MASSACHUSETTS DEPARTMENT OF
ELEMENTARY AND SECONDARY
EDUCATION

Release of Spring 2021 MCAS Test Items

from the

Grade 8 Science and Technology/Engineering Paper-Based Test

June 2021
Massachusetts Department of Elementary and Secondary Education

MASSACHUSETTS DEPARTMENT OF
ELEMENTARY AND SECONDARY
EDUCATION

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Overview of Grade 8 Science and Technology/Engineering Test

The spring 2021 grade 8 Science and Technology/Engineering (STE) test was a next-generation assessment that was administered in two primary formats: a computer-based version and a paper-based version. The vast majority of students took the computer-based test. The paper-based test was offered as an accommodation for students with disabilities who are unable to use a computer, as well as for English learners who are new to the country and are unfamiliar with technology.

Most of the operational items on the grade 8 STE test were the same, regardless of whether a student took the computer-based version or the paper-based version. In places where a technology-enhanced item was used on the computer-based test, an adapted version of the item was created for use on the paper test. These adapted paper items were multiple-choice or multiple-select items that tested the same STE content and assessed the same standard as the technology-enhanced item.

This document displays released items from the paper-based test. Released items from the computer-based test are available on the MCAS Resource Center website at mcas.pearsonsupport.com/released-items.

Test Sessions and Content Overview

The grade 8 STE test was made up of two separate test sessions. Each session included selected-response questions and constructed-response questions. On the paper-based test, the selected-response questions were multiple-choice items and multiple-select items, in which students select the correct answer(s) from among several answer options.

In 2021, due to the COVID-19 pandemic, the Department reduced testing time for students in grades 3–8 through a session sampling approach, in which each student took only a portion of each MCAS assessment. Instead of taking two sessions in each subject, individual students took one session each.

Standards and Reporting Categories

The grade 8 STE test was based on learning standards in the four major content strands in the April 2016 version of the *Massachusetts Science and Technology/Engineering Curriculum Framework*. The four content strands are listed below.

- Earth and Space Science
- Life Science
- Physical Science
- Technology/Engineering

The 2016 *Massachusetts Science and Technology/Engineering Curriculum Framework* is available on the Department website at www.doe.mass.edu/frameworks/current.html.

Science and Technology/Engineering test results are reported under four MCAS reporting categories, which are identical to the four framework content strands listed above.

The tables at the conclusion of this document provide the following information about each released and unreleased operational item: reporting category, standard covered, practice category covered (if any), item type, and item description. The correct answers for released selected-response questions are also displayed in the released item table.

Reference Materials

Each student taking the paper-based version of the grade 8 STE test was provided with a plastic ruler. An image of the ruler is not reproduced in this document. Each student also had sole access to a calculator.

During both STE test sessions, the use of bilingual word-to-word dictionaries was allowed for current and former English learner students.

Grade 8
Science and Technology/Engineering
SESSION 1

This session contains 6 questions.

Directions

Read each question carefully and then answer it as well as you can. You must record all answers in this Test & Answer Booklet.

For some questions, you will mark your answers by filling in the circles in your Test & Answer Booklet. Make sure you darken the circles completely. Do not make any marks outside of the circles. If you need to change an answer, be sure to erase your first answer completely.

If a question asks you to show or explain your work, you must do so to receive full credit. Write your response in the space provided. Only responses written within the provided space will be scored.

1 The students in a class plan to build a small catapult to launch marbles. They want to test the properties of different materials so they can choose the best materials to build the catapult.

Which two properties of the materials should they test in order to build a catapult that launches marbles the **greatest** distance?

