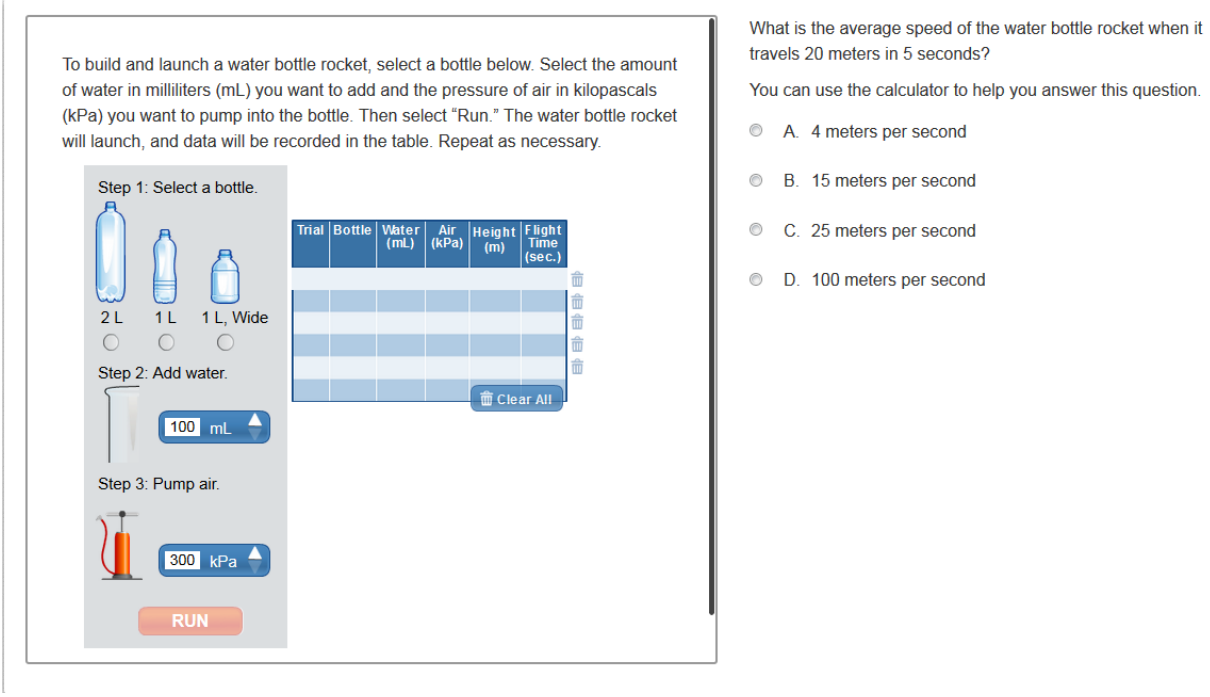
Benchmark: 6.2.2.2.2

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
Correct: All 3 arrows pointing down.	The student understands that the force of gravity acts to pull an object towards the Earth's surface.	No data available
Incorrect: All other responses	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.	No data available

Question 9



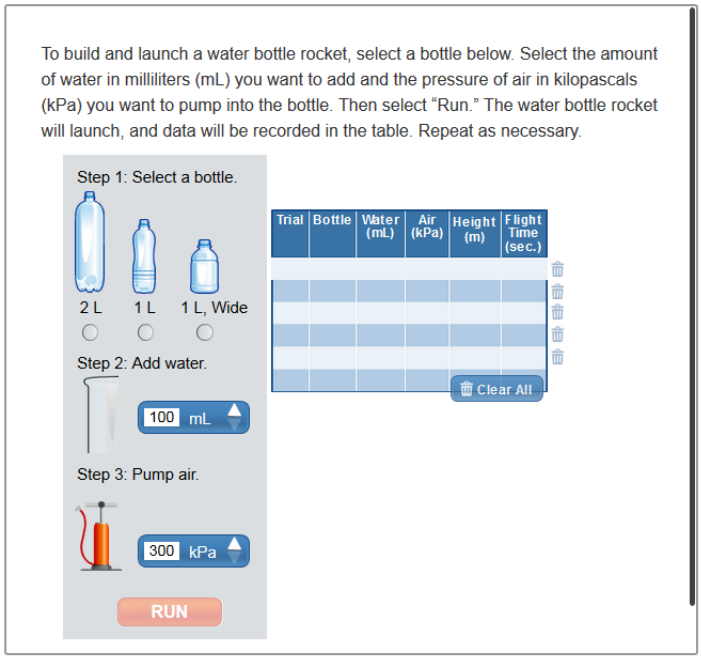
Benchmark: 6.2.2.1.1

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

DOK 1

Answer option	Rationale	Percent of student responses
Correct: A	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



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.

