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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 eight.

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: Select the appropriate components to develop a model to illustrate the conservation of atoms/mass.
ILCS: Select the appropriate components to develop a model to illustrate the conservation of atoms/mass.

Nitrogen gas \((N_2)\) reacts with hydrogen gas \((H_2)\) to form ammonia gas \((NH_3)\). Models of the molecules are shown.

Which model correctly shows that the mass is conserved in the reaction?

Key: C (1 point)
ILCS: Explain why one variation of the trait is more advantageous given the introduction of a predator to the environment.

A species of small fish lives in a shady pond with a dark bottom. Some of these small fish are light colored, and some are dark colored. A new predator is added to the pond, and one of its primary food sources is the small fish. The table shows the percent of each color of fish in this population before and after the predator was added.

<table>
<thead>
<tr>
<th>Color of Fish</th>
<th>Before New Predator</th>
<th>After New Predator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>51%</td>
<td>29%</td>
</tr>
<tr>
<td>Dark</td>
<td>49%</td>
<td>71%</td>
</tr>
</tbody>
</table>

Based on the data in the table, select the best phrase from the menus to complete each sentence.

After the new predator is added to the pond, the [ ] have a better chance of surviving than fish of the other color. This is because the predator [ ].

**Key:** First drop-down menu: dark-colored fish. Second drop-down menu: cannot see them as well as fish of the other color. (1 point)
ILCS: Construct a sound argument using evidence from the data, that an increase in an objects mass, increases the magnitude of gravitational force acting on the object.

Students used a computer simulation to determine the variables that affect the gravitational force between two objects. They collected the data shown in the table.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>25</td>
<td>4</td>
<td>$2.6 \times 10^{-9}$</td>
<td>$2.6 \times 10^{-9}$</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
<td>8</td>
<td>$6.5 \times 10^{-10}$</td>
<td>$6.5 \times 10^{-10}$</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>8</td>
<td>$1.0 \times 10^{-8}$</td>
<td>$1.0 \times 10^{-8}$</td>
</tr>
<tr>
<td>100</td>
<td>1</td>
<td>8</td>
<td>$1.0 \times 10^{-10}$</td>
<td>$1.0 \times 10^{-10}$</td>
</tr>
</tbody>
</table>

**Part A**

Choose the claim statement that best agrees with the data.

A. Mass does not affect the gravitational force between two objects.

B. Mass is the only variable that affects the gravitational force between two objects.

C. Distance is the only variable that affects the gravitational force between two objects.

D. Both mass and distance are variables that affect the gravitational force between two objects.

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

Select the correct words from the menus to complete the following statement to support the claim.

As the masses of both objects increased, the gravitational force between them [ ] , and as the distance between the two objects increased, the gravitational force between them [ ] .

**Key:**

**Part A:** D (1 point)  
**Part B:** First drop-down menu: increased. Second drop-down menu: decreased. (1 point)
ILCS: Match each of several designs with a list of the prioritized criteria and constraints or trade-offs in building materials for schools in an area where earthquakes occur.

There are two schools in a town where earthquakes sometimes happen. The town leaders want to make the school buildings stronger and safer to protect students and teachers during an earthquake. The leaders ask three different construction companies to propose a plan for making the schools safer. Each plan should match three important criteria and constraints.

- The schools will be made safe within two years.
- The cost cannot be more than $0.47 per square meter of building space.
- Both schools will be able to withstand an earthquake of magnitude 8.0.

The table shows important details for three plans submitted by the construction companies.

<table>
<thead>
<tr>
<th>Criteria and Constraints</th>
<th>Plan 1</th>
<th>Plan 2</th>
<th>Plan 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to complete the plan for both schools</td>
<td>2 years</td>
<td>2 years, 1 month</td>
<td>3 years</td>
</tr>
<tr>
<td>Cost per square meter of building space</td>
<td>$0.52</td>
<td>$0.46</td>
<td>$0.45</td>
</tr>
<tr>
<td>Maximum magnitude earthquake that the schools will be able to withstand</td>
<td>7.9</td>
<td>8.2</td>
<td>7.7</td>
</tr>
</tbody>
</table>

Select the plan that best matches the criteria and constraints made by the town leaders.

Key: Plan 2 (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:** Evaluate (with reasoning) whether the provided evidence/data are sufficient to defend the claim based on almond production and the effect it has on water supplies in California.

**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.

This graph shows almond production in the United States since 2012. Almost all of the almonds grown in the United States come from California, and about 70% of California’s almonds are sold overseas. About 4% of California’s freshwater supply is used to grow almonds.

![Almond Production Graph](image)

Globally, the quantity of almonds eaten per person has increased in recent years. Scientists claim that this increased demand for almonds will directly cause a decrease in California’s limited freshwater supply. Based on the data, select the words or phrases that **best** complete the statement.

The data □ the scientists’ claim because, as the demand for almonds increases, almond production in California will most likely □.

**Key:** First drop-down menu: support. Second drop-down menu: increase, which will cause the use of freshwater. (1 point)
**ILCS**: Explain how resource availability affects population growth and carrying capacities.

A paramecium is a single-celled freshwater organism that can be observed using a microscope. A typical paramecium is shown.

A scientist started a paramecium culture in the laboratory to study population growth. A model of population growth for the paramecium culture is shown in the graph. The carrying capacity is the number of individuals that the environment has enough resources to support.

![Carrying Capacity Graph](image)

Explain why the paramecium population growth is rapid at the part labeled A and why the population growth rate is slower at the part labeled B, where the population is at carrying capacity. Enter your answer in the box provided.

*Rubric follows on the next page.*
2 point

**Exemplar:**

At point A, the paramecium population is growing rapidly because there are unlimited resources (or more than enough resources). At point B, the growth rate slows down because there are more individuals in the same area who need resources, or resources are limited.

**Rubric:**

The response explains that at point A resources are plentiful (unlimited) and the population can grow rapidly. AND

The response explains that at point B, carrying capacity, resources are limited and so the growth rate slows down.

1 point

**Exemplar:**

At point A, the paramecium population is growing rapidly because there are unlimited resources (or more than enough resources). OR

At point B, the growth rate slows down because there are more individuals who need the resources, or resources are limited.