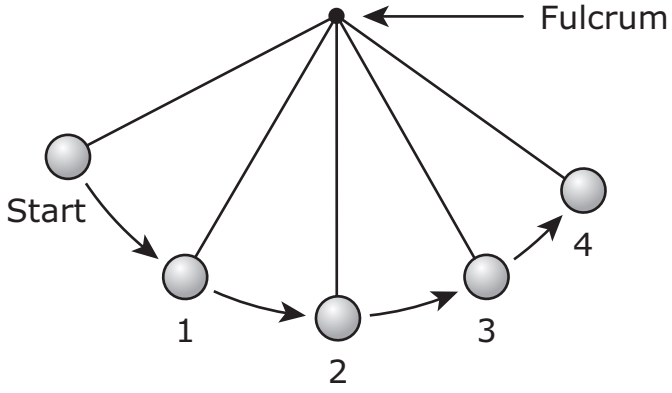
Ⓐ strength and flexibility

Ⓑ hardness and flexibility

Ⓒ strength and malleability

Ⓓ hardness and malleability

2 A pendulum is hanging from a fixed point called a fulcrum. When the pendulum is raised to the start position and released, it swings. The pendulum is shown in four numbered positions after it is released.



At which numbered position does the pendulum have the **greatest** amount of kinetic energy?

Ⓐ position 1

Ⓑ position 2

Ⓒ position 3

Ⓓ position 4

3 Which of the following cellular structures store the instructions that determine the color of a cat's fur?

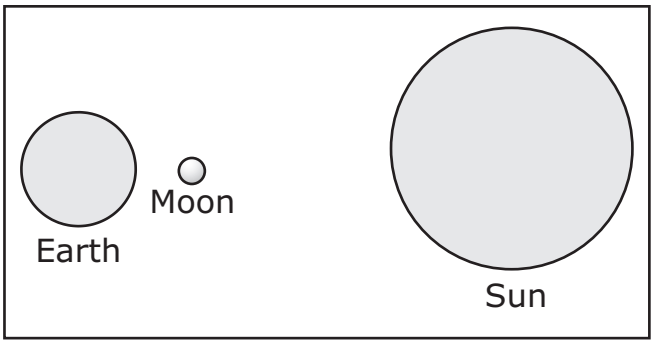
Ⓐ flagella

Ⓑ vacuoles

Ⓒ chloroplasts

Ⓓ chromosomes

4 The diagram shows the relative positions of Earth, the Moon, and the Sun at a certain time.



(not to scale)

Which of the following could be observed from Earth when Earth, the Moon, and the Sun are in these positions?