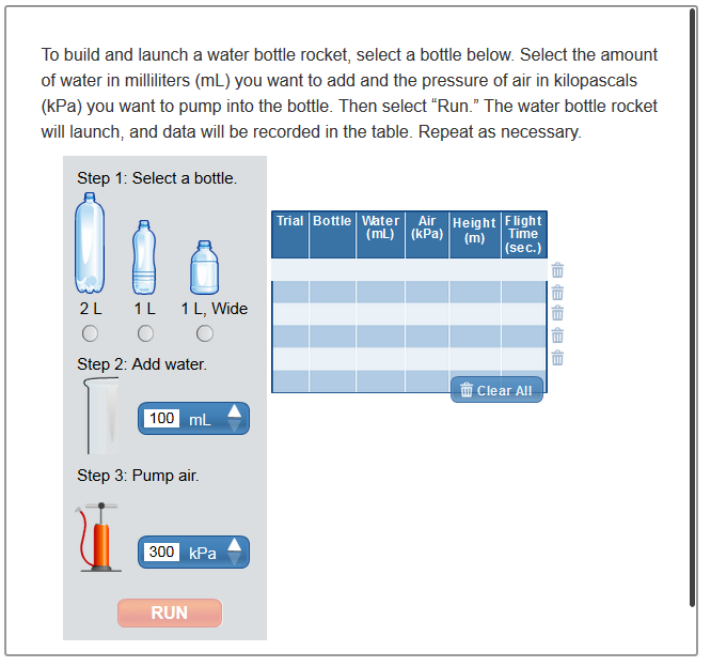
Benchmark: 7.1.1.2.3

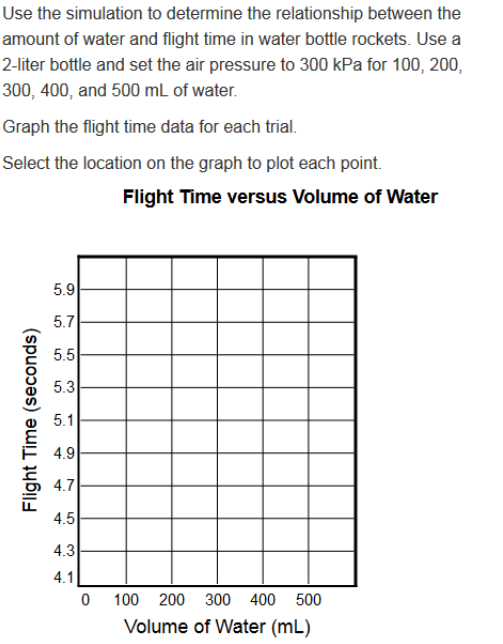
Generate a scientific conclusion from an investigation, clearly distinguishing between results (evidence) and conclusions (explanation).

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
Correct: C	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





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

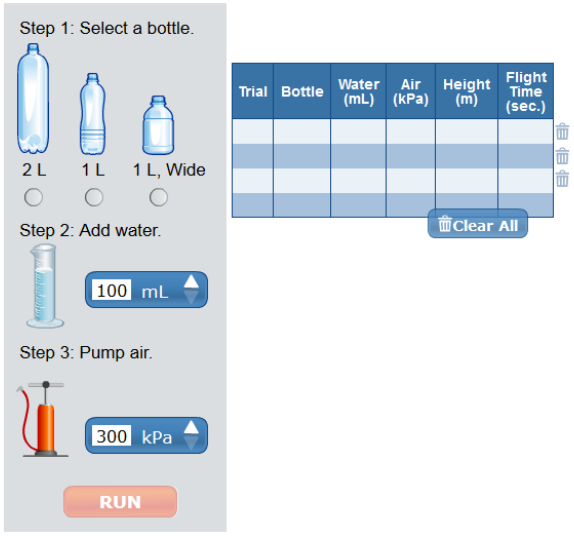
Answer option	Rationale	Percent of student responses
Correct: The student plots the points 100,4.3; 200,4.8; 300,5.1; 400,5.3; 500,5.4.	The student correctly runs the simulation with the variables given and plots the results.	No data available
Incorrect: All other responses	The student does not plot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

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.