**Rubric:**

The response explains that at point A resources are plentiful (unlimited) and the population can grow rapidly. OR

The response explains that at point B, carrying capacity, resources are limited and so the growth rate slows down.

0 point

**Exemplar:**

The population doesn’t change size. OR

Resources are not needed.

**Rubric:**

A 0-point response attempts to answer the prompt but is incorrect.
ILCS: Evaluate the information provided on earthquakes and identify a pattern between the location and severity of a natural disaster.

A tsunami is a series of waves, and it is usually caused by an earthquake. A tsunami can only be predicted after an earthquake has already occurred. Most tsunamis are caused by earthquakes with magnitudes over 7.0 that occur under the ocean or near coastlines. These earthquakes are also less than 100 kilometers (km) below Earth’s surface. This table summarizes the magnitude, location, and depth of four earthquakes.

<table>
<thead>
<tr>
<th>Earthquake</th>
<th>Magnitude</th>
<th>Location</th>
<th>Depth (below Earth’s surface)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3.6</td>
<td>Coastline</td>
<td>52 km</td>
</tr>
<tr>
<td>B</td>
<td>8.9</td>
<td>Ocean</td>
<td>28 km</td>
</tr>
<tr>
<td>C</td>
<td>7.2</td>
<td>Ocean</td>
<td>180 km</td>
</tr>
<tr>
<td>D</td>
<td>8.5</td>
<td>Mid-continental</td>
<td>85 km</td>
</tr>
</tbody>
</table>

Based on this information, which earthquake has the greatest likelihood of causing a tsunami to develop?

A  Earthquake A
B  Earthquake B
C  Earthquake C
D  Earthquake D

Key: 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>
<tbody>
<tr>
<td>9</td>
<td>8</td>
<td>MS-PS2-5</td>
<td>3. Planning and Carrying Out Investigations</td>
<td>PS2.B Types of Interactions</td>
<td>2. Cause and Effect</td>
<td>3</td>
</tr>
</tbody>
</table>

**ILCS:** Evaluate data to determine if there is evidence that fields exert forces on nearby objects without direct contact.

A student wants to show a friend that a magnetic field exists in the region around a permanent magnet.

For each demonstration listed in the table, select a check box to indicate whether the student can use the demonstration to show that a field exists in a region around a magnet.

<table>
<thead>
<tr>
<th>Does show a field exists</th>
<th>Does not show a field exists</th>
</tr>
</thead>
<tbody>
<tr>
<td>A magnet touched to a paper clip picks it up from a table.</td>
<td></td>
</tr>
<tr>
<td>A magnet held near a small metal ball makes the ball roll across a table.</td>
<td></td>
</tr>
<tr>
<td>The north pole of a magnet sticks to the south pole of a second magnet when they touch.</td>
<td></td>
</tr>
<tr>
<td>A small magnet held under a piece of paper with iron filings on top makes the filings move into a pattern that covers the whole piece of paper.</td>
<td></td>
</tr>
</tbody>
</table>

**Key:** (1 point)

<table>
<thead>
<tr>
<th>Does show a field exists</th>
<th>Does not show a field exists</th>
</tr>
</thead>
<tbody>
<tr>
<td>A magnet touched to a paper clip picks it up from a table.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>A small magnet held under a piece of paper with iron filings on top makes the filings move into a pattern that covers the whole piece of paper.</td>
<td></td>
</tr>
</tbody>
</table>
ILCS: Explain the role of plants (or animals) in the cycling of matter.

The processes of photosynthesis and cellular respiration are involved in the cycling of carbon dioxide (CO₂) and oxygen (O₂) among organisms.

Select at least one check box in each row to indicate the organisms that perform each process that contributes to the carbon cycle.

<table>
<thead>
<tr>
<th>Plants</th>
<th>Animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produce CO₂ that is used in photosynthesis</td>
<td>✔</td>
</tr>
<tr>
<td>Use CO₂ in photosynthesis</td>
<td>✔</td>
</tr>
<tr>
<td>Produce O₂ that is used in cellular respiration</td>
<td>✔</td>
</tr>
<tr>
<td>Use O₂ in cellular respiration</td>
<td>✔</td>
</tr>
</tbody>
</table>

Key: (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:** Select the suitable equipment necessary to investigate heat transfer.

A student learning about heat transfer makes the claim shown.

Some metals change temperature more rapidly than other metals.

The student proposes to test the claim in the laboratory by using metal rods made of iron (Fe), copper (Cu), and aluminum (Al). In addition to the metal rods, which pieces of equipment would be useful for investigating the claim?

- A) prism, heat lamp, screen, meterstick
- B) beaker, digital scale, stopwatch, clamps
- C) litmus paper, beaker, pan balance, battery
- D) hot water, pan to hold water, stopwatch, thermometer

**Key:** D (1 point)
ILCS: Select the processes that represent the rock cycle and also identify the limitations to using a model.

A student uses wax crayons to model different parts of the rock cycle. The model has several steps as shown.

**Part A**

Drag the process to the step that most closely models that part of the rock cycle. Each process is used only once.

<table>
<thead>
<tr>
<th>Step</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crayons are grated into small pieces.</td>
<td></td>
</tr>
<tr>
<td>Grated pieces of crayons are squeezed together with hands.</td>
<td></td>
</tr>
<tr>
<td>Squeezed crayon pieces are wrapped in foil and flattened with a warm iron.</td>
<td></td>
</tr>
<tr>
<td>Flattened crayon pieces are placed in a beaker and heated until liquid.</td>
<td></td>
</tr>
<tr>
<td>Liquid crayon is poured into a Petri dish to cool and solidify.</td>
<td></td>
</tr>
</tbody>
</table>

**Processes**

<table>
<thead>
<tr>
<th>Weathering and erosion of igneous rock</th>
<th>Formation of metamorphic rock</th>
<th>Formation of sedimentary rock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magma or lava forming igneous rock</td>
<td>Metamorphic rock changing to magma</td>
<td></td>
</tr>
</tbody>
</table>

*Item continues on the next page.*
Part B

The rock cycle is different from the student's model, because in the rock cycle:

- processes take a much longer time.
- pressure is involved in some processes.
- there are both liquid and solid materials.
- thermal energy is needed for some processes.

