# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Practice Test Answer Guide</td>
<td>1</td>
</tr>
<tr>
<td>Example of Metadata</td>
<td>2</td>
</tr>
<tr>
<td>Grade Five Practice Test Items</td>
<td>3</td>
</tr>
</tbody>
</table>
Introduction to Practice Test Answer Guide

This California Science Test (CAST) practice test items scoring guide offers details about the items, student response types, correct responses, and related scoring considerations for the practice test items. These items have been selected to show some of the new approaches to measuring the California Next Generation Science Standards (CA NGSS) that can be found in the assessment. The practice test items are not fully representative of all possible item types included in the CAST. The practice test covers a selection of items from performance expectations in grade five.

The following information is presented along with each item:

- **Performance Expectations (PE) Code**: References the assessable evidence statements of what students should know and be able to do.

- **Science and Engineering Practices (SEP)**: Descriptions of behaviors that scientists and engineers engage in as they investigate the natural world and design solutions, respectively.

- **Disciplinary Core Ideas (DCI)**: Essential ideas in the science disciplines that all students should understand.

- **Crosscutting Concepts (CCC)**: Interdisciplinary skills that unify the study of science and engineering through common application across fields.

- **Depth of Knowledge (DOK)**: A measure of complexity that considers the students’ cognitive process in response to an item (There are four DOK levels, with 4 being the highest.)

- **Item-Level Claim Statement (ILCS)**: A brief statement that illustrates how an item aligns to the PE through at least two of the dimensions (An ILCS is included with each item to help item reviewers (1) identify the intent of the alignment, (2) determine if the alignment is appropriate and valid, and (3) identify the content reflected in item-level specifications.)

- **Item and Stimulus**: Item represents the question being asked, while stimulus is supporting information, graphics, animation or simulation included with some items.

- **Answer Key**: The expected student response or example response including score point value.

- **Rubric and Exemplar**: Rubric explains what is needed for each score point. Exemplars give a sample response from a student.

While each item is aligned to a specific PE through its dimensions, certain items, based on their contexts, incorporate aspects of environmental literacy outlined in the Environmental Principles and Concepts adopted by the State Board of Education in 2004. The items in this practice test are not fully representative of the full range of ways items can incorporate environmental literacy.

The practice test items will include numbered instructional text preceding the first item.
Each item has a metadata table as shown. Metadata contains the specific information on the alignment of the item to the NGSS standards. The item number in the table preceding each item corresponds to the sequence number of the item as it appears in the practice test.

**Example of Metadata**

<table>
<thead>
<tr>
<th>Item</th>
<th>Grade</th>
<th>PE</th>
<th>SEP</th>
<th>DCI</th>
<th>CCC</th>
<th>DOK</th>
</tr>
</thead>
</table>

**ILCS:** Describe and identify observations that are relevant to investigating the effects of weathering or the rate of erosion.
## Grade Five Practice Test Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Grade</th>
<th>PE</th>
<th>SEP</th>
<th>DCI</th>
<th>CCC</th>
<th>DOK</th>
</tr>
</thead>
</table>

**ILCS:** Describe and identify observations that are relevant to investigating the effects of weathering or the rate of erosion.

Students observe two hills, Hill A and Hill B. After a heavy rainstorm, the students observe that Hill A has more loose soil at the bottom than Hill B.

Which sentence **best** describes what **most likely** caused the loose soil?

- Hill A has fewer plants than Hill B.
- Hill A erodes more slowly than Hill B.
- Hill A has a slope not as steep as Hill B.
- Hill A receives less average rainfall than Hill B.

**Key:** A (1 point)
ILCS: Complete a model to describe the life cycle of a tomato plant. Students determine how the environmental needs of the tomato plants can be met.

Environmental Principle III: Natural systems proceed through cycles that humans depend upon, benefit from, and can alter.

**Part A**

A class planted tomato seeds in their garden. As the seeds grew, the students recorded their observations.

Complete the model showing the stages of the life cycle of the tomato plants by dragging the images in the correct order.

---

Item continues on the next page.
**Part B**

Another class grows tomato plants inside their classroom instead of outside in the garden. The students plant seeds and make sure the plants get plenty of water and sunlight. After a few months they have healthy plants with flowers but no tomatoes.

Which sentence best describes why the classroom plants did not grow any tomatoes?

- A. The class needs to wait longer, and the plants will eventually grow tomatoes.
- B. The windows blocked the rays from the Sun that the plants need to grow tomatoes.
- C. By keeping the plants inside, pollinators such as bees were unable to pollinate the plants.
- D. In the classroom, the plants were not placed close enough to another plant for reproduction to happen.

*Key continues on the next page.*

---

**Key:**

- **Part A:** Clockwise order of the images: Mature plant, flower, fruit (1 point)
- **Part B:** C (1 point)
### ILCS: Identify the properties to observe or measure that provide evidence of chemical change that would be useful to the investigation.

Students mix an unknown white powder with an unknown clear solution. Select three observations that might indicate that a new substance is produced.

- [ ] Bubbles are produced.
- [ ] All the powder dissolves.
- [ ] The temperature increases.
- [ ] The solution changes color.
- [ ] The volume of liquid increases.

**Key:** First, third, and fourth options. (1 point)
ILCS: Use a model to construct an explanation of how the speed of an object is related to its energy.

The figure shows a ramp with four labeled positions. A student releases a marble from the four positions. The marble rolls down the incline onto a horizontal surface where it collides with a stopper and sticks to it.

The student tests how far the stopper moves as the marble is released from the different positions on the ramp. The results are shown in the figures.

Item continues on the next page.
**Part A**

When released from which position was the marble moving the fastest upon colliding with the stopper?

A  position 1  
B  position 2  
C  position 3  
D  position 4  

**Part B**

Based on the evidence provided, choose the phrase from the menu that best explains what happened.

