

Massachusetts MCAS 2019
Grade 5 Science

Exam Materials
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XVI. Science and Technology/Engineering, Grade 5

Grade 5

Science and Technology/Engineering

SESSION 1

This session contains 11 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 in your Test & Answer Booklet. Only responses written within the provided space will be scored.

- 1 A teacher has five samples of unlabeled substances. The table shows some information about the five samples.

| Sample | Does It Dissolve in Water? | Is It Magnetic? | Does It Float on Top of Water? | Weight |
|--------|----------------------------|-----------------|--------------------------------|--------|
| 1 | yes | no | no | 10 g |
| 2 | yes | no | no | 15 g |
| 3 | no | yes | no | 18 g |
| 4 | no | no | no | 2 g |
| 5 | no | no | yes | 5 g |

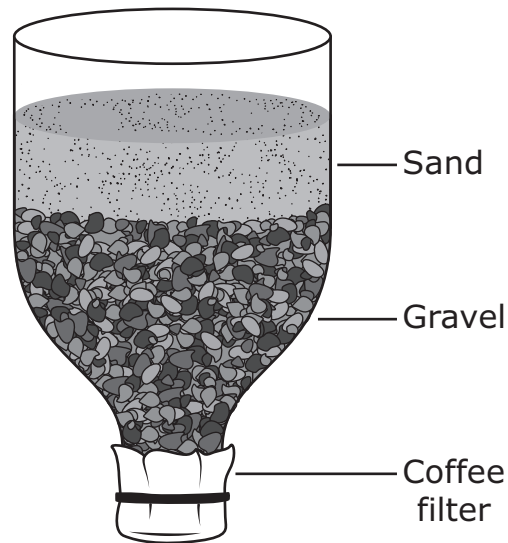
The teacher does the following:

- adds three of the samples to a beaker and mixes them together
- adds water to the beaker
- stirs the contents of the beaker with a powerful magnet
- removes the magnet from the beaker

After the magnet is removed, only a colorless liquid remains in the beaker. Which three samples did the teacher most likely mix together?

- Ⓐ samples 1, 2, and 5
- Ⓑ samples 1, 2, and 3
- Ⓒ samples 2, 3, and 4
- Ⓓ samples 3, 4, and 5

- 2 Students used sand, gravel, and a coffee filter to make a simple water filter. A diagram of the water filter is shown.



Which of the following should the students observe or measure to find out how well the water filter works?

- Ⓐ how clear the filtered water is
- Ⓑ how much water needs to be filtered
- Ⓒ the length and width of the water filter
- Ⓓ the amount of sand used to make the water filter

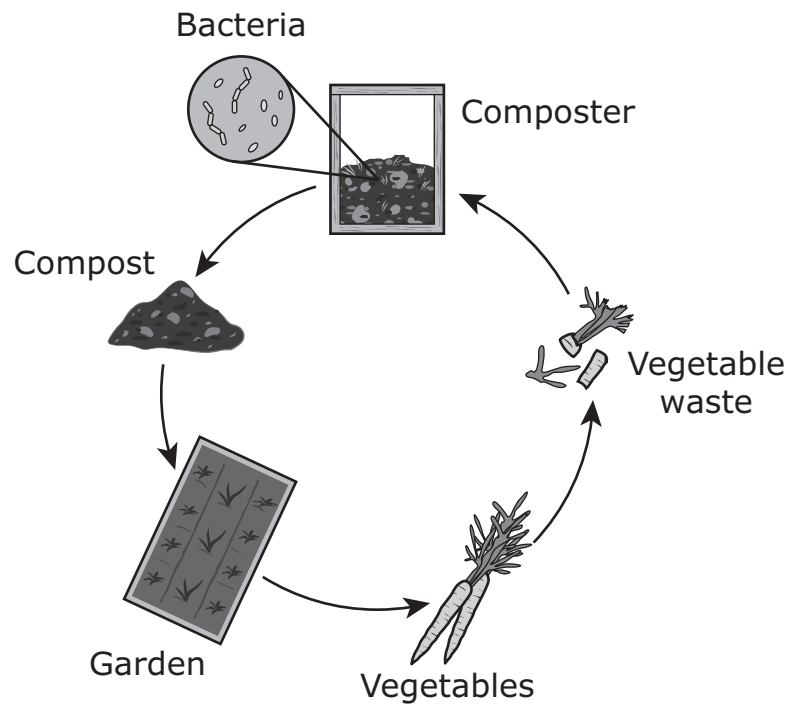
The following section focuses on composters and the movement of matter in a garden.

