Developed by OSPI in collaboration with WestEd
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Purpose Statement

The purpose of the Washington Comprehensive Assessment of Science (WCAS) is to measure the level of science proficiency that Washington students have achieved based on the Washington State 2013 K–12 Science Learning Standards. The standards are the Next Generation Science Standards (NGSS), and are organized into four domains: Physical Sciences; Life Sciences; Earth and Space Sciences; and Engineering, Technology, and the Applications of Science. Each domain has three-dimensional performance expectations that integrate science and engineering practices, disciplinary core ideas, and crosscutting concepts. The assessments were first administered in grades 5, 8, and 11 for federal and state accountability purposes in spring 2018.

This item specifications document describes how the item clusters (stimuli and items) and standalone items for the WCAS assessments are developed to assess the NGSS (referred to as “the standards” in the remainder of this document) and includes the second publicly released drafts of the item specifications for the WCAS.

The item specifications are based on the Performance Expectations (PEs) in the standards. The item specification for an individual PE describes how students can demonstrate understanding of the PE on the WCAS. The item specifications will be updated annually based on input from Washington educators. Each draft will be accompanied by a modifications log that will be updated at each subsequent publication.

Assessment Development Cycle

The WCAS is written by trained science educators from Washington. Each item cluster and standalone item is planned by the Office of Superintendent of Public Instruction (OSPI) Science Assessment Team in conjunction with an educational assessment contractor and then written, reviewed, and revised by educators during an item cluster writing workshop. From there, the development process involves formal reviews with science educators for all clusters and standalone items and for the scoring criteria in the rubrics of technology-enhanced and short-answer items. The development process assures the assessment contains items that meet the following criteria:

- Include authentic stimuli describing scientific phenomena that students might encounter
- Achieve tight alignment to a specified two- or three-dimensional item specification
- Provide a valid measure of a specified science learning standard
- Include item scoring rubrics that can be applied in a valid manner
- Include technology-enhanced and short-answer items that can be scored in a reliable manner

The Science Assessment Development Cycle flowchart summarizes the two-year process of review and field testing that precedes clusters and standalone items being used on an operational test.
OSPI solicits critical input from Washington educators by means of four key workgroups each year:

In the **Item Cluster Writing Workgroup**, teams of 2–3 educators write stimuli, items, and rubrics designed to validly measure student understanding of the standards.

In the **Content Review Workgroup**, educators review the products of the item cluster writing workgroup to ensure that every stimulus, item, and rubric is scientifically accurate and gathers appropriate evidence about student understanding and application of the standards. At the same time, a separate committee of community members reviews the items and stimuli for any bias or sensitivity issues.

In the **Field Test Rangefinding Workgroup**, educators look at a range of student responses to short answer items and decide how to score each response. This educator workgroup refines scoring rubrics and produces the materials that will be used to score the field test items.

In the **Content Review with Data Workgroup**, educators use item performance data, as well as participants’ science content knowledge, to decide whether the item should become available for operational testing.
Structure of the Test

The WCAS is composed of item clusters and standalone items aligned to the PEs. Advisory groups composed of national education experts, science assessment experts, and science educators recommend the item cluster structure for large-scale assessment of the standards because item clusters involve significant interaction of students with stimulus materials leading to a demonstration of the students’ application of knowledge and skills. Standalone items increase the PE coverage that can be achieved in a single test administration.

Item Clusters

Item clusters that assess a PE bundle make up the core of the WCAS. A PE bundle is generally two or three related PEs that are used to explain or make sense of a scientific phenomenon or a design problem. A phenomenon gives an item cluster conceptual coherence. The items within an item cluster are interconnected and focused on the given phenomenon. Items are also structured to support a student’s progression through the cluster.

Students must make sense of the phenomenon for an item cluster by using a science and engineering practice (SEP), disciplinary core idea (DCI), and crosscutting concept (CCC) represented in the PE bundle. PE bundles are often within a single domain, but may include PEs from different domains. PE bundles sometimes share a similar practice or crosscutting concept or may include multiple practices or crosscutting concepts. Each item within the cluster will align to two or three dimensions (2-D, 3-D) from one or more of the PEs in the bundle. Achieving as full coverage as possible requires developing items that target a variety of the dimensions represented in the PE bundle. In all cases, item clusters achieve full coverage of the dimensions of each PE within a PE bundle.

The Sample Item Cluster Map shows how the items in a sample cluster work together to achieve full coverage of the dimensions in a two-PE bundle.

Sample Item Cluster Map
Standalone Items
A standalone item is a focused measurement tool that uses a single item to address two or three dimensions of one PE.

Online Test Delivery
The WCAS is delivered online using the same platform as the Smarter Balanced ELA and Mathematics assessments. Students will be familiar with most of the online features of the WCAS; however, there are a few unique features that support efficient and reliable delivery of the clusters and standalone items.

Collapsible Stimuli
The WCAS has some item clusters that include more than one stimulus. Each stimulus is delivered along with the items most closely associated to that stimulus. Once a stimulus is presented, it is available to the student throughout the cluster. To minimize vertical scrolling and the need to move back to previous screens within a cluster, a stimulus is collapsed once the next stimulus is provided. A +/- icon in the heading of a collapsed stimulus section allows the stimulus to be hidden from view or expanded to suit a student’s current need.

Locking Items
WCAS clusters include some locking items in which the student cannot change their answer once they have moved on to the next item. A padlock icon next to the item number alerts students that they are answering a locking item. When they start to move on from the item, an “attention” box warns the student that they will not be able to change their answer once they move on. The student can either return to the item or move forward and lock in their answer.

Locking items allow the student to be updated with correct information in subsequent items or stimuli. In addition, locking items help to limit item interaction effects or clueing between items in a cluster.

Students can return and view an item that has been locked. The student will see their answer, but they cannot change their answer.

Animation
In addition to diagrams and graphics, the online platform supports the use of animations in stimuli. The animations provide additional scaffolding for the student.

Screen Display
Item clusters are displayed with a stimulus pane and an item pane on the same screen. The stimulus occupies 40% of the screen, while the item occupies 60% of the screen. However, by clicking expansion arrows, a student can expand either pane to a width of 90% of the screen. Standalone items are displayed on the entire width of the screen.
Item Types
The WCAS include several item types. Collectively, these item types enable measurement of understanding and core competencies in ways that support student engagement. The majority of the item types are represented on the WCAS Training Tests, which are accessed on the Washington Comprehensive Assessment Program (WCAP) Portal.