The faster the marble is going, ▼.  

---

**Key:**

**Part A:** D (1 point)  
**Part B:** Drop-down menu: the more energy can be transferred to the stopper. (1 point)
ILCS: Select the most appropriate design solution for a volcanic warning system.

**Environmental Principle I:** The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.

**Environmental Principle III:** Natural systems proceed through cycles that humans depend upon, benefit from, and can alter.

A tiltmeter is an instrument that is used to measure changes in the tilt of the ground. The ground near volcanoes moves before a volcano erupts, so scientists use tiltmeters to try to predict when a volcano may erupt. The map shows a city near a volcano.

Scientists want to place a tiltmeter in a location where people can be quickly alerted when the volcano is going to erupt.

Which location for the tiltmeter is best, and why?

- Location A, since it will measure only the strongest movements from the volcano.
- Location B, since it will measure volcano movements closest to the city.
- Location C, since it will measure movements along the river that separates the volcano from the city.
- Location D, since it will measure movements closest to the volcano.

**Key:** D (1 point)
ILCS: Develop a model that correctly portrays evaporation or condensation as the movement of particles in the air from or to a surface, respectively.

Students set up three glass cups with water as described in the table and record their observations. The students develop a model to explain why water droplets form on the outer surface of the cup when it has water and ice.

<table>
<thead>
<tr>
<th>Cup</th>
<th>Description</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Room temperature water open to the air</td>
<td>No water droplets on outer surface</td>
</tr>
<tr>
<td>2</td>
<td>Water and ice open to the air</td>
<td>Water droplets on outer surface</td>
</tr>
<tr>
<td>3</td>
<td>Water and ice with a lid on top</td>
<td>Water droplets on outer surface</td>
</tr>
</tbody>
</table>

Based on the observations, how should the formation of water droplets be described in the model?

- Ice in a cup makes water droplets form on the outer surface more slowly.
- Invisible particles of water in the air run into the cold outer surface and form droplets.
- Small droplets of water escape through the top of the cup and land on the outer surface.
- Particles of water shrink when cold and move through tiny holes in the cup to the outer surface.

Key: B (1 point)
ILCS: Complete an incomplete model of a food web.

Students are studying ecosystems. Their teacher assigned groups to make posters that show how matter and energy flow through a food chain. One group drew this model.

Which would be the best choice to fill the empty box and complete the model?

A a mouse that eats matter in the form of seeds produced by grass

B a tree that makes its own matter using sunlight, carbon dioxide, and water

C microbes that break down dead organisms, releasing their matter to be reused in the food chain

D a chicken farmer that scares away a hawk to keep it from eating matter in the form of his chickens

Key: C (1 point)
ILCS: Use the data to correctly identify patterns and make a prediction about shadow movements caused by the changing daily position of the sun.

An upright stick casts a shadow over flat ground. A student records the direction and length of the shadow hourly, starting at 5 a.m. This table shows the data collected by the student.

<table>
<thead>
<tr>
<th>Time</th>
<th>Shadow Length (centimeters)</th>
<th>Shadow Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 a.m.</td>
<td>571.3</td>
<td>West</td>
</tr>
<tr>
<td>6 a.m.</td>
<td>39.3</td>
<td>West</td>
</tr>
<tr>
<td>7 a.m.</td>
<td>18.8</td>
<td>Northwest</td>
</tr>
<tr>
<td>8 a.m.</td>
<td>11.7</td>
<td>Northwest</td>
</tr>
<tr>
<td>9 a.m.</td>
<td>8.1</td>
<td>North</td>
</tr>
</tbody>
</table>

Which statement best describes what the student will find at 10 a.m.?

○ The shadow will be longer at 10 a.m. than it was at 9 a.m., and its direction will be North.
○ The shadow will be shorter at 10 a.m. than it was at 9 a.m., and its direction will be East.
○ The shadow will be shorter at 10 a.m. than it was at 9 a.m., and its direction will be North.
○ The shadow will be the same length at 10 a.m. as it was at 9 a.m., and its direction will be Northwest.

Key: C (1 point)
ILCS: Describe an advantage that character variation may confer on an individual hare in an arctic ecosystem throughout the year.

Arctic hares live in the northernmost parts of North America where the ground is covered in snow during the coldest months. Arctic hares change fur color by molting and growing new fur twice a year. The diagram shows a hare in July and a hare in January.

![July (brown fur) vs. January (white fur) diagram]

Explain how the change from a brown fur coat to a white fur coat helps arctic hares to survive in the winter.

Enter your answer in the box provided.

---

Rubric follows on the next page.
2 point

Exemplar:
White fur is good camouflage in the snow, so the arctic hare can hide more easily from predators.

Rubric:
The response indicates that white fur helps arctic hares hide (or be camouflaged) in the snow. AND
The response indicates that white fur protects arctic hares from predators.

1 point

Exemplar:
The white fur helps arctic hares hide in the snow. OR
The white fur helps prevent the arctic hare from being eaten.

Rubric:
The response indicates that white fur helps arctic hares hide (or be camouflaged) in the snow. OR
The response indicates that white fur protects arctic hares from predators.

0 point

Exemplar:
The white fur helps the hare to stay warm. OR
The white fur helps the arctic hares survive in the winter.

Rubric:
A 0-point response does not indicate that the white fur helps arctic hares hide or that it protects them from predators.
ILCS: Identify which wants/needs the design solution meets and which it failed to meet when sampling aquatic organisms.

Environmental Principle II: The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.

When a whale comes to the surface, it exhales warm air through its spout. Scientists want to collect samples from whale spouts to learn more about the health of whales.

Scientists are considering two methods for collecting samples:

1. Drone: A silent remote-controlled drone robot that flies over a whale and collects a sample quickly. The cost is $5,000.

2. Boat: A gasoline-powered speedboat that is already owned by the scientists. It drives up to a whale and a passenger collects a sample quickly. The cost is $0.