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

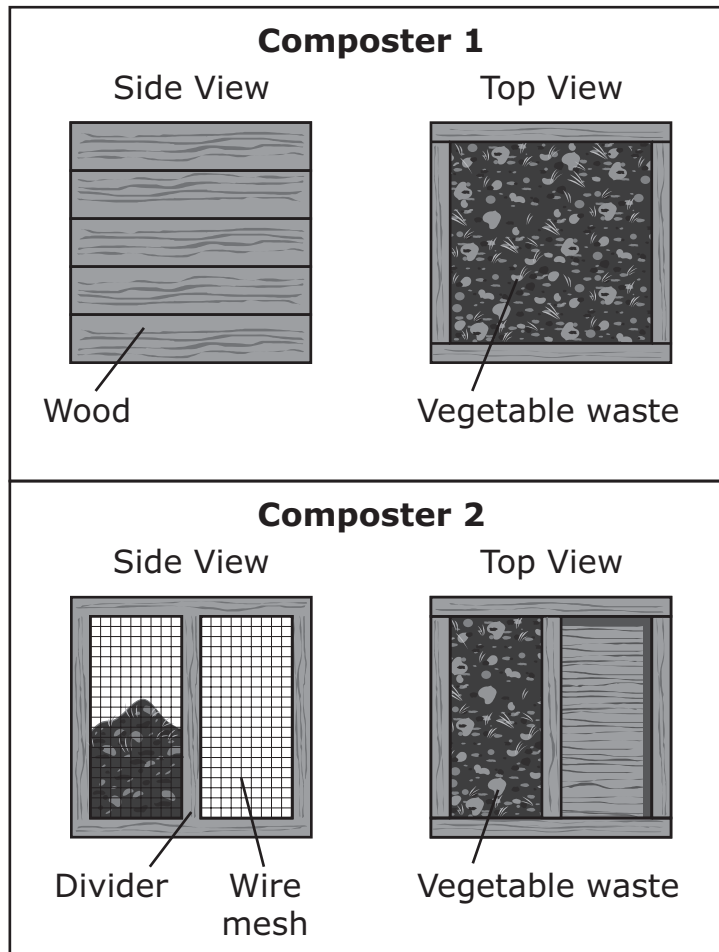
Students grew vegetable plants in their school's garden. They learned that waste from the vegetables can be composted.

When vegetable waste is placed in a composter, bacteria help turn the waste into compost over time. The compost can then be used in a garden.

The students made this model to show how matter moves through a composter and a garden.



The students designed and built two composter prototypes. The diagrams show the designs of the two prototypes.



Composter 1 has wooden sides and its top is open to the air. The vegetable waste in the composter is mixed once a week, which exposes the waste to air. Composter 2 has sides made of wire mesh and a wooden divider that creates two separate sections. All the vegetable waste is first placed in one section. After a week, the vegetable waste is moved to the other side of the divider. As the vegetable waste is moved from one side to the other, it is mixed and exposed to air.

- 3** The vegetable plants in the school garden used photosynthesis to grow. Which of the following describes how the vegetable plants use photosynthesis to grow?
- Ⓐ In photosynthesis, vegetable plants use the energy from sunlight to convert air and water into sugar.
 - Ⓑ In photosynthesis, vegetable plants use the energy from sugar to convert sunlight into air and water.
 - Ⓒ In photosynthesis, vegetable plants use the energy from air and water to convert sunlight into sugar.
 - Ⓓ In photosynthesis, vegetable plants use the energy from sunlight to convert sugar into air and water.

- 4** The students added the same amount and type of vegetable waste to each composter. After several weeks, they noticed that the waste in composter 2 was breaking down faster than the waste in composter 1.

Which of the following changes could the students make to composter 1 so that waste breaks down more quickly?

- Ⓐ drill many small holes in each side
- Ⓑ cover the top with a lid made out of wire mesh
- Ⓒ cover the top with a lid made out of clear plastic
- Ⓓ replace the wooden sides with thick plastic sides

- 5** Bacteria play an important role in the movement of matter in the students' model. Which of the following describes the role of bacteria in a composter?
- Ⓐ Bacteria in a composter are producers because they produce sugars.
 - Ⓑ Bacteria in a composter are composers because they produce sugars.
 - Ⓒ Bacteria in a composter are consumers because they recycle materials.
 - Ⓓ Bacteria in a composter are decomposers because they recycle materials.