Edit Task Inline Choice (ETC)
• Students select words, numbers, or phrases from drop-down lists to complete a statement.
• The number of drop-down lists in an item will typically be between two and four.
• The length of options in a drop-down list will typically be one to four words.
• A drop-down list can be part of a table.

Grid Interaction (GI)
• Drag and drop
  o Students place arrows, symbols, labels, or other graphical elements into predesignated boxes on a background graphic.
  o The elements are designated as refreshable (able to be used multiple times) or non-refreshable (able to be used only one time).
• Hot Spot
  o Students interact with and construct simple graphs.

Hot Text (HT)
• Students move statements into an ordered sequence.
• The statements are designated as refreshable (able to be used multiple times) or non-refreshable (able to be used only one time).

Multiple Choice (MC)
• Includes a question, or a statement followed by a question.
• The question will present a clear indication of what is required so students will know what to do before looking at the answer choices.
• Students typically select from four options (one correct answer and three distractors).
• The options are syntactically and semantically parallel.
• The options are arranged in numerical or chronological order or according to length.
• Distractors can reflect common errors, misunderstandings, or other misconceptions.
• Distractors will not be partially correct.
• The options “All of the above” and “None of the above” will not be used.
Multiple Select (MS)

- Includes a clear direction or includes a statement followed by a clear direction.
- The clear direction indicates how many options a student should select to complete the item (e.g., “Select two pieces of evidence that support the student’s claim”).
- The direction will present a clear indication of what is required so students will know what to do before looking at the answer choices.
- Students select from a maximum of eight options that have at least two correct responses.
- There should be at least three more distractors than correct answers.
- The options are syntactically and semantically parallel.
- The options are arranged in numerical or chronological order or according to length.
- Distractors can reflect common errors, misunderstandings, or other misconceptions.
- Distractors will not be partially correct.
- The options "All of the above" and "None of the above" will not be used.

Short Answer (SA)

- Students write a response based on a specific task statement.
- Directions will give clear indications of the response required of students.
- When appropriate, bullets after phrases like “In your procedure, be sure to include:” or “In your description, be sure to:” will provide extra details to assist students in writing a complete response.
- A response that requires multiple parts may be scaffolded with response boxes to draw attention to the parts.
- Any SA item that requires the students to use information from a stimulus will specifically prompt for the information, such as “Use data from the table to ...” or “Support your answer with information from the chart.”
- Students type text and/or numbers into a response box using the keyboard. SA items are scored by human readers using a scoring rubric.

Simulation (SIM)

- Students use a simulation to control an investigation and/or generate data.
- Simulations can vary in their interaction, design, and scoring.
- The data can be scored directly or used to answer related questions, or both.

Table Input (TI)

- Students complete a table by typing numeric responses into the cells of the table using the keyboard.
- Positive values, negative values, and decimal points are accepted.

Table Match (MI)

- Students check boxes within the cells of a table to make identifications, classifications, or predictions.
- Students are informed when a row or column may be checked once, more than once, or not at all.
Scoring Rubric Development Guidelines

- An item-specific scoring rubric will be developed for each ETC, HT, SIM, TI, MI, and SA during the writing of the item.
- Scoring rubrics will not consider conventions of writing (complete sentences, usage/grammar, spelling, capitalization, punctuation, and paragraphing).
- Scoring rubrics will be edited during field test rangefinding and rubric validation based on student responses.
- Scoring rubrics may be edited during operational rangefinding based on student responses.

Multipart Items

Some items are divided into multiple parts. Typically, this includes two parts (part A and part B). Item parts are mutually reinforcing and strengthen alignment to a PE.

Multipart items can use different types of interactions in each part (e.g., an MC followed by an ETC). One example of this approach would be an item that asks a student to evaluate a claim in part A, and then in part B asks the student to identify how a particular trend in data or piece of evidence supports their evaluation of that claim.

Multipart items can be scored collectively, with each part contributing toward a single point, or separately, with each part earning a single point.

When assessed in an item that does not have multiple parts, the following score points are typically assigned for each item type:
- ETC, HT, MC, MS, SIM, TI, and MI items are worth 1 point.
- GI and SA items are worth 1 or 2 points.
Test Design

Operational Test Form
Each operational test form will contain the same items in a given year. This is known as a “fixed form test,” which is unlike the “adaptive” Smarter Balanced test. Approximately 33% of the points of the test are anchored or linking items with established item calibrations from previous years.

The operational component of the WCAS counts toward a student’s score and is composed of five clusters and six to twelve standalone items.

In addition:

- One PE from each domain (ESS, PS, LS, and ETS) is included in at least one item cluster.
- A minimum of three different SEPs are included across the clusters.
- A minimum of three different CCCs are included across the clusters.
- Standalone items will increase DCI, SEP, and CCC coverage to achieve overall expectations.

Field Test Items
Operational test forms will contain embedded field test items, which will either be a set of items associated with a cluster or a group of standalone items. Several clusters and/or standalone items will be field tested in a given administration. The field test items will not contribute to the student’s score.

Testing Times
The WCAS is intended to be administered online in one to three sessions. The approximate 120-minute administration time includes 30 minutes for giving directions and distributing materials, 75 minutes for the operational form, and 15 minutes for the embedded field test. Contact your district testing coordinator for further information on the specific test schedule for your district or building.

Online Calculator
A calculator is embedded in the online platform for all items in the WCAS. Students should be familiar with the functionality of the calculator prior to using it on the assessment. The calculator is available online and as an app for practice. In grade 5, students use a basic four-function calculator. In grades 8 and high school, students use a scientific calculator.

Tools, Supports, and Accommodations
The WCAS may be taken with or without tools, supports, or accommodations. Tools are available to all students and can be used at the student's discretion. Supports are available to English language learners and any student with a need identified by an educator. Accommodations are for students who receive special education services with a documented need noted in an IEP or 504 plan. More information is available in the Guidelines on Tools, Supports, & Accommodations which can be downloaded from the WCAP Portal.
Test Blueprint

The total number of points for the WCAS at grade 5 will be 35 points. The point percentages of the WCAS reflect the percentages of the PEs per domain within the standards.