The table shows three different requirements for deciding which method to use. Select the requirements that best fit each method.

<table>
<thead>
<tr>
<th>Quiet</th>
<th>Low cost</th>
<th>Least harmful to the environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drone</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Boat</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

Key follows on the next page.
### Key:

Drone: Quiet and Least harmful to the environment. AND

Boat: Low cost. (1 point)

<table>
<thead>
<tr>
<th></th>
<th>Quiet</th>
<th>Low cost</th>
<th>Least harmful to the environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drone</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Boat</td>
<td></td>
<td>✔</td>
<td>◯</td>
</tr>
</tbody>
</table>
### ILCS:
 Correctly construct an argument using the provided evidence, data, or model and scientific concepts (e.g., the gravitational force) to support the claim about the specifics of gravity.

A student competes in the long jump track event. She runs forward, jumps up into the air as she runs, reaches her highest point, and returns to the ground.

#### Part A

A student claims that gravity acts on the long jumper throughout her jump. Which statement best supports this claim?

- (a) Objects weigh less on the moon than on Earth.
- (b) Objects thrown up in the air return back to Earth.
- (c) Heavy objects fall at the same speed as light ones.
- (d) The force of gravity decreases as the distance between objects increases.

*Item continues on the next page.*
Part B

For each location in the picture, drag the arrow that shows the direction of the force of gravity on the long jumper as she moves through the air. Each arrow can be used as many times as needed.

Key:
Part A: B (1 point)
Part B: A downward arrow in every box. (1 point)
ILCS: Use scientific models to construct an explanation for the differences in growth in direct sunlight or partial shade of the same species of plant.

The marigold plants shown in this field all have the same parent. Some of the plants are growing in the sun, and some are growing in the shade under a tree. The plants in the sunny area have more flowers than the plants in the shade.

Select the statements that best complete these explanations.

The difference between the two groups of marigolds shows that the number of flowers a marigold produces [blank]. A marigold only produces one flower if it [blank].

Key: First drop-down menu: changes with the environment. (1 point) AND Second drop-down menu: does not receive enough light energy. (1 point)
ILCS: Identify the factor that is needed to accurately model melting glaciers.

Glaciers are large sheets of ice found in areas where the air temperature remains cold most of the year. Students use a computer model to study how glaciers can affect land and living things. The students also study data that show that glaciers are melting rapidly.

Which changes to the computer model should the students make to show the most likely effect of melting glaciers?

A Make the oceans more salty.
B Cover some coastal lands with water.
C Decrease the amount of water in the atmosphere.
D Move animals living at the poles closer to the equator.

Key: B (1 point)
ILCS: Select the design solution that best tests a simple electrical circuit.

This is a picture of an electric circuit containing a wire, a battery, a switch, and a lightbulb. A student wants to use the circuit to find the battery that lasts the longest.

Which test should the student perform? Complete the sentence by selecting the correct word from the menu.

The student should change the type of __________ and measure how long the circuit works.

Key: Drop-down menu: battery. (1 point)
ILCS: Identify patterns or relationships revealed in the diagrams or graphs about the hydrosphere.

The pie charts show where the water on Earth is. Most of the water is in the oceans. Most of the water that is not in the oceans is frozen in ice caps and glaciers.

Select the words from the menus to best complete the sentence.

Most of Earth’s freshwater is [______], and most of Earth’s surface freshwater is found in [______].

Key: First drop-down menu: frozen. Second drop-down menu: lakes. (1 point)
### Item 17

<table>
<thead>
<tr>
<th>Item</th>
<th>Grade</th>
<th>PE</th>
<th>SEP</th>
<th>DCI</th>
<th>CCC</th>
<th>DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>5</td>
<td>3-5- ETS1-2</td>
<td>6. Constructing Explanations and Designing Solutions</td>
<td>ETS1.B Developing Possible Solutions</td>
<td>N/A</td>
<td>2</td>
</tr>
</tbody>
</table>

**ILCS:** Generate a design pattern that fits within the parameters of the foil boat competition while still meeting the criteria for success.

A group of students enters an engineering competition. They have to build a small boat using only a single piece of aluminum foil. The boat that holds the greatest number of pennies without sinking wins the competition. The students are given these materials:

- Pennies
- Square piece of aluminum foil, 15 x 15 centimeters
- Large plastic container, half-filled with water

The first thing they need to do is create a design.

Select **three** factors the students need to consider when creating a design for the foil boat.

- [ ] shape of the boat
- [ ] number of pennies
- [ ] what type of material to use
- [ ] how much aluminum foil costs
- [ ] what makes a boat float or sink

**Key:** First, second, and fifth options. (1 point)
ILCS: Select relevant constraints on potential solutions for a butterfly garden design.

Environmental Principle V: Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes.

Students are learning about butterfly habitats and want to design a garden at their school to attract butterflies.

What do the students need to know now, and what might they need to know later? Complete the chart by dragging each choice to the correct column.

<table>
<thead>
<tr>
<th>Need to Know Now</th>
<th>Might Need to Know Later</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amount of money in the budget</td>
</tr>
<tr>
<td>Types of plants that attract butterflies in the region</td>
<td>How to expand the layout of the butterfly garden</td>
</tr>
</tbody>
</table>

Key: (1 point)
ILCS: Identify relevant, valid, and/or reliable piece(s) of evidence/data that support the claim about the distance from Earth to a star.

Two students are looking at stars in the sky on a moonless night. One student points at a certain star and says that it is closer to Earth than all the other stars.

What evidence best supports the student’s claim about the closeness of the star?

A. The star is a different color than the other stars.
B. The star is twinkling more than the other stars.
C. The star appears brighter than the other stars.
D. The star appears smaller than the other stars.

Key: C (1 point)
ILCS: Identify the plan that will provide the best evidence of a pattern that can be used to make a prediction about future motion of a swing.