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

- 6** The students want to design a third composter. They need to decide whether they should make a prototype or a diagram of the design.
- A. Describe one advantage of making a prototype instead of a diagram.
 - B. Other than cost, describe one advantage of making a diagram instead of a prototype.
 - C. One of the students wants to make the sides of the new composter out of cardboard. Describe one disadvantage of making the sides out of cardboard instead of wood.

6

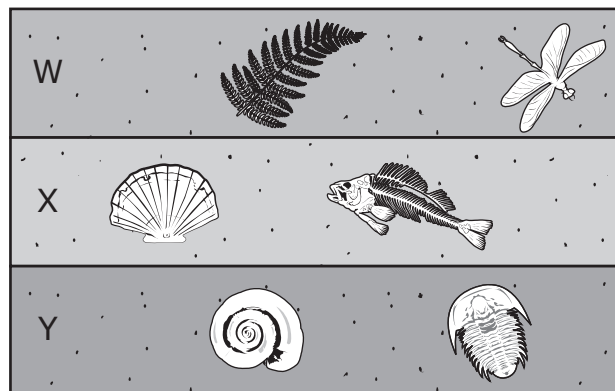
- 7 A town is having a water shortage, and the people in the town have been asked to reduce their use of the town's water supply. A gardener wants to continue to water plants in a garden.

Which of the following would be the most effective way to water the plants and still reduce water use?

- Ⓐ use soapy water
- Ⓑ use filtered water
- Ⓒ use water from water bottles sold in stores
- Ⓓ use water from rain collected in large containers

This question has two parts.

- 8 A scientist finds the fossils shown in the rock layers in this diagram.



Part A

The fossils in which rock layer are the oldest?

- Ⓐ Layer W, because the fossils are in the top layer
- Ⓑ Layer X, because the fossils were formed from ocean organisms
- Ⓒ Layer Y, because the fossils are in the bottom layer

Part B

Which of the following **best** explains why scientists study fossils?

- Ⓐ to learn about rocks that formed many years ago
- Ⓑ to learn about different types of very old minerals
- Ⓒ to learn about extinct organisms that lived long ago
- Ⓓ to learn about ancient technologies humans once used

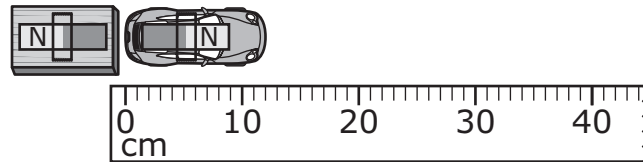
- 9 An engineer is testing different types of pervious concrete to use in a new parking area. Pervious concrete is a special kind of concrete that can help reduce flooding by allowing rainwater to pass through and soak into the ground.

Which of the following should the engineer measure to see how well a type of pervious concrete will reduce flooding?

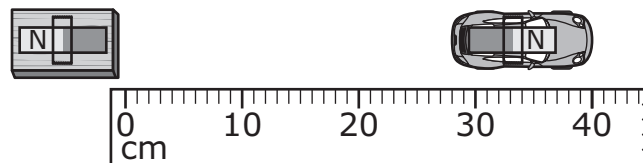
- Ⓐ the weight of 10 cubic meters of the concrete
- Ⓑ the strength of a 15-centimeter layer of the concrete
- Ⓒ the amount of water needed to mix a cubic meter of the concrete
- Ⓓ the number of liters of water per minute that can move through the concrete

- 10 A student places a wooden block next to a meter stick and then tapes a bar magnet on top of the block. Next, the student tapes a bar magnet to the roof of a toy car. The car is placed beside the meter stick, next to the bar magnet. The diagram below shows what the student observed before and after the car was released.

Before



After



What question is the student most likely trying to answer from this setup?

- Ⓐ How far can the magnets pull the car?
- Ⓑ How far can the magnets push the car?
- Ⓒ Is a force applied by the car to the magnet on the car?
- Ⓓ Is the magnet on the block attracted to or repelled by the car?

- 11** The tables show average temperature and precipitation data for four regions of the world.