Ⓐ full moon

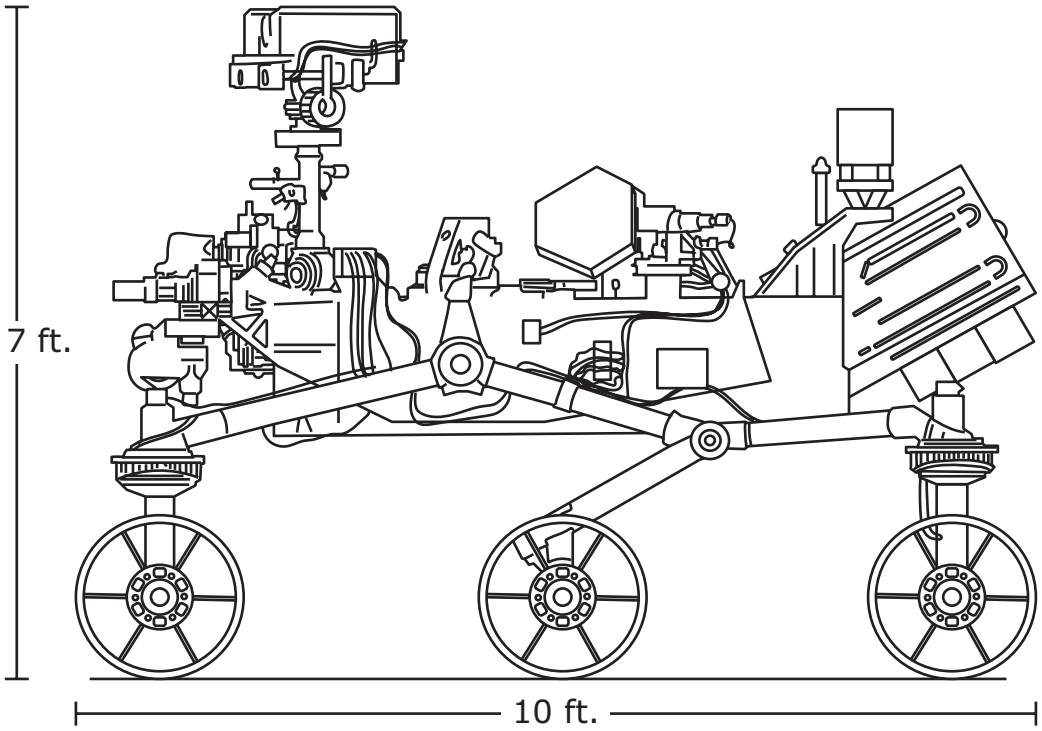
Ⓑ solar eclipse

Ⓒ lunar eclipse

Ⓓ gibbous moon

5 *Use your ruler to answer question 5.*

A vehicle was sent to the planet Mars to collect scientific data. The actual dimensions of the vehicle are labeled in the drawing.



Which scale was used to make the drawing of the vehicle?

Ⓐ 1 in. = 20 ft.

Ⓑ 1 in. = 2 ft.

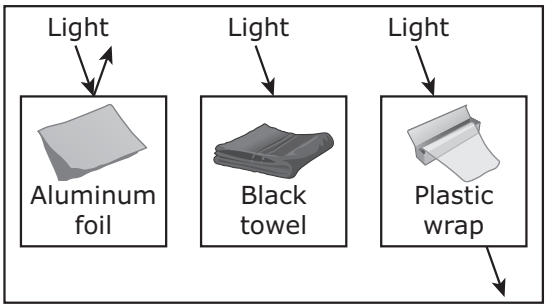
Ⓒ 2 in. = 1 ft.

Ⓓ 20 in. = 1 ft.

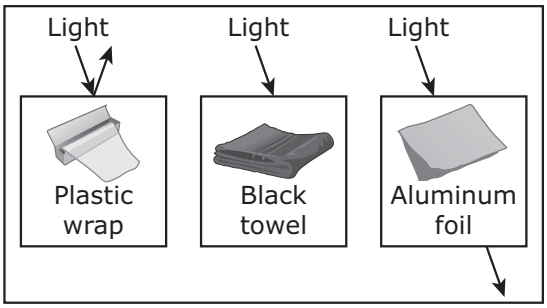
6 Light can be transmitted through, absorbed by, or reflected by different materials. Three objects made of different materials are shown.

Which set of diagrams best shows how most of the light interacts with each material?

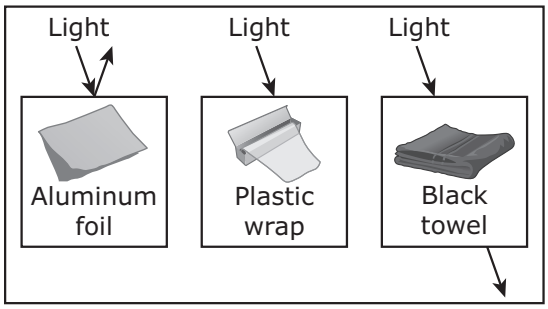
Ⓐ



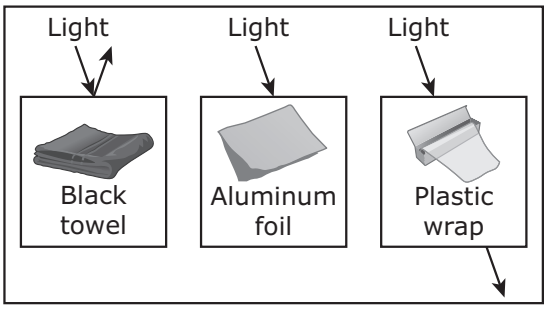
Ⓑ



Ⓒ



Ⓓ



Grade 8
Science and Technology/Engineering
SESSION 2

This session contains 14 questions.