Students observe a girl being pushed on a swing by her father in a park. The students want to describe the pattern of this motion.

Which two measurements can the students use to describe the pattern?

☐ the height of the father
☐ the air temperature at the park
☐ the weight of the girl on the swing
☐ the amount of time between each push
☐ the height of the swing when it changes direction

Key: Fourth and fifth options. (1 point)
ILCS: Use data to support an explanatory account of the effects watering has on plant growth.

Two plants of the same type are planted on the same day under similar conditions, but they receive different amounts of water. The table shows how often each plant was watered and the observed traits of each plant.

<table>
<thead>
<tr>
<th>Plant</th>
<th>Watered</th>
<th>Traits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Daily</td>
<td>Tall and lots of flowers</td>
</tr>
<tr>
<td>2</td>
<td>Once a week</td>
<td>Short and few flowers</td>
</tr>
</tbody>
</table>

Using the information in the table, explain how the traits of each plant are influenced by its environment. Enter your answer in the box provided.

2 point

Exemplar:

The plant that gets more water is taller and has more flowers. OR

The plant that gets less water is shorter and has fewer flowers.

Rubric:

The response describes the amount of water as the environmental cause. AND

The response describes how traits (height and the number of flowers) are influenced.

*Rubric continues on the next page.*
1 point

Exemplar:
The difference in the amount of water a plant gets can affect its traits. OR
One plant is shorter and has fewer flowers than the other one because of the environment.

Rubric:
The response describes the amount of water as the environmental cause. OR
The response describes how traits (height and the number of flowers) are influenced.

0 point

Exemplar:
The height and the number of flowers are determined by genetics.

Rubric:
A 0-point response does not describe how traits can be influenced by the environment.
**ILCS:** Use data represented in tables and graphical displays to describe typical weather conditions expected during a particular season.

Students are studying weather conditions in different regions of the world. The average monthly temperatures in Sydney, Australia, are shown in degrees Celsius (°C) in Figure 1. The average monthly rainfall is shown in millimeters (mm) in Figure 2.

**Part A**

Complete this sentence by selecting words from the menus. Based on the data in the graph, one of the colder winter months in Sydney is [ ] and one of the warmer summer months is [ ].

**Part B**

Based on the information presented in the graphs, which prediction about the weather in Sydney, Australia, is correct?

- The weather is coolest and driest during January.
- The hottest and driest weather is during February.
- The weather is warm and wet during March and April.
- The hottest and wettest weather is during July and August.

*Key follows on the next page.*
Key:

Part A: First drop-down menu: June. Second drop-down menu: January. (1 point)
Part B: C (1 point)
**ILCS:** Evaluate the competing solutions and select the most appropriate one given certain criteria and constraints for reversing the decrease of the frog population.

**Environmental Principle II:** The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.

Scientists did a study to find out why the number of frogs in a certain area decreased. The scientists found that it was because of chemicals used by local farmers. The farmers argue that they need the chemicals to protect their crops.

The residents propose solutions they hope will be good for both the farmers and the frogs.

Which proposal is the **most** reasonable?

- Introduce a different species of frog to the area.
- Expand the size of the farms’ fields so more crops can grow.
- Set aside an area with a pond that is protected from the chemicals.
- Put a fence around the farms’ fields to keep the chemicals from getting out.

**Key:** C (1 point)
**ILCS:** Select relevant constraints on potential solutions for the tower design challenge.

Students were challenged to build the tallest and strongest tower possible to withstand strong winds. It had to be made out of spaghetti sticks and marshmallows only. Each spaghetti stick cost $0.01, and each marshmallow cost $0.05. The total cost of the tower could not exceed $5.00. When finished, the tower needed to be able to withstand wind from a fan for 40 seconds. Students had 30 minutes to build the structure.

The limitations of a design are known as design constraints. Select two constraints for this design challenge.

- the cost of the fan
- the height of the tower
- the kinds of building materials
- the time allowed for construction
- the number of students available to help

**Key:** Third and fourth options. (1 point)
ILCS: Identify a question that best considers the cause-and-effect relationship between magnetic field strength and the distance between two magnetically attracted objects.

Students are planning an experiment to learn about magnetic attraction. Their setup is shown in Picture 1. The tip of the paper clip is at one end of the meterstick.

**Picture 1**

![Picture 1](image_url)

**Part A**

What is the best question that the students could ask about the relationship between distance and the paper clip’s attraction to the magnet?

- A. How does changing the size of the paper clip affect the attraction to the magnet?
- B. How does moving the magnet closer to the paper clip affect the attraction to the magnet?
- C. How does the length of time the magnet is near the paper clip affect the attraction to the magnet?
- D. How does switching the metal paper clip with a plastic paper clip affect the attraction to the magnet?

*Item continues on the next page.*
Part B

The students begin the experiment.

On Picture 2, drag the magnet to the location that shows the strongest attraction between the magnet and the paper clip.

Key:
Part A: B (1 point)
Part B: The image of the magnet is placed in the far right box. (1 point)
ILCS: Identify factors that would need to be controlled to get a satisfactory measure of the functioning of the prototype.

A student is learning about how forces act on a bridge.

The task is to design a paper bridge as shown in the picture that can support the greatest number of pennies. The student must use these materials:

- one piece of copy paper
- four books (two on each side, 20 centimeters apart)
- up to 25 pennies

The student places 10 pennies on the bridge, and it collapses. Select which parts of the design **most likely** need to be changed to improve the design of the bridge and which need to stay the same.