Region W

| | January | March | May | July | September | November |
|---------------------|---------|-------|-----|------|-----------|----------|
| Temperature (°F) | 22 | 25 | 31 | 35 | 29 | 26 |
| Precipitation (in.) | 2 | 5 | 7 | 3 | 6 | 8 |

Region X

| | January | March | May | July | September | November |
|---------------------|---------|-------|-----|------|-----------|----------|
| Temperature (°F) | -38 | -4 | 46 | 64 | 45 | -20 |
| Precipitation (in.) | 0 | 0 | 1 | 2 | 1 | 1 |

Region Y

| | January | March | May | July | September | November |
|---------------------|---------|-------|-----|------|-----------|----------|
| Temperature (°F) | 70 | 66 | 52 | 48 | 54 | 66 |
| Precipitation (in.) | 2 | 2 | 1 | 0 | 1 | 2 |

Region Z

| | January | March | May | July | September | November |
|---------------------|---------|-------|-----|------|-----------|----------|
| Temperature (°F) | 77 | 79 | 84 | 82 | 82 | 81 |
| Precipitation (in.) | 5 | 2 | 4 | 8 | 10 | 8 |

Which region is most likely a tropical rainforest?

- Ⓐ region W
- Ⓑ region X
- Ⓒ region Y
- Ⓓ region Z

Grade 5

Science and Technology/Engineering

SESSION 2

This session contains 9 questions.

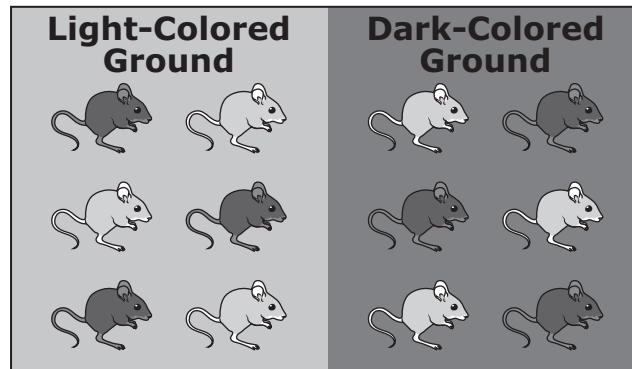
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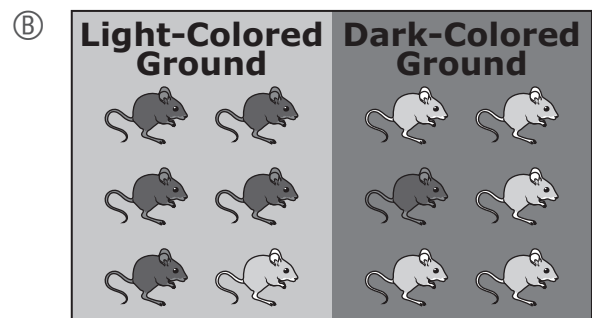
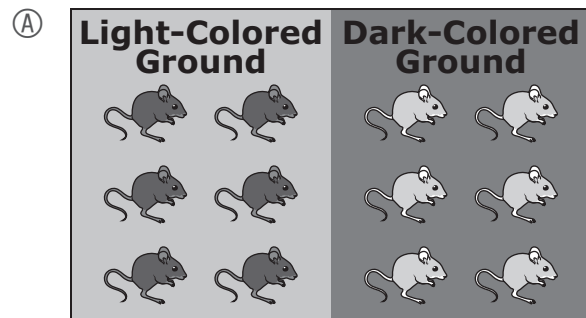
If a question asks you to show or explain your work, you must do so to receive full credit. Write your response in the space provided in your Test & Answer Booklet. Only responses written within the provided space will be scored.

- 12 A certain mouse species lives in the desert. These mice can have light fur or dark fur. The mice live in an area where some of the ground is dark colored and some is light colored. Light-colored mice and dark-colored mice live on both types of ground, as represented in the diagram.