Directions

Read each question carefully and then answer it as well as you can. You must record all answers in this Test & Answer Booklet.

For some questions, you will mark your answers by filling in the circles in your Test & Answer Booklet. Make sure you darken the circles completely. Do not make any marks outside of the circles. If you need to change an answer, be sure to erase your first answer completely.

If a question asks you to show or explain your work, you must do so to receive full credit. Write your response in the space provided. Only responses written within the provided space will be scored.

7 A scientist is studying mutations in bacteria. Which of the following describes something the scientist could do to determine whether a mutation in a bacterial cell causes changes to a trait in the bacterial cell?

Ⓐ make changes to the cell's genes and then look for changes in the proteins created

Ⓑ make changes to the nutrients available to the cell and then look for changes in the nucleus

Ⓒ make changes to the cell's color using dye and then observe whether the cell changes shape

Ⓓ make changes to the air temperature surrounding the cell and then observe whether the cell changes size

8 A student observes trout, a type of fish, living in two ponds, pond X and pond Y. The average size of trout in pond X is larger than the average size of trout in pond Y. The student makes a list of factors that could affect the size of the trout in each pond, as shown.

1. Pond X is three times the size of pond Y.
2. There is more food available for trout in pond X than in pond Y.
3. The trout in pond X have different genes than the trout in pond Y.
4. Pond X has a different species of predator that preys on trout than pond Y.

The student will determine which factors are environmental and which are hereditary.

Which of the factors in the student's list are environmental factors?

Ⓐ factors 1 and 3 only

Ⓑ factors 2 and 4 only

Ⓒ factors 1, 2, and 3

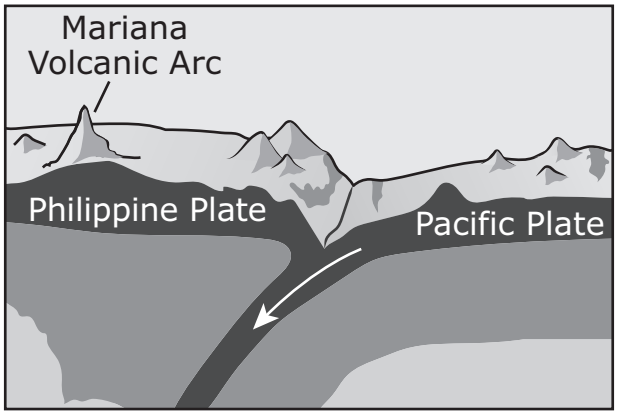
Ⓓ factors 1, 2, and 4

The following section focuses on changes to Earth's surface.

Read the information below and use it to answer the three selected-response questions and one constructed-response question that follow.

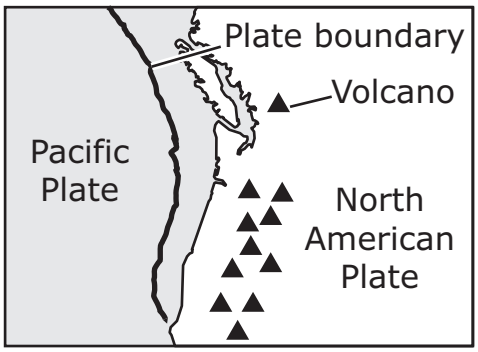
A student studied three examples of Earth's changing surface. The diagram below shows example 1, the Pacific and Philippine Plates under the Pacific Ocean.