Key:

Part A: (1 point)

<table>
<thead>
<tr>
<th>Step</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crayons are grated into small pieces.</td>
<td>Weathering and erosion of igneous rock</td>
</tr>
<tr>
<td>Grated pieces of crayons are squeezed together with hands.</td>
<td>Formation of sedimentary rock</td>
</tr>
<tr>
<td>Squeezed crayon pieces are wrapped in foil and flattened with a warm iron.</td>
<td>Formation of metamorphic rock</td>
</tr>
<tr>
<td>Flattened crayon pieces are placed in a beaker and heated until liquid.</td>
<td>Metamorphic rock changing to magma</td>
</tr>
<tr>
<td>Liquid crayon is poured into a Petri dish to cool and solidify.</td>
<td>Magma or lava forming igneous rock</td>
</tr>
</tbody>
</table>

Processes:

- Weathering and erosion of igneous rock
- Formation of metamorphic rock
- Formation of sedimentary rock

Part B: A (1 point)
ILCS: Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.

DNA contains a code for synthesizing proteins. Three nucleotides in a row code for a particular amino acid. There are four nucleotides in DNA, which are abbreviated as A, T, C, G. The amino acids are joined to form a protein.

Genetic mutations can occur in the DNA of individuals. Some mutations are harmful, some have no effect, and some might be beneficial to the organism. The table shows the nucleotide sequence of DNA that codes for a protein in one individual and the nucleotide sequence of the same segment of DNA in an individual with a mutation.

<table>
<thead>
<tr>
<th>Original Sequence</th>
<th>TTA</th>
<th>TAG</th>
<th>GTT</th>
<th>ATG</th>
<th>TAT</th>
<th>TT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mutated Sequence</td>
<td>TTA</td>
<td>TAG</td>
<td>GAT</td>
<td>TAT</td>
<td>GTA</td>
<td>TTT</td>
</tr>
</tbody>
</table>

Which statement describes the most likely impact of the mutation in the mutated sequence?

A. There will be no effect because the rest of the DNA is normal.
B. The extra nucleotide will be deleted before the protein is formed.
C. The protein formed will not be the same as that formed from the original DNA sequence.
D. The mutated DNA will code for the same number of amino acids as the original sequence.

Key: C (1 point)
**ILCS:** Ask a testable question that could be used to evaluate global impacts from a volcano that has erupted.

In June 1991, Mount Pinatubo in the Philippines erupted. The eruption released large amounts of gases, such as sulfur dioxide, water vapor, and carbon dioxide, into the atmosphere. Sulfur dioxide reacted with water to form aerosol particles, and an aerosol cloud formed that covered a large portion of Earth.

Students want to determine what effect the eruption had on global climate. Which question should the students investigate to **best** determine the effect?

- What was the temperature of the lava that flowed onto Earth’s surface when Mount Pinatubo erupted?
- Was the amount of rain that fell on Mount Pinatubo in the days after the eruption greater or less than average?
- Do aerosol particles of this type cause the amount of solar energy that reaches Earth’s surface to increase or decrease?
- How did the temperature of the gases as they were ejected from Mount Pinatubo compare to the temperature of the gases ejected from other volcanoes?

**Key:** C (1 point)
ILCS: Link the evidence/data to a claim how the impact of La Niña caused a change in the rate of photosynthesis within a tropical forest ecosystem.

During a La Niña event, the temperature of the Pacific Ocean near Central America becomes cooler than normal. As a result, more clouds form, and this can block sunlight from reaching plants in Central American forests. A researcher studying the effects of La Niña measured the amount of carbon dioxide (CO₂) uptake by tropical plants under different light intensities. The data are shown in the graph.

**Predict how a La Niña event affects the rate of photosynthesis by plants in the tropical forests of Central America. Provide evidence from the graph to support your prediction. Enter your answer in the box provided.**

**2 point**

**Exemplar:**

The rate of photosynthesis will decrease. The decrease is because, with less sunlight, the plants take up less carbon dioxide.

*Rubric continues on the next page.*
Rubric:

The response indicates that the rate of photosynthesis will decrease. AND
The response indicates that there is a decreased rate of carbon dioxide (or CO₂) uptake by the plants at lower light intensities.

1 point

Exemplar:

The rate of photosynthesis will decrease. OR
With less sunlight, the plants take up less carbon dioxide.

Rubric:

The response indicates that the rate of photosynthesis will decrease. OR
The response indicates that there is a decreased rate of carbon dioxide (or CO₂) uptake by the plants at lower light intensities.

0 point

Exemplar:

The rate of photosynthesis will increase. OR
The rate of photosynthesis will increase because of the warmer climate. OR
Carbon dioxide uptake will increase.

Rubric:

A 0-point response attempts to answer the prompt but is incorrect.
ILCS: Identify evidence that is irrelevant/invalid and would not support the argument that certain flower colors attract more pollinators.

A biologist wanted to study how certain plant structures, such as colored flowers, might affect how often the plants are pollinated during the day. For one hour on a sunny summer day, the biologist observed bee, butterfly, hummingbird, and beetle pollinators of a population of plants with equal numbers of purple, white, and pink flowers. Based on the data collected and shown in the table, the biologist made the claim that plants with purple flowers in this population attract more pollinators than do plants with flowers of other colors.

<table>
<thead>
<tr>
<th>Flower Color</th>
<th>Bees</th>
<th>Butterflies</th>
<th>Hummingbirds</th>
<th>Beetles</th>
<th>Total Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purple</td>
<td>12</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>White</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Pink</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Which evidence could be used to **challenge** the biologist’s claim that purple flowers in the population of plants attract more pollinators than other flower colors do?

A. The purple flowers did not have any butterfly or beetle pollinators.

B. Bees pollinated the purple flowers 12 times and the white flowers only 1 time.

C. Hummingbirds pollinated the purple flowers 5 times and did not pollinate the white or pink flowers.

D. The purple flowers were pollinated 17 times, the white flowers were pollinated 3 times, and the pink flowers were pollinated 2 times.

**Key:** A (1 point)
ILCS: Use the model to identify how the energy of the wave changes based on a change in amplitude.

A scientist measures the amplitude and wavelength of waves in the ocean. The scientist also calculates the amount of energy contained in one square meter of water for each wave. The data and calculations for four different waves are shown in the table.