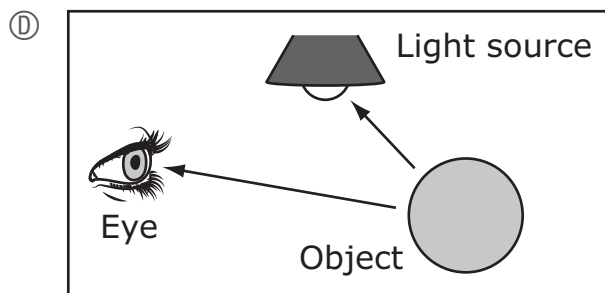
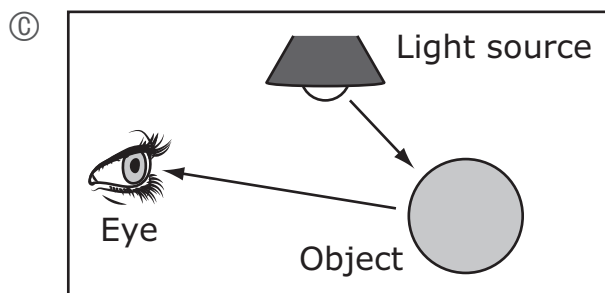
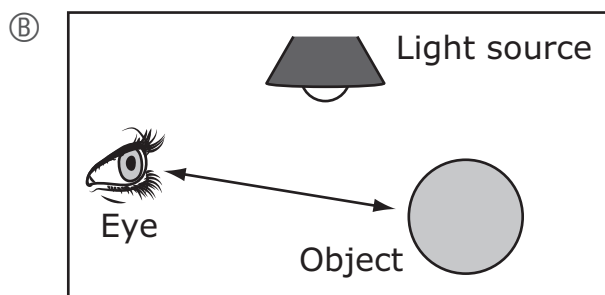
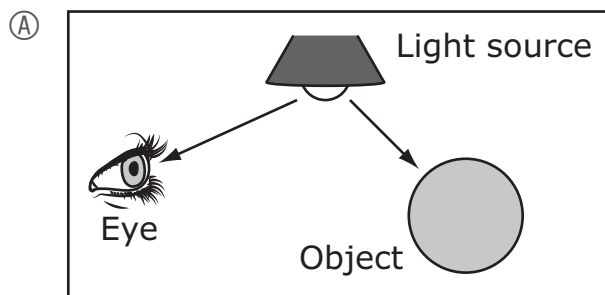


A population of hawks moves into the area, and the hawks prey on the mice. Many generations after the hawks move into the area, the mouse population changes.

Which of the following shows how the population most likely changed?



- 13 Which of the following diagrams best shows how a person sees an object?

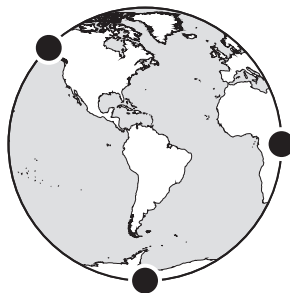


- 14** Sometimes seeds from plants that produce red raspberries will grow into plants that produce yellow raspberries. When two yellow raspberry plants reproduce with each other, the resulting seeds grow into plants that produce yellow raspberries.

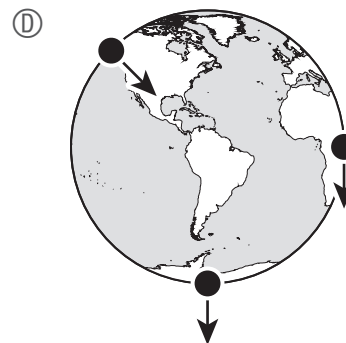
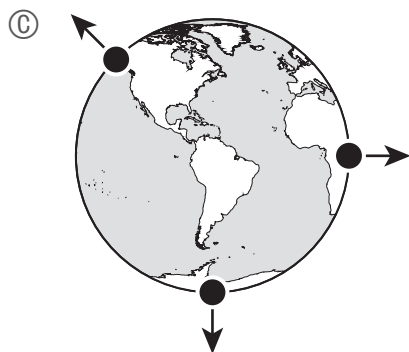
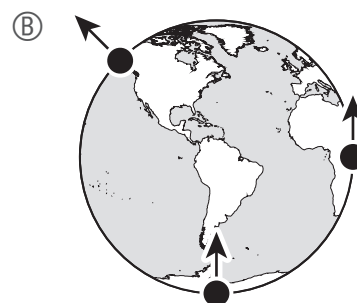
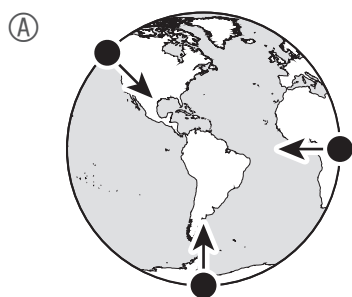
Which of the following best describes how raspberries get their color?

- Ⓐ Raspberry color is an inherited trait that varies among raspberry plants.
- Ⓑ Raspberry color is controlled by the amount of sugar that raspberry plants produce.
- Ⓒ Raspberry color is controlled by the amount of sunlight that raspberry plants receive.
- Ⓓ Raspberry color is an inherited trait that changes when raspberry plants have a disease.