The Engineering, Technology, and Applications of Science (ETS) domain will not be represented by a separate item cluster, but will be bundled in at least one item cluster with one or more PEs from the Physical Sciences (PS), Life Sciences (LS), or Earth and Space Sciences (ESS) domain. ETS points are not specified, and ETS PEs were not included when calculating the percentages in Table 1.

Table 1 specifies the percentage and point ranges of the WCAS in reference to the reporting claims.

<table>
<thead>
<tr>
<th>Reporting Area</th>
<th>Percentage of PEs per Science Domain in the Standards</th>
<th>Percentage Range for the WCAS per Science Domain</th>
<th>Score Point Range for the WCAS per Science Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practices and Crosscutting Concepts in Physical Sciences</td>
<td>40%</td>
<td>35–45%</td>
<td>12–16</td>
</tr>
<tr>
<td>Practices and Crosscutting Concepts in Life Sciences</td>
<td>29%</td>
<td>25–35%</td>
<td>8–12</td>
</tr>
</tbody>
</table>

Two grade 5 test forms were administered in Spring 2018. The points for a few reporting areas fell slightly outside of the score point range due to the limited size of the item bank. Forms for the 2019 WCAS and beyond will meet all reporting area ranges.
Washington Standards Overview

The WCAS is designed to align to the standards in a way that honors the original intent of the document *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (2012) and supports Washington educators in their interpretation of assessment results, instructional design, and classroom practice. This section discusses the structure and usage of PEs as a guiding framework for the development of the WCAS item specifications.

Performance Expectations

The standards are organized into Performance Expectations (PEs). Each PE provides a statement of what students should be able to do by the end of instruction. There are 45 PEs for grades 3–5, 59 PEs for middle school, and 71 PEs for high school. The PEs are further categorized by grade or grade band (K, 1, 2, 3, 4, 5, MS, HS) and by domain: Physical Sciences (PS); Life Sciences (LS); Earth and Space Sciences (ESS); and Engineering, Technology, and Applications of Science (ETS).

Identifying a PE

Each PE is identified by a three-part PE code. The first set of letters or numbers indicates the grade level (or grade band) of the PE (e.g., HS for high school). The middle set of letters and numbers in a PE code refers to an overarching organizing concept that is developed across grades. For example, in MS-ESS1-2, “ESS1” refers to “Earth’s Place in the Universe.”

Finding Related PEs

Searching the NGSS website for an organizing concept will pull up a complete list of associated PEs at the given grade level. For example, searching the website for MS-ESS1 will pull up a list of associated PEs at the middle school level (MS-ESS1-1 through MS-ESS1-4). Substituting another grade level for “MS” will pull up a complete list of standards related to “Earth’s Place in the Universe” for any other grade level. This strategy is helpful for understanding where a particular PE fits in a learning progression, and it can provide insight into the assessable boundaries of a PE.

PE Structure

Each PE starts with the PE statement, which is a brief synopsis of the performance the PE is meant to address. Each PE statement incorporates the three dimensions of the NGSS framework: one or more Science and Engineering Practices (SEPs), one or more Disciplinary Core Ideas (DCIs), and one or more Crosscutting Concepts (CCCs). The PE statement can provide some insight as to how students are expected to utilize the SEPs, DCIs, and CCCs together to achieve the PE.

Clarification Statements and Assessment Boundaries

The PE statement may be followed by a clarification statement and/or an assessment boundary. When present, the clarification statement supplies examples or additional clarification to the PE. The assessment boundaries are meant to specify limits for large-scale assessment of a PE. They are not meant to limit what can or should be taught or how it is taught. The main function of an assessment boundary statement is to provide guidance to assessment developers.
Dimensions—SEPs, DCIs, and CCCs

Science and Engineering Practices
The standards include a total of eight SEPs that develop across grade levels and grade bands:

1. Asking Questions and Defining Problems
2. Developing and Using Models
3. Planning and Carrying Out Investigations
4. Analyzing and Interpreting Data
5. Using Mathematical and Computational Thinking
6. Constructing Explanations and Designing Solutions
7. Engaging in Argument from Evidence
8. Obtaining, Evaluating, and Communicating Information

For the standards and the WCAS Item Specifications, the SEP statement is presented in the leftmost column inside a blue box. Each SEP statement contains a particular skill or practice from a particular grade level, as determined by the PE. Bulleted text under the grade-level description of the SEP presents a subskill associated with the specific PE. Additional details on the subskills and their progressions across grade bands can be found in NGSS Appendix F.

Disciplinary Core Ideas
Science knowledge is represented as a collection of disciplinary core ideas, which have been explicitly developed in grade-level progressions. For the standards and the WCAS Item Specifications, the DCI statement is presented in the central column, inside an orange box. The number of DCIs is intentionally limited, so as to allow deeper exploration and eventual proficiency of key concepts as students broaden and deepen their understanding of science. The sum total of all DCIs is not meant to be an exhaustive list of all topics that should be taught in a science classroom. Rather, DCIs provide for links among classroom lesson or activity topics at a high level.

To build the links, DCIs are broken up into several groups within three primary domains: Life Sciences (LS), Physical Sciences (PS), and Earth and Space Sciences (ESS). The Engineering, Technology, and Applications of Science (ETS; also sometimes called Engineering Design) DCIs are treated somewhat differently from the other DCIs in that they appear in separate ETS PEs.

For the standards and the WCAS Item Specifications, the DCI statement is presented in the central column, inside an orange box. Each DCI statement contains key ideas appropriate to a particular grade level, as determined by the PE. Bulleted text under the grade-level description of the DCI presents ideas and understandings associated with the specific DCI. Additional details on these ideas and understandings and their progressions across grade bands can be found in NGSS Appendix E.
Crosscutting Concepts
The standards contain seven CCCs that progress throughout each grade level and grade band. The seven CCCs are:

1. Patterns
2. Cause and Effect
3. Scale, Proportion, and Quantity
4. Systems and System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

For the standards and the WCAS Item Specifications, the CCC statement is presented in the rightmost column, inside a green box. Bulleted text under the grade-level description of the CCC presents sub-concepts associated with the specific PE. Additional details on these sub-concepts and their progressions across grade bands can be found in NGSS Appendix G.