<table>
<thead>
<tr>
<th>Amplitude (meters)</th>
<th>Wavelength (meters)</th>
<th>Energy (joules)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.20</td>
<td>8.0</td>
<td>200</td>
</tr>
<tr>
<td>0.20</td>
<td>16.0</td>
<td>200</td>
</tr>
<tr>
<td>0.40</td>
<td>8.0</td>
<td>800</td>
</tr>
<tr>
<td>0.40</td>
<td>16.0</td>
<td>800</td>
</tr>
</tbody>
</table>

Which wave characteristics, if any, does the energy in the wave depend on?

A. the amplitude only
B. the wavelength only
C. both the amplitude and the wavelength
D. neither the amplitude nor the wavelength

Key: A (1 point)
ILCS: State that increasing an object’s speed results in an increase of the object’s kinetic energy proportional to the square of its speed.

The picture shows a tugboat pushing a barge loaded with coal up a river to a power plant.

The tugboat’s computer generates a graph of the boat’s speed during each minute of its journey.

Select the box on the graph that shows the location where the tugboat’s kinetic energy is the greatest.

Key continues on the next page.
Key: (1 point)

![Graph showing speed over time](image-url)
<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>19</td>
<td>8</td>
<td>MS-ESS1-4</td>
<td>6. Constructing Explanations and Designing Solutions</td>
<td>ESS1.C The History of Planet Earth</td>
<td>3. Scale, Proportion, and Quantity</td>
<td>2</td>
</tr>
</tbody>
</table>

**ILCS:** Use scientific concepts, principles, and theories to explain how the evidence supports a conclusion about Earth’s history based on sedimentary rock layers.

The diagram shows a cross section of layers of sedimentary rocks. The types of fossils in each layer are shown.

![Diagram of sedimentary rock layers with fossils](diagram.png)

Based on the information in the cross section, select the three statements that are most likely correct.

- Layer C is below Layer B, so Layer C is older.
- Layer A is at the top, so it is the youngest layer.
- The ammonite fossil is above the crinoid fossil, so the crinoid is older.
- There is no coral fossil in Layer D, so corals must have become extinct.
- The gastropod fossils are above the crinoid fossil, so gastropods evolved from crinoids.

**Key:** First, second, and third options. (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:** Select the processes that represent mechanisms and behaviors within the rock cycle.

This model of the rock cycle shows magma (the molten rock found under the surface of Earth) and the major types of rocks. The arrows represent some processes that rocks go through as they are changed from one type to another.

**Part A**

Drag the processes to the correct positions to complete the model. Each process is used only once.

![Diagram of the rock cycle]

- Sedimentary rock
- Metamorphic rock
- Igneous rock
- Magma

<table>
<thead>
<tr>
<th>Process</th>
<th>Sedimentary rock</th>
<th>Metamorphic rock</th>
<th>Igneous rock</th>
<th>Magma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion and deposition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating under pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solidification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Item continues on the next page.*
Part B

Based on the model, which is a correct statement about the rock cycle?

A. Rocks and minerals are the same thing.
B. All processes in the rock cycle occur at the same rate.
C. Rocks are always found in the same locations as where they formed.
D. Rocks are changed into different types as a result of Earth processes.

Key:

Part A: (1 point)

Heating under pressure
Sedimentary rock
Metamorphic rock
Melting
Magma
Erosion and deposition
Igneous rock
Solidification

Part B: D (1 point)
ILCS: Analyze pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.

The embryos of two vertebrate animals at the same stage of development are shown in the figure.

Which **best** explains why the embryos are similar in appearance, yet the adults look different?

- A. Pigs and chickens are in the same genus.
- B. All vertebrate embryos have the same DNA.
- C. As the embryos grow, they undergo mutations.
- D. Some developmental processes are shared by vertebrates.

**Key:** D (1 point)
ILCS: Evaluate the information given on the energy used to make plastic bottles and the impact manufacturing has on natural resources.

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

Plastic A is commonly used to make disposable water bottles. Plastic B can also be used to make these bottles. Information about Plastic A and Plastic B is given in the table.

<table>
<thead>
<tr>
<th>Plastic</th>
<th>Common Source of Raw Material</th>
<th>Energy Used to Make One Kilogram of Plastic</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Oil</td>
<td>16.5 megajoules</td>
</tr>
<tr>
<td>B</td>
<td>Corn</td>
<td>12.1 megajoules</td>
</tr>
</tbody>
</table>

Based on the information in the table, explain two ways how using Plastic B instead of Plastic A to make disposable water bottles can help conserve natural resources. Enter your answer in the box provided.

2 point

Exemplar:
Plastic B comes from corn, which is a renewable resource. Plastic A comes from oil, which is a nonrenewable resource. It takes less energy to make Plastic B than to make Plastic A, so making bottles out of Plastic B will conserve energy.

Rubric continues on the next page.
Rubric:

The response describes that the raw material for Plastic B comes from a renewable resource (corn), but the raw material for Plastic A comes from a nonrenewable resource (oil). AND

The response describes that it takes less energy to make Plastic B than it does to make Plastic A.

1 point

Exemplar:

Plastic B comes from corn, which is a renewable resource (it can be grown again). Plastic A comes from oil, which is a nonrenewable resource (it takes a long time to make again). OR

It takes less energy to make Plastic B than to make Plastic A. Making bottles out of Plastic B will conserve energy.

Rubric:

The response describes that the raw material for Plastic B comes from a renewable resource (corn), but the raw material for Plastic A comes from a nonrenewable resource. OR

The response describes that it takes less energy to make Plastic B than it does to make Plastic A.

0 point

Exemplar:

Plastic B does not use any natural resources. OR

Plastic B uses more energy than Plastic A does. OR

Plastic B contains less energy than Plastic A does.

Rubric:

A 0-point response attempts to answer the prompt but is incorrect.
ILCS: Explain how the increasing frequency for plant height at a certain elevation of one plant species is advantageous.

A certain species of flowering plant has populations that grow near sea level and populations that grow at high elevations. Scientists collected seeds from the plants growing at different elevations and planted the seeds at a high elevation and near sea level. The heights of the plants grown from the seeds are shown in this table.