Example 1



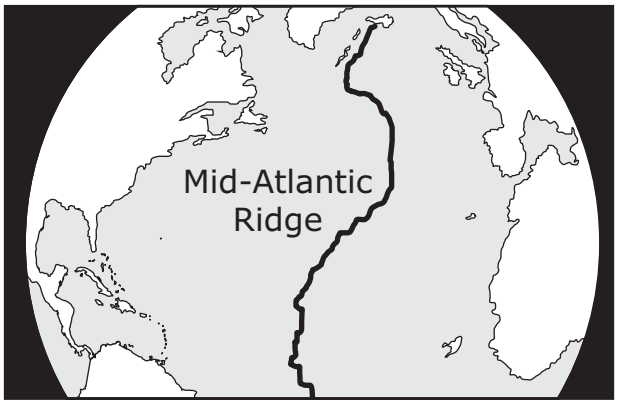
Example 2 includes parts of the Pacific and North American Plates. The Pacific Plate is oceanic and the North American Plate is continental, as shown in the diagram below.

Example 2



Example 3, shown in the diagram below, is the Mid-Atlantic Ridge under the Atlantic Ocean.

Example 3



9 What will most likely happen to the material moving underneath the Philippine Plate in example 1?

Ⓐ It will melt.

Ⓑ It will turn into rock.

Ⓒ It will become new sea floor.

Ⓓ It will move into Earth's core.

10 Which example shows evidence that an ocean is getting larger?

Ⓐ example 1

Ⓑ example 2

Ⓒ example 3

Which of the following is causing the ocean to get larger in the example you chose?

Ⓐ earthquakes

Ⓑ sea-floor spreading

Ⓒ active volcano chains

11 Which of the following best explains why the total amount of crust on Earth remains relatively the same?

Ⓐ Plate material is constantly melting.

Ⓑ The continents always stay in the same place.

Ⓒ The continents are frequently flooded and then dry out.

Ⓓ Plate material is continually being both created and destroyed.

This question has three parts. Write your response on the next page. Be sure to label each part of your response.

12 The three examples show how the surface of Earth changes.

A. Identify the type of energy in the convection currents that cause the changes in Earth shown in the examples.

B. Explain why volcanoes often form near each other, as in example 2.

C. Earthquakes often occur in the same areas where volcanoes are found.

Explain why earthquakes are evidence that Earth's plates are moving.

12

This question has two parts. Write your response on the next page. Be sure to label each part of your response.

13 Before a race, a runner eats a banana. The banana provides nutrients that help the runner complete the race.

A. Identify **two** body systems that are involved in getting the nutrients from the banana to different parts of the runner's body.

B. Describe how the two body systems you identified in Part A work together to get the nutrients to different parts of the runner's body.

13

This question has two parts. Write your response in the space provided on page 20. Be sure to label each part of your response.

14 Students in an engineering class used blocks to build a model house. They first evaluated four types of blocks using the following criteria:

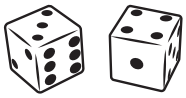
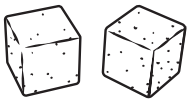
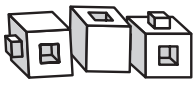
- low cost
- easy to build with
- durable
- able to stick together

The students scored each type of block from worst to best using the criteria. The results are shown in the decision matrix.

Scoring Key

Worst ⟶ Best

1	2	3	4

Type of Block	Criteria				Total Points
	Low Cost	Easy to Build With	Durable	Able to Stick Together	
Number cubes 	3	2	4	1	10
Sugar cubes 	4	1	1	1	7
Interlocking cubes 	2	3	4	4	13
Modeling clay 	2	3	2	3	10

A. Some students chose to use number cubes to build the model house.

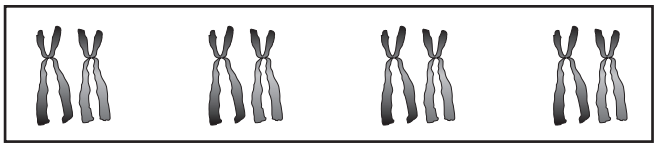
Identify **two** criteria from the decision matrix that the students used to make their choice.