Evidence Statements
OSPI uses the NGSS evidence statements to guide development of two- and three-dimensional items. The evidence statements were designed to support a granular analysis of proficiency with specific PEs, via an explicit articulation of how students can use SEPs to demonstrate their understanding of DCIs through the lens of the CCCs. They do this by clarifying several important details related to the three dimensions:

- How the three dimensions can be assessed together, rather than in independent units
- The underlying knowledge required to develop each DCI
- The detailed approaches to application of the SEP
- How CCCs might be used to deepen content understanding and practice-driven learning

Evidence statements are written primarily from the focus of the SEP dimension. Therefore, developing two-dimensional items aligned to a DCI and a CCC sometimes requires moving entirely outside the scope of the evidence statement. With that said, it is also acceptable to write items to a particular part of an evidence statement (e.g., leaving the SEP portion of the evidence statement out of the item design and writing only to the CCC and DCI elements). Aligning an item to a combination of evidence statements is also permissible, and is often done when items leverage the complexity of real-world scientific phenomena.

NGSS Progressions Appendices
When working to establish learning progressions or continuity and growth of skills across grade levels, educators will find value in the NGSS progressions appendices (see the “Resources” section). Organized by dimension (SEP, DCI, and CCC), the appendices present detailed learning progressions and comparisons of various skills and competencies across grade levels.

The WCAS Item Specifications use the NGSS progressions appendices in unpacking PE dimension statements to reveal and incorporate elements from a given learning progression. For example, consider a grade 4 PE that lists Planning and Carrying Out Investigations as its SEP dimension and has bulleted text that focuses on making observations. According to the NGSS learning progressions, making observations may be expanded within grade 4 to also include elements of planning, prediction, or evaluations of a fair test. Therefore, from an assessment perspective, items written using these linked subskills still align to the SEP.
## Resources

<table>
<thead>
<tr>
<th><strong>Resource</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>K–12 Framework</strong></td>
<td>Provides information about the foundational principles that were used to develop the NGSS.</td>
</tr>
<tr>
<td><strong>SAIC Assessment Framework</strong></td>
<td>Provides options and rationales for development of high-quality, NGSS-aligned summative assessment items.</td>
</tr>
<tr>
<td><strong>SAIC Prototype Item Cluster</strong></td>
<td>Demonstrates a three-dimensional NGSS-aligned item cluster using a variety of stimuli and innovative item types.</td>
</tr>
<tr>
<td><strong>Developing Assessments for the Next Generation Science Standards</strong></td>
<td>Provides guidance on an approach to science assessment that supports the vision of the NGSS.</td>
</tr>
<tr>
<td><strong>NGSS Appendix E</strong></td>
<td>Includes tables showing the DCI progressions by grade level.</td>
</tr>
<tr>
<td><strong>NGSS Appendix F</strong></td>
<td>Includes tables showing the SEP progressions by grade level.</td>
</tr>
<tr>
<td><strong>NGSS Appendix G</strong></td>
<td>Includes tables showing the CCC progressions by grade level.</td>
</tr>
<tr>
<td><strong>NGSS Evidence Statements</strong></td>
<td>Provides additional detail on what students should know and be able to do based on performance expectations.</td>
</tr>
</tbody>
</table>
References


WCAS Item Specifications

Introduction
The science assessment team at OSPI has been working with assessment research and development partners to create assessment item specifications that support multidimensional item development, and assist teachers in their interpretation of WCAS assessment data. The following two pages present a sample of one such item specification.

The WCAS Item Specifications are a guiding framework that is built to evolve and change; OSPI will revise them as needed, in collaboration with teachers and other stakeholders. While the item specifications are not intended to dictate curricula in any way, examples of science topics or contexts within the scope of the PE may occasionally be provided in the details and clarifications section. Such examples will be noted in parenthetical remarks after a particular clarification, and denoted with the convention “e.g.”

The first page of a WCAS item specification consolidates key information under the same PE code used by the corresponding standard in the NGSS. It also directs users to pertinent pages in the K–12 Framework and the NGSS progressions appendices for each dimension (SEP, DCI, or CCC). The first page also presents any clarification statements or assessment boundaries associated with the PE. Items in the grade 5 WCAS use language targeted to the previous grade or lower readability with the exception of the expected science terms. A list of expected SEP, DCI, and CCC vocabulary is included at the end of this document.

The second page of each item specification presents four alignment codes for the PE. These codes identify the various combinations of PE dimensions that can be measured using a multidimensional item. Additionally, each item specification includes a list of details and clarifications that help unpack the elements used to determine item alignment.

For example, when using the WCAS Item Specifications, an item with an alignment code of 4-LS1-1.2 indicates that the item aligns to both the SEP and DCI dimensions of the PE 4-LS1-1. The item specification suggests that this type of item will involve making observations of specific types of evidence related to the DCI. The Details and Clarifications section lists types of observations that are permissible under this PE, as well as the forms of evidence that are within the bounds of the PE.

As stated earlier in this document, item specifications will be updated annually based on input from Washington educators. Future drafts will include a modification log that will be updated at each subsequent publication.
Physical Sciences

Disciplinary Core Ideas:

- PS1 Matter and Its Interactions
- PS2 Motion and Stability: Forces and Interactions
- PS3 Energy
- PS4 Waves and Their Applications in Technologies for Information Transfer
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>5-PS1-1 Develop a model to describe that matter is made of particles too small to be seen.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td></td>
</tr>
</tbody>
</table>
| Science & Engineering Practices | Developing and Using Models  
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.  
• Use models to describe phenomena. |
• Matter of any type can be subdivided into particles that are too small to see, but even then, the matter still exists and can be detected by other means.  
A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. |
| Crosscutting Concepts  | Scale, Proportion, and Quantity  
• Natural objects exist from the very small to the immensely large. |

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>pp. 106–108</td>
<td></td>
<td></td>
<td></td>
<td>pp. 6–7</td>
</tr>
</tbody>
</table>

Clarification Statement

Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.