<table>
<thead>
<tr>
<th>Needs to be changed</th>
<th>Needs to stay the same</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of sheets of paper</td>
<td>☐</td>
</tr>
<tr>
<td>The way the paper is folded</td>
<td>☐</td>
</tr>
<tr>
<td>The number of books</td>
<td>☐</td>
</tr>
</tbody>
</table>

*Key follows on the next page.*
<table>
<thead>
<tr>
<th></th>
<th>Needs to be changed</th>
<th>Needs to stay the same</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of sheets of paper</td>
<td></td>
<td>☑</td>
</tr>
<tr>
<td>The way the paper is folded</td>
<td>☑</td>
<td></td>
</tr>
<tr>
<td>The number of books</td>
<td></td>
<td>☑</td>
</tr>
</tbody>
</table>
ILCS: Complete the model by incorporating relevant components for different types of erosion.

A student is making two models to show different patterns of erosion. The first model will show how running water affects soil and rocks. The second model will show how glaciers affect soil and rocks. The materials available for making the models are listed.

Select the check boxes to mark which materials should be used for each model.

<table>
<thead>
<tr>
<th>Model of erosion by running water</th>
<th>Model of erosion by glaciers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A long tray that can be tilted</td>
<td></td>
</tr>
<tr>
<td>A pitcher of water</td>
<td></td>
</tr>
<tr>
<td>Sand and small pebbles</td>
<td></td>
</tr>
<tr>
<td>A large block of ice</td>
<td></td>
</tr>
</tbody>
</table>

Key: (1 point)

<table>
<thead>
<tr>
<th>Model of erosion by running water</th>
<th>Model of erosion by glaciers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A long tray that can be tilted</td>
<td>✔</td>
</tr>
<tr>
<td>A pitcher of water</td>
<td>✔</td>
</tr>
<tr>
<td>Sand and small pebbles</td>
<td>✔</td>
</tr>
<tr>
<td>A large block of ice</td>
<td>✔</td>
</tr>
</tbody>
</table>
**ILCS**: Identify the transfer/transformations of energy under investigation. Students correctly select the method of data collection that will provide sufficient evidence to support the goal of the investigation.

**Part A**

Students want to investigate energy transfer. They use a wire to connect a battery to a lightbulb.

Which **best** describes the energy transfer process that goes on between the battery and the lightbulb?

- **A** Heat energy from the lightbulb warms up the battery.
- **B** Electrical energy from the battery turns into heat and light in the lightbulb.
- **C** Light energy from the lightbulb is changed into electrical energy within the battery.
- **D** Chemical energy from the battery is transformed into energy of motion inside the lightbulb.

*Item continues on the next page.*
**Part B**

The students are given three different batteries. They are asked to compare how much energy each battery transfers to the lightbulb.

Drag each step into the correct order to complete the investigation.

<table>
<thead>
<tr>
<th>Step 1:</th>
<th>Observe and record the brightness of the lightbulb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2:</td>
<td>Remove battery and replace with a different battery.</td>
</tr>
<tr>
<td>Step 3:</td>
<td>Use wires to connect a battery to the lightbulb.</td>
</tr>
<tr>
<td>Step 4:</td>
<td>Repeat until all the batteries have been used.</td>
</tr>
</tbody>
</table>

Key:

Part A: B (1 point)

Part B: (1 point)
<table>
<thead>
<tr>
<th>Item</th>
<th>Grade</th>
<th>PE</th>
<th>SEP</th>
<th>DCI</th>
<th>CCC</th>
<th>DOK</th>
</tr>
</thead>
</table>

**ILCS:** Identify the effects of a given human activity on the environment.

The picture shows a tortoise that is native to the Galápagos Islands. Over the years, there has been a large drop in the number of these tortoises in the Galápagos Islands.

**Galápagos Islands Tortoise**

This list shows the possible dangers to the tortoises.

- Animals and plants that were brought in from other countries
- Increased pollution
- Increased traffic and roadways
- Tortoise pathways to food and habitat blocked

Which step would **most likely** help increase the number of tortoises on the Galápagos Islands?

- Remove fences in tortoise habitats.  
- Build new roads to help find all of the tortoises.  
- Increase the number of people visiting the Galápagos Islands.  
- Protect the animals and plants that were brought from other countries.

**Key:** A (1 point)
ILCS: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

A food web for a forest ecosystem is shown. The arrows indicate the flow of energy.

Part A

What statement best describes the role of the grass plants in the food web?

A. The grass plants break down dead plants and animals.
B. The grass plants are producers that make their own food.
C. The grass plants are the main food for the snake and lizard.
D. The grass plants are the main source of energy for the hawk.

Part B

Complete the statement by selecting the correct word from the menu.

One of the limitations of this food web is that ___________ are not included.

Key follows on the next page.
Key:

**Part A:** B (1 point)

**Part B:** Drop-down menu: decomposers (1 point)
ILCS: Select the components to develop a wave model that illustrates/explains the volume level of sound waves.

A teacher hits a drum and makes a sound. Students decide to model the sound wave by using a rope, as shown in the figure.

To make the wave, Student A lifts her hand to the height of her shoulder, pulls one end of the rope down to her waist, and then pulls it back up to her shoulder. The teacher hits the drum again with more force and the sound is louder than before. Students are asked to model the louder sound wave.

What should Student A do to create the best model for the louder wave? Select phrases from the menus to complete the sentence.

Student A should lift her arm to a height [ ] and then down to a height [ ] before returning the rope to its original location.

Key: First drop-down menu: above the shoulder. Second drop-down menu: below the waist. (1 point)
ILCS: Select which data are useful to identify the physical properties of the material(s).

A group of students is trying to find out if four unknown objects are made of metal. The students make observations and perform tests. They record the results in this table.

<table>
<thead>
<tr>
<th>Object</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object A</td>
<td>Small black solid, shiny, conducts heat</td>
</tr>
<tr>
<td>Object B</td>
<td>Small black solid, dull, does not conduct heat</td>
</tr>
<tr>
<td>Object C</td>
<td>Small white solid, dull, does not conduct heat</td>
</tr>
<tr>
<td>Object D</td>
<td>Large gray solid, shiny, conducts heat</td>
</tr>
</tbody>
</table>

Which two observations are most helpful to the students in figuring out whether an object is made of metal?