- 15 This diagram shows the locations of three objects on Earth's surface.



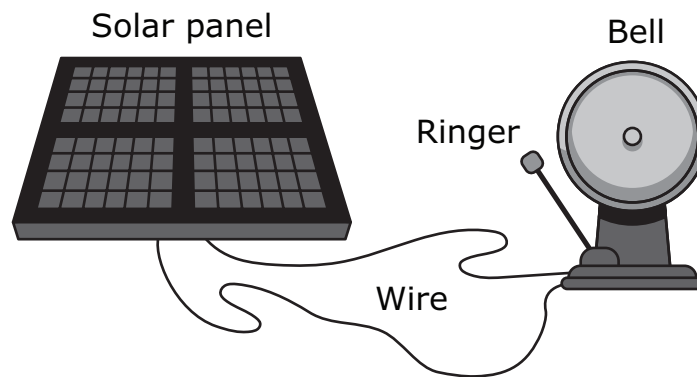
Which of the following diagrams shows the direction of the gravitational force acting on each of the objects?



- 16 Which of the following statements **best** describes how Earth moves in the six months from June 21 to December 21?
- Ⓐ Earth makes half a rotation on its axis.
 - Ⓑ Earth moves farther away from the Sun.
 - Ⓒ Earth makes half a revolution around the Sun.
 - Ⓓ Earth begins to rotate more slowly in its orbit.

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

- 17** A group of students used wire to connect a solar panel to a bell, as shown in the diagram. When sunlight shines on the solar panel, electricity flows through the wire. The electricity causes the ringer to hit the bell and a sound is made.



- A. Describe one part of the setup in which a type of energy is converted to another type of energy other than heat energy. Include the types of energy in your answer.
- B. Identify one other type of energy that is observed in this setup, other than heat energy or the types you described in Part A. Describe how the students can observe this type of energy.

17

This question has two parts.

- 18** Some bodies of water in and around Florida are shown on the map. Some of these bodies of water are freshwater sources, while others are saltwater sources.



Part A

Which of the following correctly shows whether each body of water is a freshwater source or a saltwater source?

Ⓐ

| Freshwater Source | Saltwater Source |
|---|----------------------------------|
| Caloosahatchee River Kissimmee River Lake Istokpoga Lake Okeechobee Peace River | Atlantic Ocean Gulf of Mexico |

Ⓑ

| Freshwater Source | Saltwater Source |
|--|---|
| Caloosahatchee River Kissimmee River Peace River | Atlantic Ocean Gulf of Mexico Lake Istokpoga Lake Okeechobee |

Ⓒ

| Freshwater Source | Saltwater Source |
|--|---|
| Caloosahatchee River Kissimmee River Lake Istokpoga Peace River | Atlantic Ocean Gulf of Mexico Lake Okeechobee |

Ⓓ

| Freshwater Source | Saltwater Source |
|---|--|
| Atlantic Ocean Gulf of Mexico Lake Istokpoga Lake Okeechobee | Caloosahatchee River Kissimmee River Peace River |

Describe how the amount of fresh water compares to the amount of salt water shown on the map on page 427.

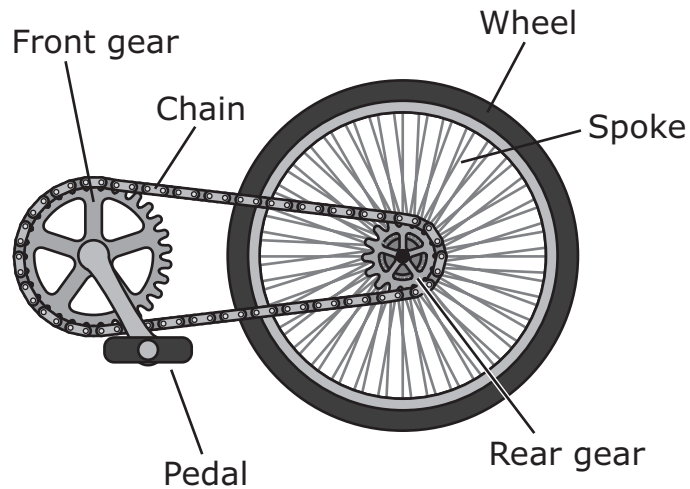
[illegible]

- 19** Polar bears hunt seals from sea ice in the Arctic. Warming Arctic temperatures have reduced the amount of ice, making it hard for polar bears to find food.

How has the reduced amount of sea ice most likely affected polar bears?