Assessment Boundary

Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.
<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-PS1-1.1</td>
<td>SEP-DCI-CCC</td>
<td>Develop and/or use a model to provide evidence that matter can be subdivided into particles that are at a scale that is too small to be seen.</td>
</tr>
<tr>
<td>5-PS1-1.2</td>
<td>SEP-DCI</td>
<td>Develop and/or use a model to describe evidence of matter that can be subdivided into particles that are too small to be seen.</td>
</tr>
<tr>
<td>5-PS1-1.3</td>
<td>DCI-CCC</td>
<td>Use the concept of scale to connect matter large enough to be seen to matter subdivided into particles too small to be seen.</td>
</tr>
<tr>
<td>5-PS1-1.4</td>
<td>SEP-CCC</td>
<td>Develop and/or use a model to describe the scale of matter.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Develop and/or use** a model is expanded to include:
  - revising a complete or partial model
  - comparing complete or partial models
  - using a model to describe a scientific principle
  - using a model to describe a process
  - using a model to make predictions

- **Models** that describe evidence of matter made up of particles too small to be seen may include, but are NOT limited to:
  - diagram, simulation, and/or description of solid material dissolving into a liquid
  - diagram, simulation, and/or description of how adding particles of gas can cause an increase in the volume of an elastic container
  - diagram, simulation, and/or description showing bulk matter is made up of much smaller particles

- **Scale** may include, but is NOT limited to:
  - observation that macroscopic scale matter can be very large
  - observation that microscopic scale matter or parts of larger matter can be too small to be seen
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>5-PS1-2 Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.</td>
<td>Using Mathematics and Computational Thinking Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.</td>
<td>PS1.A: Structure and Properties of Matter • The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.</td>
<td>Scale, Proportion, and Quantity • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.</td>
</tr>
<tr>
<td></td>
<td>PS1.B: Chemical Reactions • No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.)</td>
<td>Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems • Science assumes consistent patterns in natural systems.</td>
<td></td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F</td>
<td>Appendix E</td>
<td>Appendix G</td>
<td>Appendix H</td>
</tr>
<tr>
<td>Clarification Statement</td>
<td>Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment Boundary</td>
<td>Assessment does not include distinguishing mass and weight.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Alignment</td>
<td>Item Specification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
<td>------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-PS1-2.1</td>
<td>SEP-DCI-CCC</td>
<td>Measure and/or graph quantities using standard units to provide evidence that regardless of the type of change that occurs, the total mass of matter is conserved.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-PS1-2.2</td>
<td>SEP-DCI</td>
<td>Measure and/or graph quantities to provide evidence that regardless of the type of change that occurs, the total mass of matter is conserved.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-PS1-2.3</td>
<td>DCI-CCC</td>
<td>Use standard units to provide evidence that regardless of the type of change that occurs, the total mass of matter is conserved.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-PS1-2.4</td>
<td>SEP-CCC</td>
<td>Measure and/or graph quantities using standard units to compare objects and/or events.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Measure and/or graph quantities** is expanded to include:
  - using mathematics to represent variables and their relationships
  - measuring, comparing, and/or organizing quantitative attributes (e.g., area, volume, mass) to reveal patterns that suggest relationships
  - graphing quantities to address scientific questions and/or problems

- Examples of the type of change that occurs may include, but are NOT limited to:
  - heating
  - cooling
  - change in state
  - mixing substances, resulting in a mixture (physical change)
  - mixing substances, resulting in new substances (chemical change)

- Evidence of the total mass of matter being conserved may include, but is NOT limited to:
  - total mass of substances staying the same regardless of the type of change
  - total mass of substances staying the same regardless of a change in qualitative properties (e.g., sugar dissolving in water)

- **Standard units** may include, but are NOT limited to:
  - gram
  - kilogram
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>5-PS1-3 Make observations and measurements to identify materials based on their properties.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions</strong></td>
<td><strong>Science &amp; Engineering Practices</strong></td>
</tr>
<tr>
<td></td>
<td>Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.</td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F</td>
<td>Appendix E p. 7</td>
<td>Appendix G pp. 6–7</td>
</tr>
</tbody>
</table>

**Clarification Statement**

Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.

**Assessment Boundary**

Assessment does not include density or distinguishing mass and weight.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-PS1-3.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Make observations</strong> and/or <strong>measurements</strong> using <strong>standard units</strong> to identify <strong>materials</strong> based on their <strong>properties</strong>.</td>
</tr>
<tr>
<td>5-PS1-3.2</td>
<td>SEP-DCI</td>
<td><strong>Make observations</strong> and/or <strong>measurements</strong> to identify <strong>materials</strong>.</td>
</tr>
<tr>
<td>5-PS1-3.3</td>
<td>DCI-CCC</td>
<td>Identify <strong>materials</strong> based on <strong>properties</strong> measured and/or described in <strong>standard units</strong>.</td>
</tr>
<tr>
<td>5-PS1-3.4</td>
<td>SEP-CCC</td>
<td><strong>Make observations</strong> and/or <strong>measurements</strong> using standard units.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Make observations** and/or **measurements** is expanded to include:
  - identifying relevant variables and/or data to be gathered in an investigation
  - describing appropriate methods and/or tools to collect data
  - collecting data that can be used to support an explanation, make comparisons, and/or make predictions

- **Properties** of **materials** may include, but are NOT limited to:
  - mass
  - volume
  - temperature
  - color
  - hardness
  - reflectivity
  - electrical conductivity
  - thermal conductivity
  - response to magnetic forces
  - solubility

- **Examples of standard units** may include, but are NOT limited to:
  - kilograms
  - liters
  - Celsius
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>5-PS1-4 Conduct an investigation to determine whether the mixing of two or more substances results in new substances.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science &amp; Engineering Practices</strong></td>
<td><strong>Disciplinary Core Ideas</strong></td>
</tr>
<tr>
<td>Planning and Carrying Out Investigations</td>
<td>PS1.B: Chemical Reactions</td>
</tr>
<tr>
<td>Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</td>
<td>• When two or more different substances are mixed, a new substance with different properties may be formed.</td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F</td>
<td>Appendix E</td>
<td>Appendix G</td>
</tr>
<tr>
<td>pp. 7–8</td>
<td>p. 7</td>
<td>pp. 5–6</td>
<td></td>
</tr>
</tbody>
</table>

Clarification Statement: A clarification statement is not provided for this PE.