☐ the size of the object

☐ the color of the object

☐ whether the object is a solid

☐ whether the object is shiny

☐ whether the object conducts heat

Key: Fourth and fifth options. (1 point)
**ILCS:** Identify the correct claim that was missing from the argument about the structural function of cacti.

A student observed that a cactus has long, sharp spines that are painful to touch.

Which claim is **best** supported by the observation?

- A. The spines attract helpful insects to the cactus.
- B. The spines keep cold wind away from the cactus.
- C. The spines make it hard for animals to eat the cactus.
- D. The spines store water that can be used by the cactus.

**Key:** C (1 point)
ILCS: Identify the patterns in the variation between the parents and the offspring.

In this performance task, you will answer five questions.

A large part of a dairy cow’s ability to make milk is inherited, but the cow’s environment also has an effect.

Many dairy cows are born each year at Origin Dairy Farm. Six of the Origin Dairy Farm’s cows (called A, B, C, D, E, and F) all have the same father and closely related mothers.

The farmers at Origin Dairy Farm observe that each of these six cows made a lot of milk in March. Which statement is most likely true about the mothers of these six cows?

A. Their mothers all made a lot of milk.
B. None of their mothers made a lot of milk.
C. One of their mothers made a lot of milk, and five did not make a lot of milk.
D. Three of their mothers made a lot of milk, and three did not make a lot of milk.

Key: A (1 point)
ILCS: Use data to refute an explanatory account of a different dairy production between cattle ranches.

The six cows are sold to two nearby farms on April 1. Cows A, B, and C go to the McCoy Dairy Farm, and cows D, E, and F go to the Kim Dairy Farm.

This table compares the McCoy and Kim Dairy Farms.

<table>
<thead>
<tr>
<th></th>
<th>McCoy Dairy Farm</th>
<th>Kim Dairy Farm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food</strong></td>
<td>Standard food</td>
<td>Scientifically designed food</td>
</tr>
<tr>
<td><strong>Shelter</strong></td>
<td>Pole barn</td>
<td>Pole barn</td>
</tr>
<tr>
<td><strong>Time Spent</strong></td>
<td>8 hours per day</td>
<td>7 hours per day</td>
</tr>
<tr>
<td><strong>Outside</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td>24 hours per day</td>
<td>24 hours per day</td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Type of Fence</strong></td>
<td>Barbed-wire fence</td>
<td>Wooden fence</td>
</tr>
<tr>
<td><strong>Owner</strong></td>
<td>In family for 100 years</td>
<td>Family bought farm last year</td>
</tr>
<tr>
<td><strong>History</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A farmer claims that the cows at the McCoy Dairy Farm and the cows at the Kim Dairy Farm should produce the same amount of milk in April because they are all related and their environments are the same.

Select **three** types of data from the table that provide evidence **against** this claim.

- [ ] food
- [ ] shelter
- [ ] time spent outside
- [ ] water availability
- [ ] type of fence

Key: First, third, and fifth options. (1 point)
**ILCS:** Identify patterns in the data about production rates in different cattle ranches.

These data tables show how much milk each of the six cows made in March and April.

### Milk Production in Liters per Cow in March

<table>
<thead>
<tr>
<th>Cow</th>
<th>Origin Dairy Farm Milk Production (liters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>874</td>
</tr>
<tr>
<td>B</td>
<td>877</td>
</tr>
<tr>
<td>C</td>
<td>876</td>
</tr>
<tr>
<td>D</td>
<td>875</td>
</tr>
<tr>
<td>E</td>
<td>877</td>
</tr>
<tr>
<td>F</td>
<td>876</td>
</tr>
</tbody>
</table>

### Milk Production in Liters per Cow in April

<table>
<thead>
<tr>
<th>Cow</th>
<th>McCoy Farm Milk Production (liters)</th>
<th>Kim Farm Milk Production (liters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>848</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>851</td>
<td>-</td>
</tr>
<tr>
<td>C</td>
<td>850</td>
<td>-</td>
</tr>
<tr>
<td>D</td>
<td>-</td>
<td>897</td>
</tr>
<tr>
<td>E</td>
<td>-</td>
<td>899</td>
</tr>
<tr>
<td>F</td>
<td>-</td>
<td>898</td>
</tr>
</tbody>
</table>

Describe the patterns of change in milk production from March to April for the following two sets of cows.

- Cows A, B, and C at the McCoy Farm
- Cows D, E, and F at the Kim Farm

Enter your answer in the box provided.
2 point

Exemplar:

Cows A, B, and C made less milk at the McCoy Dairy Farm in April than they made at the Origin Dairy Farm in March. Cows D, E, and F made more milk at the Kim Dairy Farm in April than they made at the Origin Dairy Farm in March.

Rubric:

The response states that the amount of milk made by cows A, B, and C went down from March to April. AND

The response states that the amount of milk made by cows D, E, and F went up from March to April.

1 point

Exemplar:

The amount of milk that cows A, B, and C made went down in April when compared to March. OR

Cows D, E, and F made more milk in April than they did in March.

Rubric:

The response states that the amount of milk made by cows A, B, and C went down from March to April. OR

The response states that the amount of milk made by cows D, E, and F went up from March to April.

0 point

Exemplar:

All the cows made the same amount of milk. OR

Cows A, B, and C made more milk in April than in March.

Rubric:

A 0-point response attempts to answer the prompt but is incorrect.
**ILCS:** Make a qualitative conclusion regarding the relationships between dependent and independent variables based on data from dairy production ranches.

This table compares the Kim and McCoy Dairy Farms.