<table>
<thead>
<tr>
<th>Location of Collected Seeds</th>
<th>Location of Planted Seeds</th>
<th>Resulting Height of Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>High elevation</td>
<td>High elevation</td>
<td>Short</td>
</tr>
<tr>
<td>High elevation</td>
<td>Near sea level</td>
<td>Short</td>
</tr>
<tr>
<td>Near sea level</td>
<td>High elevation</td>
<td>Tall</td>
</tr>
<tr>
<td>Near sea level</td>
<td>Near sea level</td>
<td>Tall</td>
</tr>
</tbody>
</table>

Based on the data, which **two** statements about the height of this species of plant are **most likely** correct?

- The height of the plants is most directly controlled by genetic factors.
- The height of the plants is most directly controlled by environmental conditions.
- Near sea level, the taller plants are better able to survive and reproduce than the shorter plants are.
- At higher elevations, the taller plants are better able to survive and reproduce than the shorter plants are.

**Key:** First and third options. (1 point)
### ILCS: Select the appropriate components to complete the model to illustrate the conservation of atoms/mass.

One ethylene (C₂H₄) and three oxygen (O₂) molecules combine to produce carbon dioxide (CO₂) and water (H₂O) molecules. The molecules are represented by models as shown.

![Molecules](image)

Which model of the chemical reaction correctly represents the correct number of CO₂ and H₂O molecules produced if mass is conserved?

![Reaction Models]

**Key:** C (1 point)
<table>
<thead>
<tr>
<th>Item</th>
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<th>DCI</th>
<th>CCC</th>
<th>DOK</th>
</tr>
</thead>
</table>

**ILCS**: Identify the processes operating within the water cycle and the role living organisms have on the water cycle.

A student creates the model shown of the water cycle for a class presentation. The student’s main goal is to help the class understand how living organisms assist in the movement of water through the system.

![Water Cycle Diagram](image)

Based on the model, what should the student say about the role of living organisms in the water cycle?

- Plants help move water from the soil to the atmosphere.
- Animals generate heat that helps evaporate water from the land.
- Plant movements create wind that helps draw water into the atmosphere.
- Animals create pathways in the mountains that allow water to flow downhill.

**Key**: A (1 point)
ILCS: Identify possible unanticipated effects of a design solution that includes native and nonnative species within a lake ecosystem.

A biologist studying a lake is concerned that an invasive aquatic plant species is outcompeting several native aquatic plant species. The native plants are the primary food source for many animals in the lake. The biologist proposes addressing the problem by introducing a nonnative, herbivorous species of fish into the lake to eat the invasive plants.

**Select the phrases from the menus that best complete the sentences.**

Some biologists argue that introducing the fish could be a bigger problem than the invasive plant species because the fish might

> **First drop-down menu:** cause a decrease in the number of native, beneficial plants.  
> **Second drop-down menu:** only introduce fish that cannot reproduce. (1 point)

Key: First drop-down menu: cause a decrease in the number of native, beneficial plants. Second drop-down menu: only introduce fish that cannot reproduce. (1 point)
ILCS: Identify that if the results of external forces are exerted by objects in a specific direction and do not balance each other, then the system’s velocity in that direction changes.

Two students are investigating how balanced and unbalanced forces affect the motion of a small cart with freely rolling wheels. The students want to demonstrate three cases of motion:

- acceleration to the right
- acceleration to the left
- no acceleration

The students use string to attach two spring scales to the cart so that the forces exerted on it can be measured in newtons (N), as shown in the figure. The cart is then released from rest.

Which set of forces will allow the students to demonstrate all three cases of motion?

A

\[
\begin{array}{ccc}
20 \text{ N} & 20 \text{ N} & 20 \text{ N} \\
20 \text{ N} & 20 \text{ N} & 15 \text{ N} \\
15 \text{ N} & 20 \text{ N} & 15 \text{ N} \\
10 \text{ N} & 20 \text{ N} & 10 \text{ N}
\end{array}
\]

B

\[
\begin{array}{ccc}
20 \text{ N} & 20 \text{ N} & 20 \text{ N} \\
20 \text{ N} & 20 \text{ N} & 15 \text{ N} \\
10 \text{ N} & 20 \text{ N} & 10 \text{ N}
\end{array}
\]

C

\[
\begin{array}{ccc}
20 \text{ N} & 15 \text{ N} & 15 \text{ N} \\
15 \text{ N} & 20 \text{ N} & 15 \text{ N} \\
10 \text{ N} & 20 \text{ N} & 10 \text{ N}
\end{array}
\]

D

\[
\begin{array}{ccc}
20 \text{ N} & 20 \text{ N} & 20 \text{ N} \\
20 \text{ N} & 15 \text{ N} & 15 \text{ N} \\
10 \text{ N} & 10 \text{ N} & 10 \text{ N}
\end{array}
\]

Key: B (1 point)
ILCS: Propose several different processes to monitor and/or minimize the impact of human activity on water supplies.

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.

California has experienced many significant periods of drought as a result of both environmental factors and human activities. Conservation of groundwater has therefore become very important, even when California receives a lot of rain. Proposed ways of conserving groundwater include reducing water use, reusing water, and finding other sources of water.

For each conservation practice listed in the table, select how the practice most directly conserves groundwater. Select one check box per row.

<table>
<thead>
<tr>
<th>Reduces water use</th>
<th>Reuses water</th>
<th>Provides other source of water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigating crops with treated wastewater</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using indoor faucet nozzles that limit water flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using water from a rainwater collection system</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key: (1 point)
ILCS: Identify how to address factors in designing a solar cooker that heats food faster than a conventional oven.

Students are designing a solar oven that can be made from materials found around their homes. Solar ovens take more time to heat food than regular ovens. The students would like to build a solar oven that heats food as quickly as possible.

**Part A**

Which two characteristics should the students consider when addressing the time the oven takes to heat food?

- [ ] how often the oven will be used to heat food
- [ ] the type of food that will be heated in the oven
- [ ] possible ways of preventing or reducing heat loss from the oven
- [ ] constructing an oven that is portable and easy to transport from place to place
- [ ] designing an oven that will collect as much sunlight and absorb as much heat as possible

*Item continues on the next page.*
Part B

For each design criterion listed in the table, select a check box to indicate whether use of the criterion will improve or reduce the rate at which the solar oven heats food.