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.

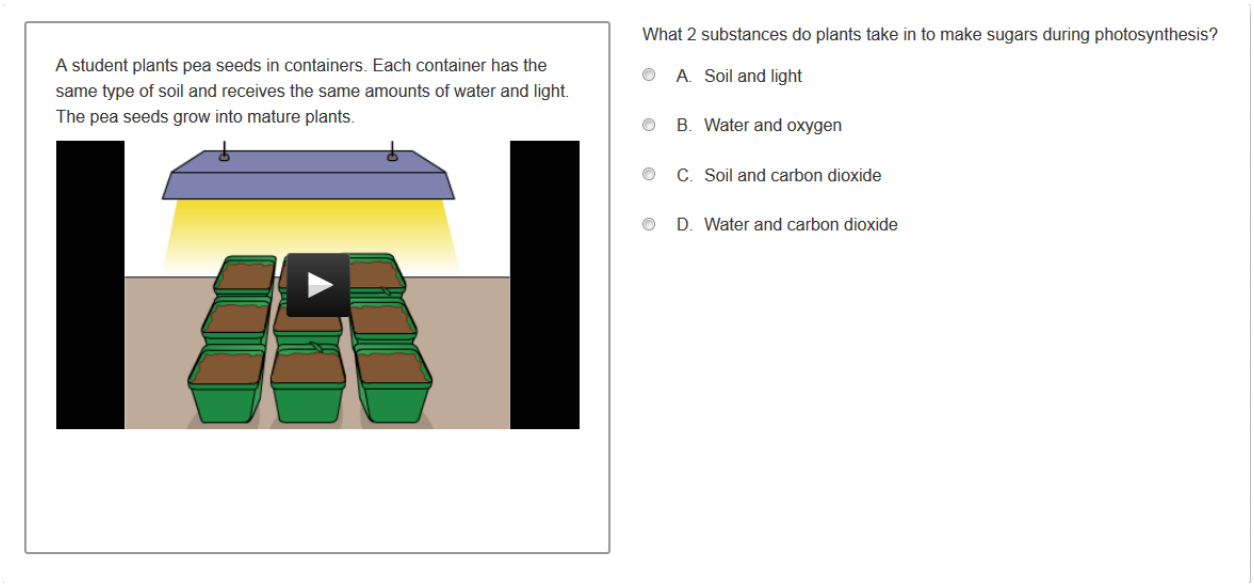
DOK: 3

Answer option	Rationale	Percent of student responses
Correct: Any combination of trials where only the amount of water is changed in all 3 trials	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.	No data available
Incorrect: All other responses	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.	No data available