Assessment Boundary: An assessment boundary is not provided for this PE.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-PS1-4.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Plan and/or conduct an investigation</strong> to produce <strong>evidence</strong> of <strong>cause and effect</strong> relationships to determine whether the <strong>mixing</strong> of two or more <strong>substances</strong> results in <strong>new substances</strong>.</td>
</tr>
<tr>
<td>5-PS1-4.2</td>
<td>SEP-DCI</td>
<td><strong>Plan and/or conduct an investigation</strong> to produce <strong>evidence</strong> to determine whether the <strong>mixing</strong> of two or more <strong>substances</strong> results in <strong>new substances</strong>.</td>
</tr>
<tr>
<td>5-PS1-4.3</td>
<td>DCI-CCC</td>
<td>Use <strong>cause and effect</strong> relationships to determine whether the <strong>mixing</strong> of two or more <strong>substances</strong> results in <strong>new substances</strong>.</td>
</tr>
<tr>
<td>5-PS1-4.4</td>
<td>SEP-CCC</td>
<td><strong>Plan and/or conduct an investigation</strong> to produce evidence of cause and effect relationships.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Plan and/or conduct an investigation** is expanded to include:
  - identifying relevant variables and/or data to be gathered in an investigation
  - describing appropriate methods and/or tools to collect data
  - collecting data that can be used to support an explanation, make comparisons, and/or make predictions

- Examples of **evidence of cause and effect** relationships include, but are NOT limited to:
  - quantitative properties (e.g., mass, volume, temperature) of substances before and after mixing
  - qualitative properties (e.g., state of matter, color, texture, odor, conductivity, solubility, response to magnetic forces) before and after mixing

- Examples of the **mixing** of two or more **substances** resulting in **new substances** may include, but are NOT limited to:
  - Mixing water and iron forms rust.
  - Mixing baking soda and vinegar forms carbon dioxide gas.
  - Mixing water and detergent results in a temperature increase.
### Performance Expectation

| 3-PS2-1 | Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. |

#### Science & Engineering Practices

**Planning and Carrying Out Investigations**

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

#### Crosscutting Concepts

**Cause and Effect**

- Cause and effect relationships are routinely identified.

<table>
<thead>
<tr>
<th>Disciplinary Core Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PS2.A: Forces and Motion</strong></td>
</tr>
<tr>
<td>- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object’s speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.)</td>
</tr>
</tbody>
</table>

| **PS2.B: Types of Interactions** |
| - Objects in contact exert forces on each other. |

These item specifications were developed using the following reference materials:

- **K-12 Framework**
  - pp. 59–61
  - pp. 114–118
  - pp. 87–89

- **NGSS Appendices**
  - Appendix F
  - pp. 7–8
  - Appendix H
  - pp. 5
  - Appendix E
  - p. 7
  - Appendix G
  - pp. 5–6

### Clarification Statement

Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.

### Assessment Boundary

Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-PS2-1.1</td>
<td>SEP-DCI-CCC</td>
<td>Plan and/or conduct an investigation to produce evidence of cause and effect relationships between the forces acting on an object and the motion of an object.</td>
</tr>
<tr>
<td>3-PS2-1.2</td>
<td>SEP-DCI</td>
<td>Plan and/or conduct an investigation to produce evidence of the forces acting on an object and/or the motion of an object.</td>
</tr>
<tr>
<td>3-PS2-1.3</td>
<td>DCI-CCC</td>
<td>Use cause and effect relationships to connect the forces acting on an object and the motion of an object.</td>
</tr>
<tr>
<td>3-PS2-1.4</td>
<td>SEP-CCC</td>
<td>Plan and/or conduct an investigation to produce evidence of cause and effect relationships between objects.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Plan** and/or conduct an investigation is expanded to include:
  - identifying relevant variables and/or data to be gathered in an investigation
  - describing appropriate methods and/or tools to collect data
  - collecting data that can be used to support an explanation, make comparisons, and/or make predictions

- **Evidence** of a change in motion may include, but is NOT limited to:
  - change in an object’s speed (e.g., slowing down, speeding up)
  - change in an object’s direction (e.g., up, down, left, right)

- **Forces** may include, but are NOT limited to:
  - a push
  - a pull
  - gravity

- **Cause and effect** relationships between force and motion may include, but are NOT limited to:
  - the force of gravity pulls an object towards Earth’s center
  - balanced forces acting on an object will result in an object’s motion staying constant
  - unbalanced forces acting on an object will result in an object’s motion changing
  - applying different strengths and/or directions of force on an object at rest will result in motion
  - applying different strengths and/or directions of force on an object in motion will result in a change in motion
  - when objects exert forces on each other (e.g., collide), their motions change
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>5-PS2-1</td>
<td>Engaging in Argument from Evidence</td>
<td>PS2.B: Types of Interactions</td>
<td>Cause and Effect</td>
</tr>
<tr>
<td></td>
<td>Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</td>
<td>• The gravitational force of Earth acting on an object near Earth’s surface pulls that object toward the planet’s center.</td>
<td>• Cause and effect relationships are routinely identified and used to explain change.</td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F</td>
<td>Appendix E p. 7</td>
<td>Appendix G pp. 5–6</td>
</tr>
<tr>
<td>Clarification Statement</td>
<td>“Down” is a local description of the direction that points toward the center of the spherical Earth.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment Boundary</td>
<td>Assessment does not include mathematical representation of gravitational force.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-PS2-1.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Support an argument</strong>, using <em>cause and effect</em> relationships, that the gravitational force exerted by Earth on objects is directed toward Earth’s center.</td>
</tr>
<tr>
<td>5-PS2-1.2</td>
<td>SEP-DCI</td>
<td><strong>Support an argument</strong> that the gravitational force exerted by Earth on objects is directed toward Earth’s center.</td>
</tr>
<tr>
<td>5-PS2-1.3</td>
<td>DCI-CCC</td>
<td>Use <em>cause and effect</em> relationships to describe that the gravitational force exerted by Earth on objects is directed toward Earth’s center.</td>
</tr>
<tr>
<td>5-PS2-1.4</td>
<td>SEP-CCC</td>
<td><strong>Support an argument</strong> using <em>cause and effect</em> relationships.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Support an argument** is expanded to include:
  - using evidence to support an argument and/or a claim
  - developing an argument and/or making a claim based on evidence, data, and/or a simple model
  - distinguishing between observations and inferences in an explanation and/or argument
  - comparing and/or refining arguments and/or claims based on evidence
  - using evidence to make a claim about the merit of a solution to a problem by describing how well the solution meets the criteria and/or the constraints of a problem