<table>
<thead>
<tr>
<th></th>
<th>Improves the rate of heating</th>
<th>Reduces the rate of heating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covering the interior walls of the oven with a reflective material such as aluminum foil</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Allowing outside air to circulate inside the oven</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Having a mirrored surface that is adjustable in angle to reflect sunlight into the oven</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Using cookware that is uncovered and open to the atmosphere</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Key:

Part A: Third and fifth options. (1 point)

Part B: (1 point)
**ILCS:** Identify the locations of several celestial objects within the solar system, including the Earth, to complete the model.

Students are asked to develop models of the solar system. One student suggests that a ball circling a pole may be used to model the Sun, Earth, and the force of gravity. The model is shown in the diagram.

Which statement best describes how the model represents the Sun and Earth?

A. The ball is the Sun, the pole is the force of gravity, and the rope is Earth.
B. The ball is the Sun, the pole is Earth, and the rope is the force of gravity.
C. The ball is Earth, the pole is the Sun, and the rope is the force of gravity.
D. The ball is Earth, the pole is the force of gravity, and the rope is the Sun.

**Key:** C (1 point)
The following stimulus accompanies grade eight items 32 and 33 in the practice test.

In this performance task, you will answer five questions.

Students are observing plants found in a field. The plants can be classified as native or invasive. Native plant species have been found in the study area for hundreds or thousands of years. Invasive plants are recent arrivals to the study area, living outside of their natural area. These invasive species, introduced by human activity, can outcompete native species for resources and can replace native species in an area.

The students monitored the field for three years, collecting data every six months. They noticed patterns of change in two thistle species, Canada thistle and Anderson’s thistle.

Drag the slider across the timeline to observe the changes to the thistles in the field.
ILCS: Identify patterns of change based on the field study of the Anderson’s thistle and the Canada thistle.

Based on the observations of the study, select the terms from the two menus that best complete the sentence.

The observations show that the Anderson’s thistle population ▼ over the three years and the Canada thistle population ▼ during the same three years.

**Key:** First drop-down menu: decreases. Second drop-down menu: increases. (1 point)
### ILCS: Predict the likely outcome for the distribution of the plant populations over time.

Looking at the three years of observations, the students assume the environmental conditions of the field will stay the same for the next three years. Which **two** student predictions are most likely to include a correct description of the field after three more years?

- The Canada thistle population will be smaller than the Anderson’s thistle population.
- The Canada thistle population will be larger than the Anderson’s thistle population.
- The Canada thistle and Anderson’s thistle populations will be the same size.
- The field will only have Anderson’s thistle.
- The field will only have Canada thistle.

**Key:** Second and fifth options. (1 point)
The following stimulus accompanies grade eight items 34 through 36 in the practice test.

Insects eating a plant affect how the plant grows. The students learn about three thistle-eating insects: a fly, a flowerhead weevil, and a stem mining weevil. The students want to know if these insects could affect the populations of the two thistle species. The table shows the results from the students’ research.

<table>
<thead>
<tr>
<th>Insect</th>
<th>Plant Eaten</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fly</td>
<td>Anderson’s thistle</td>
</tr>
<tr>
<td>Flowerhead weevil</td>
<td>Canada thistle first, then Anderson’s thistle</td>
</tr>
<tr>
<td>Stem mining weevil</td>
<td>Canada thistle</td>
</tr>
</tbody>
</table>

![Fly](image1)

![Weevil](image2)
ILCS: Predict what would occur to both plant populations with the addition of weevils into the ecosystem.

What would happen first to both thistle populations if flowerhead and stem mining weevils were introduced to the study field during year two? Use the data from the students’ research to explain and support your answer. Enter your answer in the box provided.

2 point

Exemplar:
The Anderson’s thistle population will increase and the Canada thistle will decrease because the stem mining weevil eats Canada thistle and not Anderson’s thistle.

Rubric:
The Anderson’s thistle population will increase and the Canada thistle population will decrease. AND

This trend will occur because the stem mining weevil eats the Canada thistle but not the Anderson’s thistle. OR

This trend will occur because the flowerhead weevil eats Canada thistle first.

Rubric continues on the next page.
### 1 point

**Exemplar:**

Anderson’s thistle will increase and the Canada thistle will decrease. OR  
Anderson’s thistle will increase because the stem mining weevil only eats the Canada thistle. OR  
The thistle populations will change because the stem mining weevil eats the Canada thistle but not the Anderson’s thistle.

**Rubric:**

The Anderson’s thistle population will increase and the Canada thistle population will decrease. OR  
This trend will occur because the stem mining weevil eats the Canada thistle but not the Anderson’s thistle. OR  
This trend will occur because the flowerhead weevil eats the Canada thistle first.

### 0 point

**Exemplar:**

The Anderson’s thistle population will increase. OR  
The Canada thistle population will decrease. OR  
The Canada thistle population will increase and the Anderson’s thistle population will decrease because the stem mining weevil eats both thistles.

**Rubric:**

A 0-point response attempts to answer the prompt but is incorrect.
<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>34</td>
<td>8</td>
<td>MS-LS2-5</td>
<td>7. Engaging in Argument from Evidence</td>
<td>ETS1.B Developing Possible Solutions</td>
<td>7. Stability and Change</td>
<td>3</td>
</tr>
</tbody>
</table>

**ILCS:** Identify the criteria and/or constraints that resulted with the addition of the weevils into the ecosystem.

The students learn that insects have been used to reduce the populations of invasive plants. Only a few members of an insect species are introduced to the area. To properly control the invasive species, this small population needs to rapidly grow into a large population. Select check boxes in the table to identify whether the factors listed are constraints or criteria for choosing an insect to reduce a population of invasive plants.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reproduces quickly</td>
<td></td>
</tr>
<tr>
<td>Eats the invasive plant</td>
<td></td>
</tr>
<tr>
<td>Eats the native plants present</td>
<td></td>
</tr>
<tr>
<td>Competes with native insects for resources</td>
<td></td>
</tr>
</tbody>
</table>

**Key:** (1 point)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reproduces quickly</td>
<td></td>
</tr>
<tr>
<td>Eats the invasive plant</td>
<td></td>
</tr>
<tr>
<td>Eats the native plants present</td>
<td></td>
</tr>
<tr>
<td>Competes with native insects for resources</td>
<td></td>
</tr>
</tbody>
</table>
ILCS: Select the best design to increase the Anderson’s thistle and provide justification for the selection based on evidence.