Section 2

Scenario: Pea Plant Experiment

Question 13



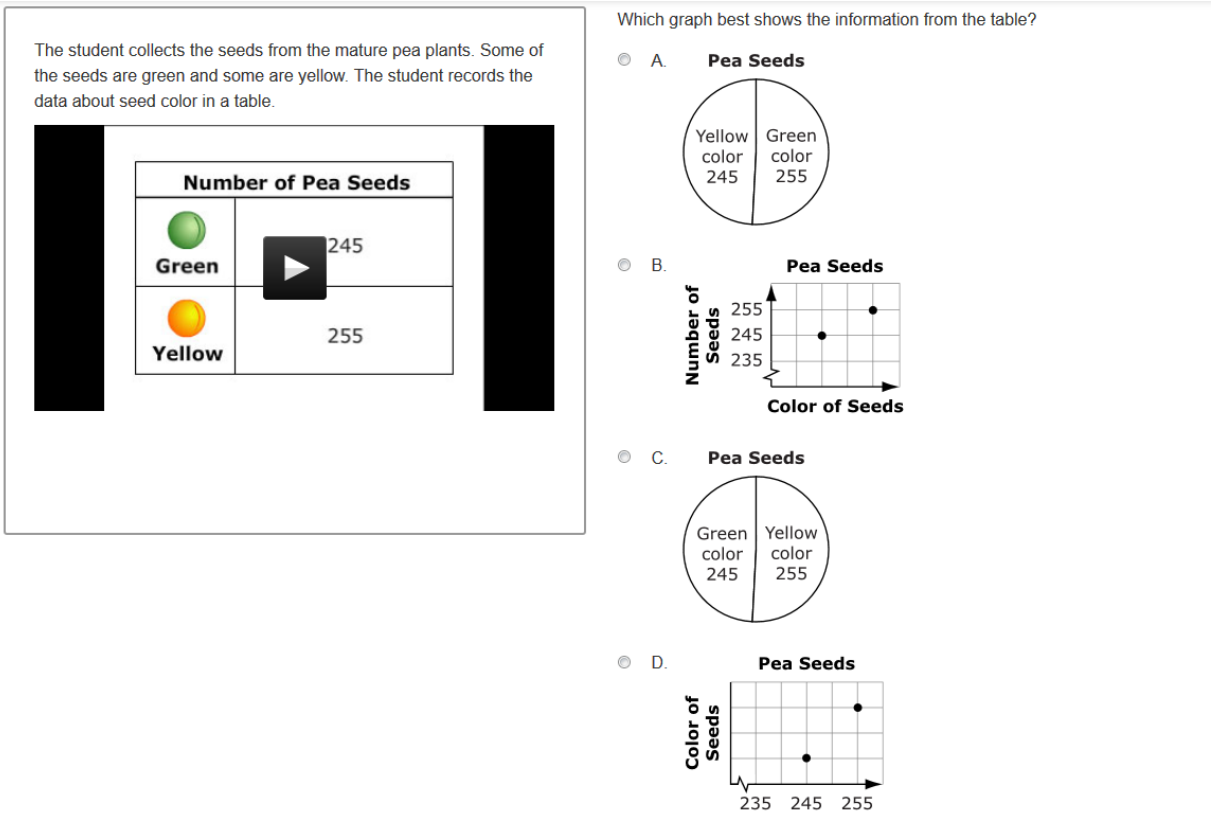
Benchmark: 7.4.2.2.1

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%
Correct: D	Plants take in water and carbon dioxide to produce sugars during photosynthesis.	53%

Question 14



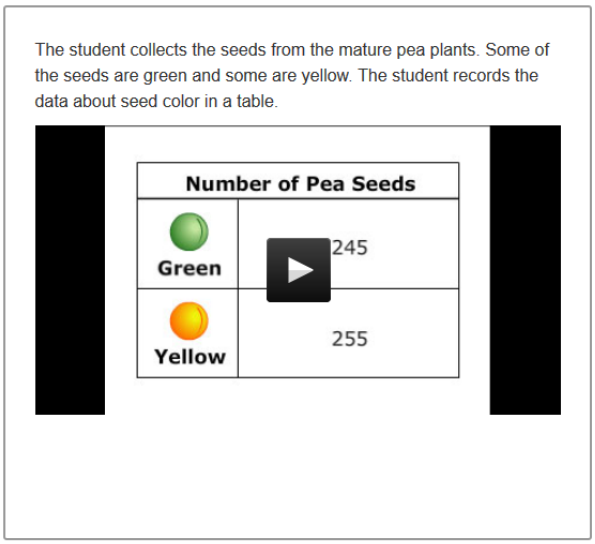
Benchmark: 7.1.3.4.2

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%
Correct: C	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



Benchmark: 7.4.3.2.3

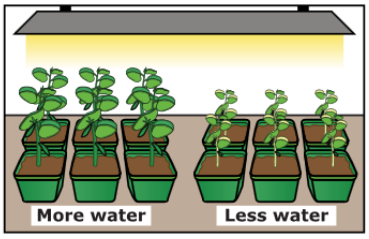
Recognize that variation exists in every population and describe how a variation can help or hinder an organism's ability to survive.