- **Cause and effect** relationships may include, but are NOT limited to:
  - Earth is spherical, so dropped objects appear to fall straight down at all locations on Earth.
  - An object that is initially stationary when held above the ground moves downward when it is released, so there must be a force acting on the object.
  - Earth is spherical and all objects appear to fall straight down, so objects fall toward Earth’s center.
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>3-PS2-2 Make observations and/or measurements of an object’s motion to provide evidence that a pattern can be used to predict future motion.</th>
</tr>
</thead>
</table>

| Dimensions |  
|------------|---------------------------------------------------------------|------------------------|----------------------|
|            | Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. | PS2.A: Forces and Motion | Patterns |
|            | • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. | • The patterns of an object’s motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) | • Patterns of change can be used to make predictions. |
|            | Connections to Nature of Science | Science Knowledge is Based on Empirical Evidence | |
|            | • Science findings are based on recognizing patterns. | |

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
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<td>Appendix E</td>
<td>Appendix G</td>
</tr>
<tr>
<td></td>
<td>pp. 7–8</td>
<td>p. 7</td>
<td>pp. 3–5</td>
</tr>
<tr>
<td></td>
<td>Appendix H</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>p. 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.

Assessment Boundary: Assessment does not include technical terms such as period and frequency.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-PS2-2.1</td>
<td>SEP-DCI-CCC</td>
<td>Make observations and/or measurements of an object’s motion to provide evidence of patterns that can be used to predict future motion.</td>
</tr>
<tr>
<td>3-PS2-2.2</td>
<td>SEP-DCI</td>
<td>Make observations and/or measurements of an object’s motion to provide evidence that can be used to predict future motion.</td>
</tr>
<tr>
<td>3-PS2-2.3</td>
<td>DCI-CCC</td>
<td>Use patterns in an object’s motion to predict future motion.</td>
</tr>
<tr>
<td>3-PS2-2.4</td>
<td>SEP-CCC</td>
<td>Make observations and/or measurements to provide evidence that patterns of change can be used to make predictions.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Make observations and/or measurements** is expanded to include:
  - identifying relevant variables and/or data to be gathered in an investigation
  - describing appropriate methods and/or tools to collect data
  - collecting data that can be used to support an explanation, make comparisons, and/or make predictions

- **Observations and/or measurements** that provide evidence may include, but are NOT limited to:
  - speed of an object’s motion
  - direction of an object’s motion
  - path of an object’s motion
  - changes in the speed, direction, and/or path of an object’s motion

- **Examples of patterns of an object’s motion** that can be used to predict future motion may include, but are NOT limited to:
  - a swinging pendulum
  - a child swinging on a swing
  - a bouncing ball
  - a ball rolling back and forth in bowl
  - a rocking chair
  - the movement of hands on a clock
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>3-PS2-3 Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science &amp; Engineering Practices</strong></td>
<td><strong>Disciplinary Core Ideas</strong></td>
</tr>
</tbody>
</table>
| Asking Questions and Defining Problems | PS2.B: Types of Interactions  
- Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. | Cause and Effect  
- Cause and effect relationships are routinely identified, tested, and used to explain change. |
| **Dimensions** | **Clarification Statement** | Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force. |
| These item specifications were developed using the following reference materials: | **Assessment Boundary** | Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity. |
| K-12 Framework | Appendix F  
pp. 4–5 | Appendix G  
pp. 5–6 |
| NGSS Appendices | Appendix E  
p. 7 | |
| pp. 54–56 | pp. 116–118 | pp. 87–89 |
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-PS2-3.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Ask questions</strong> that can be investigated using <strong>cause and effect</strong> relationships to determine that <strong>electric</strong> and/or <strong>magnetic forces</strong> between two objects do not require the objects to be in contact.</td>
</tr>
<tr>
<td>3-PS2-3.2</td>
<td>SEP-DCI</td>
<td><strong>Ask questions</strong> that can be investigated to determine that <strong>electric</strong> and/or <strong>magnetic forces</strong> between two objects do not require the objects to be in contact.</td>
</tr>
<tr>
<td>3-PS2-3.3</td>
<td>DCI-CCC</td>
<td>Use <strong>cause and effect</strong> relationships to determine that <strong>electric</strong> and/or <strong>magnetic forces</strong> can act between two objects that are not in contact.</td>
</tr>
<tr>
<td>3-PS2-3.4</td>
<td>SEP-CCC</td>
<td><strong>Ask questions</strong> that can be investigated to determine cause and effect relationships between two objects.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Ask questions** is expanded to include:
  - asking questions about what would happen if a variable is changed
  - asking and/or identifying questions that can be answered through observation and/or investigation
  - predicting the outcome of questions that can be answered through observation and/or investigation
  - asking questions about observations, data, claims, and/or proposed designs
  - defining a simple design problem that can be solved through the development of an object, tool, process, and/or system.
  - describing criteria for a successful solution
  - describing constraints on materials, time, and/or cost that could limit the success of a solution

- **Electric forces** may include:
  - forces between objects with opposite charges
  - forces between objects that have similar charges

- **Magnetic forces** may include:
  - forces between objects with opposite poles
  - forces between objects with similar poles

- **Cause and effect** relationships may include, but are NOT limited to:
  - objects with opposite charges and/or poles attract each other
  - objects with similar charges and/or poles repel each other
  - an electromagnet attracts magnetic objects
  - the strength of the force between two objects increases as the distance between the objects decreases
  - the magnetic force between two objects changes as the orientation of the objects in relation to each other changes
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>3-PS2-4 Define a simple design problem that can be solved by applying scientific ideas about magnets.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science &amp; Engineering Practices</strong></td>
<td><strong>Disciplinary Core Ideas</strong></td>
</tr>
<tr>
<td><strong>Asking Questions and Defining Problems</strong></td>
<td><strong>PS2.B: Types of Interactions</strong></td>
</tr>
<tr>
<td>Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.</td>
<td>• Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.</td>
</tr>
<tr>
<td>• Define a simple problem that can be solved through the development of a new or improved object or tool.</td>
<td></td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F</td>
<td>Appendix E</td>
<td>Appendix J</td>
</tr>
<tr>
<td>pp. 4–5</td>
<td>p. 7</td>
<td>p. 3</td>
<td></td>
</tr>
<tr>
<td>Clarification Statement</td>
<td>Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment Boundary</td>
<td>An assessment boundary is not provided for this PE.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-PS2-4.1</td>
<td>SEP-DCI-CCC</td>
<td>Define a simple design problem that can be solved by applying scientific ideas about magnetic forces between objects.</td>
</tr>
<tr>
<td>3-PS2-4.2</td>
<td>SEP-DCI</td>
<td>Define a simple design problem that can be solved using magnetic forces between objects.</td>
</tr>
<tr>
<td>3-PS2-4.3</td>
<td>DCI-CCC</td>
<td>Apply scientific ideas to magnetic forces between objects.</td>
</tr>
<tr>
<td>3-PS2-4.4</td>
<td>SEP-CCC</td>
<td>Define a simple design problem that can be solved by applying scientific ideas.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Define a simple design problem** is expanded to include:
  - asking questions about what would happen if a variable is changed
  - asking and/or identifying questions that can be answered through observation and/or investigation
  - predicting the outcome of questions that can be answered through observation and/or investigation
  - asking questions about observations, data, claims, and/or proposed designs
  - defining a simple design problem that can be solved through the development of an object, tool, process, and/or system
  - describing criteria for a successful solution
  - describing constraints on materials, time, and/or cost that could limit the success of a solution