<table>
<thead>
<tr>
<th>Food</th>
<th>McCoy Dairy Farm</th>
<th>Kim Dairy Farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard food</td>
<td>Scientifically designed food</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shelter</th>
<th>Pole barn</th>
<th>Pole barn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Spent Outside</td>
<td>8 hours per day</td>
<td>7 hours per day</td>
</tr>
<tr>
<td>Water Availability</td>
<td>24 hours per day</td>
<td>24 hours per day</td>
</tr>
<tr>
<td>Type of Fence</td>
<td>Barbed-wire fence</td>
<td>Wooden fence</td>
</tr>
<tr>
<td>Owner History</td>
<td>In family for 100 years</td>
<td>Family bought farm last year</td>
</tr>
</tbody>
</table>

Which difference between the McCoy and Kim Dairy Farms is **most likely** responsible for the difference in milk production in April?

- A. time spent outside
- B. the type of fence used on the farm
- C. how long the family has owned the farm
- D. the kind of food the cows eat on the farm

**Key:** D (1 point)
ILCS: Make a qualitative conclusion regarding the relationships between dependent and independent variables in a dairy ranch.

These tables show how much milk each of the six cows made in March and in April.

<table>
<thead>
<tr>
<th>Cow</th>
<th>Origin Dairy Farm Milk Production (liters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>874</td>
</tr>
<tr>
<td>B</td>
<td>877</td>
</tr>
<tr>
<td>C</td>
<td>876</td>
</tr>
<tr>
<td>D</td>
<td>875</td>
</tr>
<tr>
<td>E</td>
<td>877</td>
</tr>
<tr>
<td>F</td>
<td>876</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cow</th>
<th>McCoy Farm Milk Production (liters)</th>
<th>Kim Farm Milk Production (liters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>848</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>851</td>
<td>-</td>
</tr>
<tr>
<td>C</td>
<td>850</td>
<td>-</td>
</tr>
<tr>
<td>D</td>
<td>-</td>
<td>897</td>
</tr>
<tr>
<td>E</td>
<td>-</td>
<td>899</td>
</tr>
<tr>
<td>F</td>
<td>-</td>
<td>898</td>
</tr>
</tbody>
</table>

On May 1, the farmers at the McCoy Dairy Farm made a change to increase their cows’ milk production. Complete this sentence to explain how the farmers could determine whether the change worked. Select the **best** word from each menu.

Compare the amount of milk produced at the McCoy Dairy Farm in May to the amount of milk produced at the __Dairy Farm in __.

**Key:** First drop-down menu: McCoy. Second drop-down menu: April. (1 point)
ILCS: Identify the two ecosystems contributing most to the excavation of a fossil.

In this performance task, you will answer five questions.

A family goes camping on a mountain. The family returns to a spot that the family has visited before. They are surprised to see that the area looks different now.

Heavy rains have washed away some soil and exposed a large fossil embedded in rock.

What two systems contributed most to exposing the fossil? Select the correct systems from the menus to complete this statement.

The fossil was exposed by an interaction between the [ ] and the [ ].

Key: First drop-down menu: hydrosphere. Second drop-down menu: geosphere. (1 point)
Two of the family members are scientists. They examine the large fossil embedded in rock and see that it is a fossilized whale. They also see smaller marine fossils. The children are surprised to find marine fossils near the top of a mountain.

Select the phrase from the menu that best completes this sentence.

The scientists agree that finding a whale fossil near the top of a mountain means that this landscape has _______.

**Key:** Drop-down menu: changed over time. (1 point)
Two of the family members are scientists. They examine the large fossil embedded in rock and see that it is a fossilized whale. They also see smaller marine fossils. The children are surprised to find marine fossils near the top of a mountain.

Which statement best completes this sentence?

The fossil formed when

A. it was on a mountaintop.
B. the rock was exposed by rain.
C. it was in sediment on the ocean floor.
D. old bones washed down the mountain.

Key: C (1 point)
ILCS: Identify data that support the explanation of fossil deposition.

The two scientists think that even though they found the rock near the top of a mountain, the rock formed from sediment deposited on the ocean floor. They want evidence to support this claim about where the rock formed.

Select the observation that supports the scientists’ claim.

- The rock is near a campsite.
- The rock is on a mountaintop.
- The rock was exposed by heavy rain.
- The rock contains a fossilized sea star.

Key: D (1 point)
**ILCS:** Describe the reasoning for how the data support an explanation of the law of superposition and stratigraphy.

The scientists want to find another fossil that formed at a similar place and time as the whale fossil. The scientists eventually find a rock with more fossils. The rock has two distinct layers. This diagram shows the layers and their fossils. Assume the rock layers are nearly horizontal.

![Diagram of rock layers with fossil types]

**Exemplar:**

The marine fossil layer of rock is older than the land fossil layer because the marine fossils are in the lower layer of rock. The landscape where the rock was formed changed from a marine environment to a terrestrial environment. OR

The rock layer with the marine fossils is older than the rock layer with the land fossils. When the lower layer of rock was forming the area was an ocean. Later, when the upper layer of rock was forming, the area had changed to land. OR

The layer with marine fossils is older. The place changed from ocean to dry land.

*Rubric continues on the next page.*
Rubric:

The response states that the rock layer with marine fossils/the lower layer of rock is older than the rock layer with land fossils/the upper layer of rock. AND

The response states that the landscape where the rock formed changed from marine to terrestrial.

1 point

Exemplar:

When the rock was forming the area changed from ocean to land. OR

The landscape changed from ocean to land. OR

The lower layer of rock is older. The landscape has never changed. OR

The rock layer with marine/ocean fossils is older than the rock layer with land fossils.

Rubric:

The response states that the rock layer with marine fossils/the lower layer of rock is older than the rock layer with land fossils/the upper layer of rock. OR

The response states that the landscape changed from marine to terrestrial.