- Ⓐ They swim less often.
- Ⓑ Their fur is changing color.
- Ⓒ They must eat a lot more food.
- Ⓓ Their population size is decreasing.

- 20 The diagram shows parts of a bicycle that make the bicycle move.



When the pedal of the bicycle is turned, the front gear, rear gear, and wheel turn. Which of the following best describes the function of the chain?

- Ⓐ The chain keeps the spokes attached to the wheel.
- Ⓑ The chain keeps the wheel attached to the front gear.
- Ⓒ The chain transfers energy from the pedal to the front gear.
- Ⓓ The chain transfers motion from the front gear to the rear gear.

**Grade 5 Science and Technology/Engineering
Spring 2019 Released Operational Items**

| PBT Item No. | Page No. | Reporting Category | Standard | Practice Category | Item Type* | Item Description | Correct Answer** |
|---------------------|-----------------|--------------------------------|-----------------|--------------------------------------|-------------------|---|-------------------------|
| 1 | 407 | <i>Physical Sciences</i> | 5.PS.1.3 | B. Mathematics and Data | SR | Analyze data from an investigation to determine which substances were mixed together. | B |
| 2 | 408 | <i>Earth and Space Science</i> | 5.ESS.3.2 | A. Investigations and Questioning | SR | Describe what observation students should make to determine how well a simple water filter works. | A |
| 3 | 411 | <i>Life Science</i> | 5.LS.1.1 | None | SR | Describe how plants use energy from the Sun to convert air and water into sugar. | A |
| 4 | 411 | <i>Technology/Engineering</i> | 3.ETS.1.2 | C. Evidence, Reasoning, and Modeling | SR | Determine how a composteur could be improved to break down waste more efficiently. | A |
| 5 | 412 | <i>Life Science</i> | 5.LS.2.1 | None | SR | Identify bacteria as decomposers and identify the role of decomposers. | D |
| 6 | 413 | <i>Technology/Engineering</i> | 3.ETS.1.4 | None | CR | Describe advantages of different representations of a design solution and, given a design solution, describe one disadvantage of it. | |
| 7 | 415 | <i>Earth and Space Science</i> | 5.ESS.3.1 | None | SR | Determine a way to reduce the amount of water used from a town's water supply. | D |
| 8 | 415–416 | <i>Life Science</i> | 3.LS.4.1 | C. Evidence, Reasoning, and Modeling | SR | Compare fossils in rock layers to determine which fossils are oldest and determine why scientists study fossils. | C;C |
| 9 | 416 | <i>Technology/Engineering</i> | 4.ETS.1.3 | A. Investigations and Questioning | SR | Determine what should be measured to test how well a design solution meets a criterion of the design problem. | D |
| 10 | 417 | <i>Physical Sciences</i> | 3.PS.2.3 | A. Investigations and Questioning | SR | Determine the question that students were trying to answer during an investigation with magnets. | B |
| 11 | 418 | <i>Earth and Space Science</i> | 3.ESS.2.2 | B. Mathematics and Data | SR | Compare climate data from different regions and determine which region is a tropical rainforest. | D |
| 12 | 420 | <i>Life Science</i> | 3.LS.4.2 | B. Mathematics and Data | SR | Determine how variations in characteristics among individuals in the same population may provide a survival advantage in a given environment. | D |
| 13 | 421 | <i>Physical Sciences</i> | 4.PS.4.2 | C. Evidence, Reasoning, and Modeling | SR | Select a model that shows how a person sees an object. | C |
| 14 | 422 | <i>Life Science</i> | 3.LS.3.1 | C. Evidence, Reasoning, and Modeling | SR | Describe how plants have traits that are inherited, with variations in these traits existing within the population. | A |
| 15 | 423 | <i>Physical Sciences</i> | 5.PS.2.1 | C. Evidence, Reasoning, and Modeling | SR | Determine the direction of the gravitational force exerted on objects located at different locations on Earth. | A |
| 16 | 424 | <i>Earth and Space Science</i> | 5.ESS.1.2 | None | SR | Describe Earth's movement relative to the Sun at different times of year. | C |
| 17 | 425 | <i>Physical Sciences</i> | 4.PS.3.2 | C. Evidence, Reasoning, and Modeling | CR | Describe how different types of energy are converted into other types of energy in a given setup. | |
| 18 | 427–429 | <i>Earth and Space Science</i> | 5.ESS.2.2 | None | CR | Distinguish between freshwater and saltwater sources and compare the relative amount of each. | A;X |
| 19 | 430 | <i>Life Science</i> | 3.LS.4.4 | C. Evidence, Reasoning, and Modeling | SR | Identify how a change in a habitat may affect the ability of an organism to survive and reproduce. | D |
| 20 | 431 | <i>Technology/Engineering</i> | 5.ETS.3.2 | C. Evidence, Reasoning, and Modeling | SR | Interpret a diagram to determine the function of part of a device. | 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 5 Science and Technology/Engineering
Spring 2019 Unreleased Operational Items