DOK: 2

Answer option	Rationale	Percent of student responses
Correct: The student must select one of the following pairs: *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*	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.	78%
Incorrect: All other responses	The student does not understand the relationship between certain factors and the chance of survival for a species.	22%

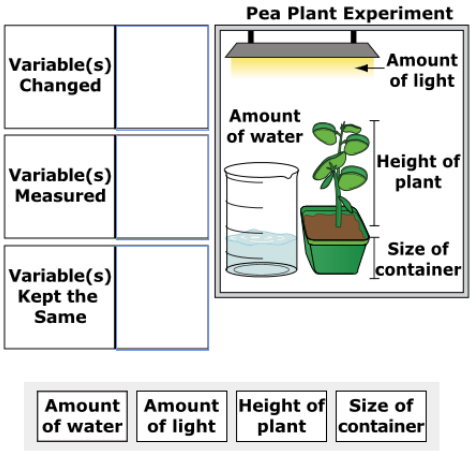
Question 16

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.



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.

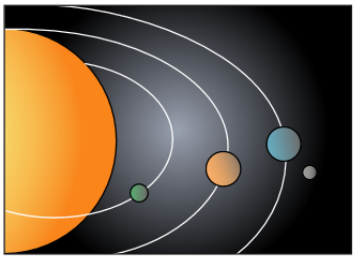
DOK: 2

Answer option	Rationale	Percent of student responses
Correct: Variable(s) Changed: *Amount of water* Variable(s) Measured: *Height of plant* Variable(s) Kept the Same: *Size of container* and *Amount of light*	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.	50%
Incorrect: All other responses	The student does not understand which variables are changed, measured or kept the same in this controlled experiment.	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

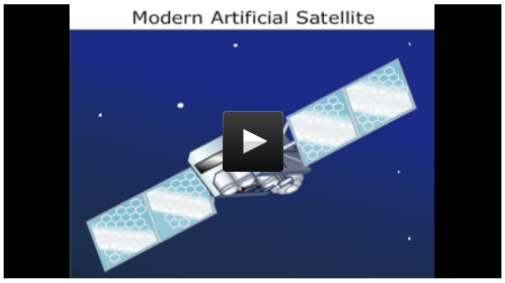
Describe how gravity and inertia keep most objects in the solar system in regular and predictable motion.

DOK 2

Answer option	Rationale	Percent of student responses
Correct: *Gravity, Inertia*	The student understands the two properties that keep objects in orbit are gravity and inertia.	31%
Incorrect: 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

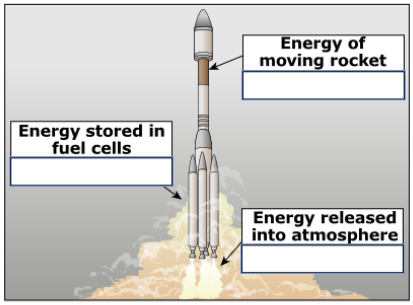
The first artificial satellite, Sputnik, was launched in 1957. Since then, many other countries, including the United States, have launched artificial satellites. These satellites are powered by an energy source such as batteries or the Sun.



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.

Launching a Rocket



Energy Types

- chemical
- electrical
- heat
- mechanical

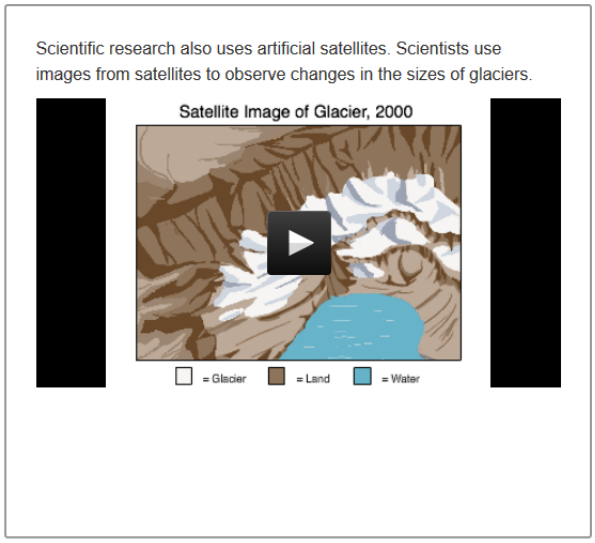
Benchmark: 6.2.3.2.2

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

Answer option	Rationale	Percent of student responses
Correct: Energy stored in fuel cells: *chemical* Energy of moving rocket: *mechanical* Energy released into atmosphere: *heat*	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%
Incorrect: 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.