B. Based on the decision matrix, the other students in the class determined there was a better type of block to use for building the model house than the number cubes.

Identify the type of block that is better for building the model house than the number cubes. Include evidence from the decision matrix to explain your reasoning.

14

15 The diagram below represents the chromosome pairs present in the body cells of a fruit fly.



Fruit flies reproduce sexually. Exactly how many chromosomes does a fruit fly offspring normally inherit from **each** parent?

Ⓐ 1 chromosome

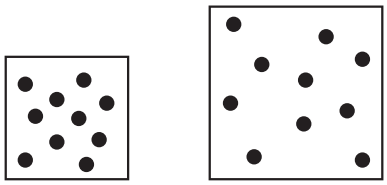
Ⓑ 2 chromosomes

Ⓒ 4 chromosomes

Ⓓ 8 chromosomes

This question has two parts.

16 Two containers with different volumes hold the same number of particles of the same gas, as shown.



Container 1
Volume: 50 mL

Container 2
Volume: 100 mL

Part A

Which of the following correctly compares the density of container 2 to the density of container 1?

Ⓐ The density of container 2 is one-half the density of container 1.

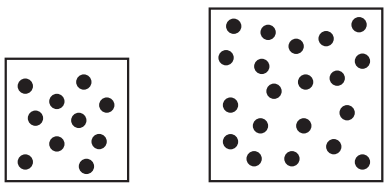
Ⓑ The density of container 2 is the same as the density of container 1.

Ⓒ The density of container 2 is two times the density of container 1.

Ⓓ The density of container 2 is four times the density of container 1.

Part B

More particles are added to container 2. It now has twice the number of particles as container 1, as shown below.



Container 1
Volume: 50 mL

Container 2
Volume: 100 mL

Which of the following correctly compares the density of the two containers?

Ⓐ The density of container 2 is now one-half the density of container 1.

Ⓑ The density of container 2 is now the same as the density of container 1.

Ⓒ The density of container 2 is now two times the density of container 1.

Ⓓ The density of container 2 is now four times the density of container 1.

17 When NASA communicates with a spacecraft orbiting Earth, the message is first converted to a signal that can be transmitted digitally. Which device is used to convert the message into a digital signal?

Ⓐ a decoder

Ⓑ an encoder

Ⓒ a receiver

Ⓓ a transmitter

18 In which of the following situations is a sugar cube undergoing a chemical change?

Ⓐ when it is burned

Ⓑ when it is crushed

Ⓒ when it is mixed with salt

Ⓓ when it is dissolved in water

19 A student created the two diagrams shown below.

Diagram 1

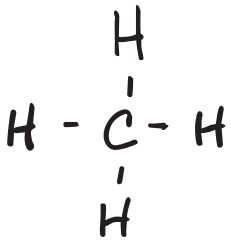
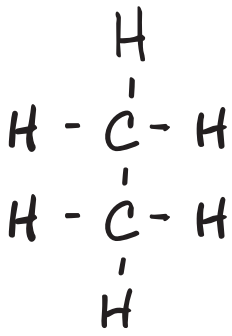


Diagram 2



Key
C = Carbon atom H = Hydrogen atom

Which of the following are represented by these diagrams?

Ⓐ two different elements

Ⓑ two different compounds

Ⓒ two different forms of the same mixture

Ⓓ two different forms of the same compound

20 A drone is a type of machine that can be controlled remotely. A team of engineers designed a drone for taking pictures on the International Space Station, which orbits Earth. Scientists on Earth use the drone to take pictures of activities on the space station. The pictures are transmitted from the drone back to the scientists on Earth.

Which of the following would be classified as feedback?