Which action would most likely increase the size of the Anderson’s thistle population?

A. introducing the flowerhead weevil to the field because it eats Canada thistle first

B. introducing the stem mining weevil to the field because it only eats Canada thistle

C. introducing the fly and flowerhead weevil to the field because they both share a food source

D. introducing the stem mining weevil and fly to the field because they have different food sources

Key: B (1 point)
The following stimulus accompanies grade eight item 37 in the practice test.

In this performance task, you will answer six questions.

Students are researching the climate in their town. Between 1976 and 2016, the number of days with a high temperature above 38 degrees Celsius (°C) in their town has increased each year. These trends are consistent across their state.

The students find this graph showing the same trend of increasing temperatures around the world. The graph also contains information about global carbon dioxide (CO₂) levels.

The article associated with the graph says the rise in CO₂ is caused by the increased use of fossil fuels by humans. The students disagree about the relationship between rising CO₂ concentrations and rising temperatures.

One student thinks the rise in average daily temperature is causing the rise in CO₂. A second student thinks the rise in CO₂ is causing the rise in average daily temperature. A third student thinks that both are rising but there is no relationship between CO₂ and change in average daily temperature.
ILCS: Identify questions about patterns in data that connect natural processes and human activities to changes in global temperatures and carbon dioxide and other greenhouse gases over the past century.

The students want to answer this question:

What is causing this change in the temperature of the town?

Which question should the students answer as part of their research?

A. Are towns with highs above 38°C counted as part of this graph?
B. Is the change in temperature correlated to a change in human activities?
C. Which season produces the most days with a high temperature above 38°C?
D. Is the change in temperature due to the tilt of Earth or Earth’s distance from the Sun?

Key: B (1 point)
The following stimulus accompanies grade eight items 38 and 39 in the practice test.

These are the claims that the students made.

Student 1: The rise in temperature is causing the rise in CO₂.

Student 2: The rise in CO₂ is causing the rise in temperature.

Student 3: Both CO₂ and temperature are rising but there is no relationship between them.

The students design an investigation using three beakers to collect evidence for the three claims. Three beakers are set up as follows:

- All beakers are the same size and contain the same amount of soil.
- All beakers contain a thermometer and a CO₂ sensor.
- Beaker 1 is left open.
- Beaker 2 is covered with plastic wrap.
- Beaker 3 is covered with plastic wrap and filled with a gas that is half air and half CO₂.

Each beaker is placed under a heat lamp with the same amount of heat for 15 minutes. The beakers are the same distance from the lamps. The diagram shows the three beakers before being placed under the heat lamps:
ILCS: Identify a potential source of evidence/data that could be used to support their claim about greenhouses.

Select the terms from the menus that best complete the sentence.

The students’ investigation should **model** the interaction between Earth’s atmosphere, greenhouse gases, and **sunlight**.

Key: First drop-down menu: model. Second drop-down menu: sunlight. (1 point)
**ILCS:** Add labels to the model to identify relationships between components affecting climate, including differences in temperature changes and thermal energy transfer.

Select the beaker number from each menu that matches the description of what each beaker represents in the setup.

Beaker □ represents the atmosphere of Earth.
Beaker □ represents the control.
Beaker □ represents the atmosphere of Earth with high levels of greenhouse gases.

**Key:** First drop-down menu: 2. Second drop-down menu: 1. Third drop-down menu: 3.

(1 point)
The following stimulus accompanies grade eight item 40 in the practice test.

The students create this graph to predict what the data from the experiment might look like.

![Graph of Temperature of Beaker Air vs. Time]

Information about the beaker setups is repeated here for reference. The students modified their claims to apply to the experiment.

**Beaker Setups**

- Beaker 1 — not covered
- Beaker 2 — covered
- Beaker 3 — covered and contains extra CO₂

**Student Claims for Experiment**

Student 1: A change in temperature will cause a change in CO₂.

Student 2: A change in CO₂ will cause a change in temperature.

Student 3: Changes to CO₂ are not connected to changes in temperature.
### ILCS: Construct an argument in support/opposition for Prediction 1 using the data provided as evidence of the increased use of fossil fuels.

#### Part A

The data shown in the Prediction 1 graph would **best** support the claim of ___ about the effect of increased use of fossil fuels by humans.

#### Part B

Select the **two** lines of data that should be compared to **best** support the claim selected in Part A.

- [ ] Beaker 1
- [ ] Beaker 2
- [ ] Beaker 3

**Key:**

**Part A:** Student 2. (1 point)

**Part B:** Second and third options. (1 point)
The following stimulus accompanies grade eight item 41 in the practice test.

The students create this second graph to make another prediction of what the data might look like.

![Graph](graph.png)

**Prediction 2**

**Temperature of Beaker Air vs. Time**

Information about the beaker setups is repeated here for reference. The students modified their claims to apply to the experiment.

**Beaker Setups**

- Beaker 1 — not covered
- Beaker 2 — covered
- Beaker 3 — covered and contains extra CO₂

**Student Claims for Experiment**

Student 1: A change in temperature will cause a change in CO₂.

Student 2: A change in CO₂ will cause a change in temperature.

Student 3: Changes to CO₂ are not connected to changes in temperature.
<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:** Evaluate (with reasoning) whether the provided evidence/data is sufficient to defend the claim for Prediction 2.

Which **two** sources of CO₂ data would provide evidence to support the claim of Student 2?

- [ ] data collected from the CO₂ sensors in the beakers
- [ ] data collected from CO₂ sensors located inside private homes
- [ ] data from outdoor CO₂ sensors recorded during periods of cooling
- [ ] data collected from CO₂ sensors located inside the school gym and auditorium

**Key:** First and third options. (1 point)
ILCS: Identify a potential source of evidence/data that could be used to support the claim for the increased use of fossil fuels.

Student 3 also claims that another possible cause for the increase in days above 38°C could be the increase in the amount of paved surfaces in the town.

Select the terms from the menus that complete the sentence.

To support this claim, the student should make a [ ] of the percentage of the [ ] surface that has been paved over time.

Key: First drop-down menu: graph. Second drop-down menu: town’s. (1 point)
**ILCS:** Select components, and describe relationships and behaviors between the components to explain potential energy based on data from a roller coaster model.