0 point

Exemplar:

The land fossils are older than the marine fossils because they are in a higher layer of rock. OR

The rock was moved by shifting tectonic plates. OR

The landscape changed from land to ocean so the layer of rock with land fossils is older.

Rubric:

A 0-point response attempts to answer the prompt but is incorrect.
ILCS: Use observations to make a qualitative conclusion about the relationship between dependent and independent variables of the experiment relating distance and speed.

In this performance task, you will answer six questions.

Alex, Mateo, and Sara form a team to compete in a science competition where students roll a ball down a ramp so that it collides with a puck at the bottom and then stops. This causes the puck to slide across a smooth gymnasium floor until it stops, as shown in the figure. Assume that most of the kinetic energy of the ball is transferred to the puck, and the puck travels in a straight line away from the ramp. The team with a puck that has the most kinetic energy after the collision will be the winner.

Before competing, each team practices by using the same ball on ramps of different heights. This allows the students to determine how far the puck slides across the floor before stopping.

Key:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable measured</th>
<th>Condition that stays the same</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass of ball</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Ramp height</td>
<td>☑</td>
<td>☐</td>
</tr>
<tr>
<td>Distance the puck travels</td>
<td>☐</td>
<td>☑</td>
</tr>
</tbody>
</table>
While practicing, Sara changes the height of the ramp and keeps the mass of the ball the same. After placing a motion sensor at the bottom of the ramp, Sara records data about the ramp height, mass of the ball, and the speed of the ball at the bottom of the ramp as shown in Table 1.

<table>
<thead>
<tr>
<th>Mass of Ball (kilograms)</th>
<th>Ramp Height (meters)</th>
<th>Speed of Ball at Bottom of Ramp (meters per second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>0.5</td>
<td>2.6</td>
</tr>
<tr>
<td>1.0</td>
<td>1.0</td>
<td>3.7</td>
</tr>
<tr>
<td>1.0</td>
<td>1.5</td>
<td>4.6</td>
</tr>
<tr>
<td>1.0</td>
<td>2.0</td>
<td>5.3</td>
</tr>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>5.9</td>
</tr>
</tbody>
</table>

Based on Table 1, which ramp height results in the most kinetic energy of the ball at the bottom of the ramp?

A. 0.5 meter, because the ball has the lowest speed.
B. 1.5 meters, because the ball almost has an average of all speeds.
C. 2.0 meters, because the mass of the ball stays the same even when ramp height is changed.
D. 2.5 meters, because the ball has the highest speed.

**Key:** D (1 point)
ILCS: Identify the transfer/transformation of energy of object collisions under investigation.

Sara rolls the ball down the ramp and lets it collide with the puck so that energy from the ball may be transferred to the puck. Mateo asks Sara, “How do we know the puck gained kinetic energy from the ball?”

Select the two observations that best provide evidence that the energy from the ball was transferred to the puck during the collision.

- A noise is heard during the collision.
- The puck begins to slide across the floor.
- After the collision, the ball rolls more slowly.
- A noise is heard as the puck slides across the floor.
- The puck stops after sliding a distance across the floor.

**Key:** Second and third options. (1 point)
**ILCS:** Use the observations or data and scientific concepts about energy to support a conclusion about how the speed of the object is related to its energy.

Since the team knows that energy is transferred to the puck, Sara asks Alex, “When comparing the results for each ramp height, what observation provides evidence that the puck has gained the most kinetic energy from the ball immediately after the collision?”

Select the explanation that correctly completes Alex’s response. Alex should say “The puck that gained the most kinetic energy . . .

A. travels the greatest distance before stopping, because it had the greatest speed after the collision.”

B. makes the loudest sound during the collision, because it transfers the most kinetic energy into sound.”

C. makes the quietest sound during the collision, because it transfers the most kinetic energy into sound.”

D. travels the least distance before stopping, because it transferred its kinetic energy the quickest to its surroundings.”

**Key:** A (1 point)
ILCS: Select or complete a model that is the best representative explanation of how velocity and energy relate.

Before the competition, the team members must pick the ramp height they want to use from a list of heights that have not been tested. The list is shown here.

<table>
<thead>
<tr>
<th>Ramp height (meters)</th>
<th>1.25</th>
<th>1.75</th>
<th>2.25</th>
<th>2.75</th>
<th>3.25</th>
</tr>
</thead>
</table>

Select the ramp height, in meters, from the list that will cause the puck to have the greatest kinetic energy after the collision. Explain your answer by stating how the ramp height affects the speed of the ball. Enter your answer in the box provided.

Rubric:

The student should say the 3.25 meter ramp height should be used. AND

The student should say that it will give the ball the most speed (or mention that it will make the ball "go the fastest/Quickest").

Rubric continues on the next page.
1 point

**Exemplar:**

The 3.25 meter height should be chosen. OR

It will make the ball have the greatest speed at the bottom of the ramp. OR

It will make the ball go the fastest/quickest.

**Rubric:**

The student should say the 3.25 meter ramp height should be used. OR

The student should say that it will give the ball the most speed (or mention that it will make the ball “go the fastest/quickest”).

0 point

**Exemplar:**

The ramp height affects the speed of the ball.

**Rubric:**

A 0-point response attempts to answer the prompt but is incorrect.
ILCS: Identify the transfer/transformation of kinetic energy under investigation when rate of friction changes.

The team wins the competition. They decide to continue their investigation by placing rough sandpaper on the gymnasium floor. Alex observes that the sound the puck makes sliding across the rough sandpaper is different than the sound the puck makes sliding across the smooth gymnasium floor.

Select a word or phrase from the menu to correctly complete the sentence about why the sound is different between the sandpaper and smooth gymnasium floor.

The sound of the puck sliding across the sandpaper is louder than the sound of the puck sliding across the gymnasium floor. This is because the friction between the puck and the floor is converting kinetic energy from the puck into sound energy.

Key: Drop-down menu: less. (1 point)