Ⓐ sending the pictures from the drone

Ⓑ receiving the pictures from the drone

Ⓒ constructing the drone's communication system

Ⓓ reporting problems about the drone's control system

Grade 8 Science and Technology/Engineering
Spring 2021 Released Operational Items

PBT Item No.	Page No.	Reporting Category	Standard	Practice Category	Item Type*	Item Description	Correct Answer**
1	3	*Technology/ Engineering*	6.ETS.2.2	A. Investigations and Questioning	SR	Determine properties of a material that should be tested to meet a design criterion for constructing a solution.	A
2	4	*Physical Science*	7.PS.3.7	None	SR	Analyze a diagram to determine when an object has the greatest amount of kinetic energy.	B
3	4	*Life Science*	8.LS.3.3	None	SR	Identify a cellular structure that stores instructions for a trait.	D
4	5	*Earth and Space Science*	6.ESS.1.1	C. Evidence, Reasoning, and Modeling	SR	Analyze a model of the Earth-Sun-Moon system to determine that a solar eclipse could be observed from Earth.	B
5	6	*Technology/ Engineering*	6.ETS.1.5	B. Mathematics and Data	SR	Determine the scale used to make a drawing of an actual object.	B
6	7	*Physical Science*	6.PS.4.2	C. Evidence, Reasoning, and Modeling	SR	Identify the model that best shows how light interacts with different materials.	A
7	9	*Life Science*	8.LS.3.1	A. Investigations and Questioning	SR	Describe how a scientist could determine whether a mutation causes changes to a trait in a bacterial cell.	A
8	10	*Life Science*	8.LS.1.5	C. Evidence, Reasoning, and Modeling	SR	Distinguish between environmental and hereditary factors influencing the size of an organism.	D
9	13	*Earth and Space Science*	8.ESS.2.1	C. Evidence, Reasoning, and Modeling	SR	Interpret a plate tectonic model to determine that crust will melt as it is subducted.	A
10	13	*Earth and Space Science*	7.ESS.2.2	C. Evidence, Reasoning, and Modeling	SR	Interpret plate tectonic models to determine which model shows an ocean is getting larger and determine why the ocean is getting larger.	C;B
11	14	*Earth and Space Science*	8.ESS.2.1	C. Evidence, Reasoning, and Modeling	SR	Explain why the total amount of crust on Earth remains relatively the same.	D
12	14	*Earth and Space Science*	6.ESS.2.3	C. Evidence, Reasoning, and Modeling	CR	Identify the type of energy responsible for convection currents and explain why volcanoes and earthquakes occur near plate boundaries.	
13	16	*Life Science*	6.LS.1.3	None	CR	Identify body systems that are involved in getting nutrients from food to different parts of the body and describe how the systems work together.	
14	18–19	*Technology/ Engineering*	7.ETS.1.2	B. Mathematics and Data	CR	Use a decision matrix to determine how well different types of objects meet the criteria for building a design solution and explain the reasoning for those determinations.	
15	21	*Life Science*	8.LS.3.4	C. Evidence, Reasoning, and Modeling	SR	Use a model of chromosomes in a body cell to determine the number of chromosomes an organism inherits from each parent.	C
16	22	*Physical Science*	6.PS.1.7	B. Mathematics and Data	SR	Compare the densities of different samples of a gas by analyzing particulate models of the samples.	A;B
17	23	*Technology/ Engineering*	7.ETS.3.1	None	SR	Identify the component of a communication system that converts a message into a digital signal.	B
18	23	*Physical Science*	8.PS.1.2	None	SR	Determine in which situation a chemical reaction is occurring.	A
19	24	*Physical Science*	8.PS.1.1	C. Evidence, Reasoning, and Modeling	SR	Determine that a pair of chemical models represents two compounds.	B
20	25	*Technology/ Engineering*	7.ETS.3.5	None	SR	Classify a part of a given communication system as feedback.	D

* Science and Technology/Engineering item types are: selected-response (SR) and constructed-response (CR).