| PBT Item No. | Reporting Category | Standard | Practice Category | Item Type* | Item Description |
|---------------------|--------------------------------|-----------------|--------------------------------------|-------------------|---|
| 21 | <i>Technology/Engineering</i> | 3.ETS.1.4 | None | SR | Identify the most helpful representation for a design solution. |
| 22 | <i>Physical Sciences</i> | 5.PS.1.2 | B. Mathematics and Data | SR | Determine the mass of a substance after a phase change. |
| 23 | <i>Technology/Engineering</i> | 5.ETS.3.1 | None | SR | Distinguish between an innovation and an invention given descriptions of two technologies. |
| 24 | <i>Life Science</i> | 5.LS.2.1 | C. Evidence, Reasoning, and Modeling | CR | Analyze a food web to describe how matter moves through the food web and how changes to one population would affect another. |
| 25 | <i>Life Science</i> | 4.LS.1.1 | C. Evidence, Reasoning, and Modeling | CR | Identify a trait that helps provide camouflage to an organism and describe how another trait helps the organism survive in its environment. |
| 26 | <i>Earth and Space Science</i> | 4.ESS.3.1 | None | SR | Describe how humans use energy and fuels and distinguish between renewable and nonrenewable energy sources. |
| 27 | <i>Technology/Engineering</i> | 4.ETS.1.5 | None | SR | Analyze a design and identify the property that is most important to consider for the design. |
| 28 | <i>Physical Sciences</i> | 4.PS.3.3 | B. Mathematics and Data | SR | Analyze data to determine which conditions will produce a louder sound during a collision. |
| 29 | <i>Physical Sciences</i> | 5.PS.1.1 | None | SR | Identify the cause of ice melting at room temperature. |
| 30 | <i>Physical Sciences</i> | 4.PS.3.4 | A. Investigations and Questioning | SR | Identify how a device can be changed to test how stored energy affects the motion of the device. |
| 31 | <i>Earth and Space Science</i> | 4.ESS.1.1 | None | SR | Describe how features of a given landscape provide evidence about the role of deposition in the landscape's formation. |
| 32 | <i>Earth and Space Science</i> | 3.ESS.2.1 | C. Evidence, Reasoning, and Modeling | SR | Identify a correctly labeled model of the water cycle. |
| 33 | <i>Earth and Space Science</i> | 4.ESS.2.1 | None | SR | Identify evidence of rocks being broken into smaller pieces through weathering. |
| 34 | <i>Earth and Space Science</i> | 3.ESS.2.1 | B. Mathematics and Data | CR | Make claims about seasonal weather in an area and support the claims with evidence from given data tables. |
| 35 | <i>Technology/Engineering</i> | 3.ESS.3.1 | A. Investigations and Questioning | SR | Determine what should be considered when designing a solution to reduce damage caused by flooding. |
| 36 | <i>Technology/Engineering</i> | 4.ESS.3.2 | None | SR | Determine which design solution will work best for a given situation. |
| 37 | <i>Physical Sciences</i> | 3.PS.2.1 | C. Evidence, Reasoning, and Modeling | SR | Determine which diagrams show balanced and unbalanced forces acting on an object and identify what occurs when forces acting on an object are balanced. |
| 38 | <i>Life Science</i> | 3.LS.1.1 | None | SR | Determine when a plant and an animal are going through the same life cycle stage. |
| 39 | <i>Physical Sciences</i> | 4.PS.4.1 | C. Evidence, Reasoning, and Modeling | SR | Determine the type of energy transferred by water waves. |
| 40 | <i>Technology/Engineering</i> | 3.ETS.1.1 | A. Investigations and Questioning | SR | Determine the problem a given structure was designed to solve. |
| 41 | <i>Life Science</i> | 5.PS.3.1 | A. Investigations and Questioning | SR | Determine which activity a scientist should study to learn how animals get energy for life processes. |

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