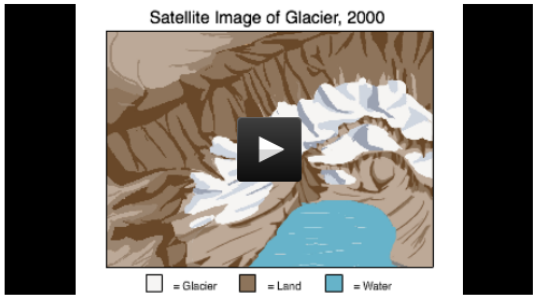
DOK: 1

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%
Correct: C	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.

Satellite Image of Glacier, 2000



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

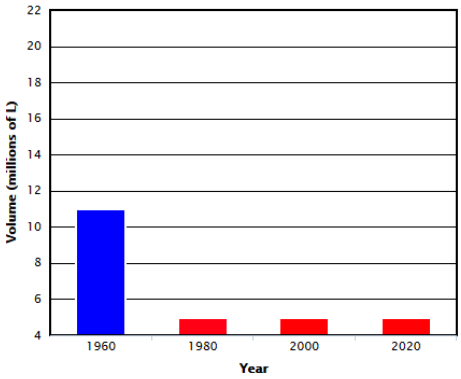
Year	1960	1980	2000
Area (km^2)	9	6	3

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.

Lake Water Volume



Benchmark: 8.1.3.4.1

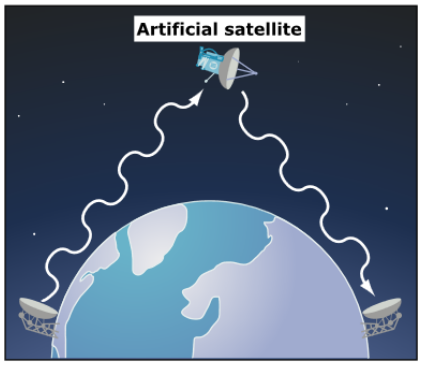
Use maps, satellite images and other data sets to describe patterns and make predictions about local and global systems in Earth science contexts. For example: Use data or satellite images to identify locations of earthquakes and volcanoes, ocean surface temperatures, or weather patterns.

DOK: 3

Answer option	Rationale	Percent of student responses
Correct: Bar for 1980 goes to 12 Bar for 2000 goes to 13 Bar for 2020 goes to 14	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.	21%
Incorrect: All other responses	The student does not graph the information correctly or misunderstands how the melting ice increases the lake water volume.	79%

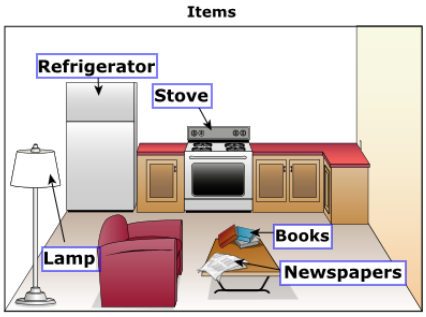
Question 21

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

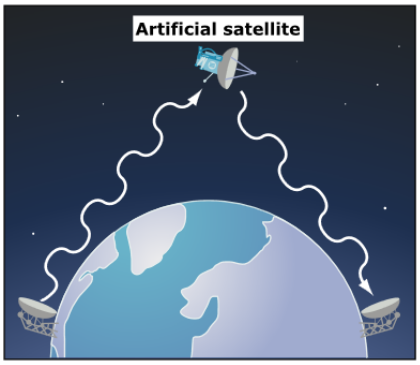
Identify a common engineered system and evaluate its impact on the daily life of humans. For example: Refrigeration, cell phone or automobile.

DOK: 2

Answer option	Rationale	Percent of student responses
Correct: *Books* and *Newspapers*	The student correctly chooses the 2 items for which the Internet can provide the same service for humans.	81%
Incorrect: 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.

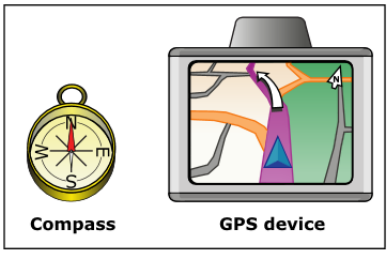
DOK: 1

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%
Correct: C	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
Correct: Similar: *Shows which direction is north* Different: *Cost, Number of functions, Includes a map*	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.	71%
Incorrect: All other responses	The student does not understand the similarities and differences between a compass and a GPS device.	29%