** Answers are provided here for selected-response items only. Sample responses and scoring guidelines for constructed-response items will be posted to the Department's website later this year.

Grade 8 Science and Technology/Engineering
Spring 2021 Unreleased Operational Items

PBT Item No.	Reporting Category	Standard	Practice Category	Item Type*	Item Description
21	*Life Science*	7.LS.2.5	C. Evidence, Reasoning, and Modeling	SR	Determine which action will most likely help protect populations of a certain organism.
22	*Life Science*	8.LS.4.4	None	SR	Explain how new species can arise in different environmental conditions.
23	*Physical Science*	7.PS.3.6	C. Evidence, Reasoning, and Modeling	SR	Identify a model that shows how heat flows from warmer areas to colder areas.
24	*Physical Science*	8.PS.1.4	B. Mathematics and Data	SR	Analyze temperature data from an experiment to predict missing temperatures at a given time.
25	*Physical Science*	8.PS.1.5	B. Mathematics and Data	SR	Determine the mass of products after a chemical reaction has occurred.
26	*Physical Science*	7.PS.3.3	A. Investigations and Questioning	CR	Evaluate the effectiveness of a device designed to minimize thermal energy transfer, and describe and explain how design changes will improve the device.
27	*Technology/ Engineering*	7.ETS.3.4	C. Evidence, Reasoning, and Modeling	CR	Identify live loads, tension forces, and compression forces in a system and describe how those forces act on the system.
28	*Earth and Space Science*	8.ESS.2.5	C. Evidence, Reasoning, and Modeling	SR	Describe how the amount of moisture in air changes as air moves over an ocean and then over a mountain.
29	*Technology/ Engineering*	7.ETS.3.3	None	SR	Use a diagram of a vehicle to classify some of its parts into transportation subsystems.
30	*Earth and Space Science*	8.ESS.1.2	C. Evidence, Reasoning, and Modeling	CR	Analyze a diagram to compare how the strength of the gravitational force between two objects changes when the position or mass of one of the objects changes.
31	*Life Science*	8.LS.3.2	None	SR	Describe an advantage and a disadvantage of asexual reproduction in bacteria.
32	*Earth and Space Science*	8.ESS.1.1	None	SR	Explain what causes seasonal differences in hours of daylight.
33	*Life Science*	7.LS.1.4	C. Evidence, Reasoning, and Modeling	SR	Determine and explain the changes to flowering plant populations when the size of an insect population changes.
34	*Earth and Space Science*	8.ESS.3.5	B. Mathematics and Data	SR	Use a graph to determine changes in carbon dioxide levels in the atmosphere and identify several activities that have contributed to these changes.
35	*Life Science*	7.LS.2.3	C. Evidence, Reasoning, and Modeling	SR	Interpret a food web to determine one way energy flows through an ecosystem.
36	*Technology/ Engineering*	8.ETS.2.5	None	SR	Determine that the manufacturing process of conditioning occurs in a given scenario.
37	*Life Science*	7.LS.2.2	C. Evidence, Reasoning, and Modeling	SR	Analyze information to determine that the type of ecological relationship between two organisms is mutually beneficial.
38	*Technology/ Engineering*	6.ETS.2.3	B. Mathematics and Data	SR	Use a ruler to determine the appropriate location to cut a wooden rod.
39	*Physical Science*	6.PS.4.1	C. Evidence, Reasoning, and Modeling	SR	Use a model to identify the characteristic of a wave that is related to the amount of energy carried in that wave.
40	*Physical Science*	7.PS.2.3	C. Evidence, Reasoning, and Modeling	SR	Identify the set of models that shows how pairs of spheres behave, depending on each sphere's electric charge.
41	*Life Science*	6.LS.4.1	C. Evidence, Reasoning, and Modeling	SR	Use fossil evidence to determine how the environment of a location changed over time.

* Science and Technology/Engineering item types are: selected-response (SR) and constructed-response (CR).