In this performance task, you will answer seven questions.

Students are collecting data about a roller coaster called the Goliath.

Before riding the roller coaster, students are asked to look at a diagram of the track and evaluate the relative potential energy at four points on the roller coaster. The four points, along with their height in meters (m), are shown on this diagram.

Which **two** statements correctly describe the relative potential energy at various points on the track?

- At ① the potential energy is greater than the potential energy at ③.
- At ② the potential energy is greater than the potential energy at ③.
- At ③ the potential energy is greater than the potential energy at ④.
- At ④ the potential energy is greater than the potential energy at ②.

**Key:** First and second options. (1 point)
### Item 43

<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:** Select components and describe relationships and behaviors between the components to explain potential energy based on data from a roller coaster model.

Most roller coasters begin with a large hill where the roller coaster train is lifted up the hill using a motor, such as from ① to ② on this diagram of the Goliath. The motor is designed to always move the roller coaster train with the same velocity. At the top of the hill, the roller coaster train continues moving, with no further input of energy.

![Diagram of roller coaster with points 1, 2, 3, 4, and distances marked: 5 m, 36 m, 2 m, 20 m.](image)

Select words from the menus to correctly describe the changes in energy as the roller coaster train moves down the first hill, from ② to ③, and up the second hill, from ③ to ④.

The energy stored in the train at ② is transformed from ______ energy into motion, thermal, and sound energy as the train moves down to ③. As the train moves up to ④, the ______ energy is transformed back into ______ energy, but some ______ energy remains because ④ is not as high as ②.

**Key:** First drop-down menu: potential. Second drop-down menu: kinetic. Third drop-down menu: potential. Fourth drop-down menu: kinetic. (1 point)
ILCS: Select components and describe relationships and behaviors between the components to explain potential energy based on data from a roller coaster model.

Most roller coasters begin with a large hill where the roller coaster train is lifted up the hill using a motor, such as from 1 to 2 on this diagram of the Goliath. The motor is designed to always move the roller coaster train with the same velocity. At the top of the hill, the roller coaster train continues moving, with no further input of energy.

Which statement best describes why the second hill of a roller coaster ride is lower than the first hill of a roller coaster ride?

If the second hill wasn’t lower than the first hill, the roller coaster train would

A. need more mass to absorb enough potential energy to move up the second hill.

B. have a higher velocity as it moved down the second hill, potentially creating a dangerous ride.

C. need a source of energy other than the potential energy from the first hill to make it up the second hill.

D. have even more kinetic energy as it moved down the second hill, potentially creating a dangerous ride.

Key: C (1 point)
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**ILCS:** Analyze statements that connect the evidence to the claim about energy loss during movement.

Measurements of the speed of the train at additional points on the ride indicate that energy is being lost.

The students present two claims for the cause of this energy loss.

**Claim 1:** The loss of energy is due to the air pushing back on the train as it moves down the track.

**Claim 2:** The loss of energy is due to the friction of the train wheels with the track.

Three possible observations are proposed to test these claims, as shown in the chart. Indicate if each observation would support Claim 1 or Claim 2 by selecting the check boxes in the chart.

<table>
<thead>
<tr>
<th>Supports Claim 1</th>
<th>Supports Claim 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>The train moves faster after the cars are streamlined.</td>
<td></td>
</tr>
<tr>
<td>The tracks are warmer after the train has passed.</td>
<td></td>
</tr>
<tr>
<td>The train moves faster after oil is applied to the wheels and tracks.</td>
<td></td>
</tr>
</tbody>
</table>

**Key continues on the next page.**

**Key:** (1 point)

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<td>✔</td>
</tr>
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</tr>
<tr>
<td>The train moves faster after oil is applied to the wheels and tracks.</td>
<td>✔</td>
</tr>
</tbody>
</table>
The following stimulus accompanies grade eight items numbered 47 through 49 in the practice test.

The Goliath roller coaster train is made up of six cars that have a total mass of 3,300 kilograms (kg) when empty. The students attach a sensor to the train that automatically measures the velocity of the train in meters per second (m/s) as the train reaches the bottom of the first hill. They use these data to calculate the kinetic energy of the train in joules (J).

The first test is conducted with an empty train.

A second test is conducted, with enough students riding to fill three cars. The mass of the students is added to the mass of the empty train.

A third test is conducted, with enough students to fill all six cars. Again, the mass of the students is added to the mass of the empty train. The students’ data are shown in the table.

<table>
<thead>
<tr>
<th>Number of Full Cars</th>
<th>Mass of Train and Students (kg)</th>
<th>Velocity at the Bottom of the First Hill (m/s)</th>
<th>Calculated Kinetic Energy (J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3,300</td>
<td>28</td>
<td>1,300,000</td>
</tr>
<tr>
<td>3</td>
<td>3,747</td>
<td>28</td>
<td>1,500,000</td>
</tr>
<tr>
<td>6</td>
<td>4,575</td>
<td>28</td>
<td>1,800,000</td>
</tr>
</tbody>
</table>
**ILCS:** State that increasing the object’s mass results in a directly proportional increase of the object’s kinetic energy.

Use the two menus to complete the sentence.

As the mass of the train ▼, the expected kinetic energy of the train ▼ in proportion to the change of mass.

**Key:** First drop-down menu: increases. Second drop-down menu: increases. (1 point) OR First drop-down menu: decreases. Second drop-down menu: decreases. (1 point)
**ILCS:** State that increasing the object’s mass results in a directly proportional increase of the object’s kinetic energy.

If two more cars were added to the train, and both were filled with students, how would the data compare to that of a six-car train?

Select the terms from the menus to correctly complete the answer.

The kinetic energy would **increase** and the velocity would **remain the same**. (1 point)

**Key:** First drop-down menu: increase. Second drop-down menu: remain the same. (1 point)
ILCS: State that increasing the object’s mass results in a directly proportional increase of the object’s kinetic energy.

What would happen to the calculated kinetic energy of the empty train if the cars were made out of a material that reduced the mass of the empty train to 1,650 kg?

Complete the answer by selecting the terms from the menus.

The kinetic energy would ▼ by approximately ▼.

**Key:** First drop-down menu: decrease. Second drop-down menu: 650,000 J. (1 point)