- **Applying scientific ideas** may include, but is NOT limited to:
  - using scientific ideas to design a solution, such as:
    - the opposite poles of a magnet attracting each other
    - magnets that are not in contact exerting forces on each other
    - the force between two magnets decreasing as distance between them increases
  - using engineering processes to design a solution, like:
    - describing the desirable features for a solution (e.g., uses few materials, lightweight)
    - describing limitations to the success of a solution (e.g., “high cost,” “unsafe,” “noisy”)

- Using **magnetic forces** to solve a simple design problem may include, but is NOT limited to:
  - designing a way to open a door from a distance
  - designing a way to softly close a cupboard door
  - designing a way to hold two objects together
  - designing a way to pick up paperclips that have fallen on the floor
  - designing a way to organize safety pins so they do not get jumbled together
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td></td>
</tr>
</tbody>
</table>
| Science & Engineering Practices | Constructing Explanations and Designing Solutions  
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.  
• Use evidence (e.g., measurements, observations, patterns) to construct an explanation. | Disciplinary Core Ideas | PS3.A: Definitions of Energy  
• The faster a given object is moving, the more energy it possesses. |
| Crosscutting Concepts   | Energy and Matter  
• Energy can be transferred in various ways and between objects. |
| These item specifications were developed using the following reference materials: |                                                                                                        |
| K–12 Framework          | pp. 67–71                                                                                               |
| NGSS Appendices         | Appendix F  
pp. 11–12                                                                                              |
| Clarification Statement | A clarification statement is not provided for this PE.                                                   |
| Assessment Boundary     | Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy. |
**Items may ask students to:**

<table>
<thead>
<tr>
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<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-PS3-1.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Use evidence</strong> to construct an explanation <strong>relating</strong> the <strong>speed</strong> of an object to the <strong>energy</strong> of that object.</td>
</tr>
<tr>
<td>4-PS3-1.2</td>
<td>SEP-DCI</td>
<td><strong>Use evidence</strong> to construct an explanation about the <strong>speed</strong> of an object.</td>
</tr>
<tr>
<td>4-PS3-1.3</td>
<td>DCI-CCC</td>
<td>Connect concepts of <strong>energy</strong> to the <strong>speed</strong> of a moving object.</td>
</tr>
<tr>
<td>4-PS3-1.4</td>
<td>SEP-CCC</td>
<td><strong>Use evidence</strong> to construct an explanation that energy can be transferred in various ways and/or between objects.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Use evidence** is expanded to include:
  - using measurements, observations, and/or patterns to support an explanation
  - using measurements, observations, and/or patterns to generate and/or compare solutions to a problem
  - using evidence to design a solution to a problem
  - comparing solutions to a problem as to how well they meet criteria for success
  - comparing solutions in terms of constraints that limit the success of the solution

- **Relating** the **speed** of a object to the **energy** of that object may include, but is NOT limited to:
  - a faster-moving object having more energy than a slower-moving object
  - a slower-moving object having less energy than a faster-moving object
  - an object at rest having no motion energy

- Examples of **evidence** may include, but are NOT limited to:
  - a stationary object moving faster following a collision with a fast-moving object than following a collision with a slow-moving object
  - a stationary object moving farther following a collision with a fast-moving object than following a collision with a slow-moving object
  - the sound produced when fast-moving objects collide being louder than the sound produced when slow-moving objects
  - the amount of heat produced when a fast-moving object moves over a surface being greater than when a slow-moving object moves over a surface
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>5-PS3-1 Use models to describe that energy in animals’ food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science &amp; Engineering Practices</strong></td>
<td><strong>Disciplinary Core Ideas</strong></td>
</tr>
<tr>
<td>Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</td>
<td>• The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water).</td>
</tr>
<tr>
<td>• Use models to describe phenomena.</td>
<td><strong>LS1.C: Organization for Matter and Energy Flow in Organisms</strong></td>
</tr>
<tr>
<td></td>
<td>• Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary)</td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
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<td>Appendix E</td>
<td>Appendix G</td>
<td>Appendix G</td>
</tr>
<tr>
<td>p. 6</td>
<td>p. 8</td>
<td>pp. 8–9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Clarification Statement: Examples of models could include diagrams, and flow charts.

Assessment Boundary: An assessment boundary is not provided for this PE.
Items may ask students to:

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<tr>
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</thead>
<tbody>
<tr>
<td>5-PS3-1.1</td>
<td>SEP-DCI-CCC</td>
<td>Develop and/or use a model to describe that the energy in animals’ food was once energy from the sun and/or that energy can be transferred between organisms and/or that organisms use energy from food for life functions.</td>
</tr>
<tr>
<td>5-PS3-1.2</td>
<td>SEP-DCI</td>
<td>Develop and/or use a model to describe that the energy and matter in animals’ food can be used for life functions.</td>
</tr>
<tr>
<td>5-PS3-1.3</td>
<td>DCI-CCC</td>
<td>Track energy flow from the sun to animals’ food and/or between organisms and/or for maintaining for life functions.</td>
</tr>
<tr>
<td>5-PS3-1.4</td>
<td>SEP-CCC</td>
<td>Develop and/or use a model to describe that energy can be transferred among objects.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- Develop and/or use a model is expanded to include:
  - revising a complete or partial model
  - comparing complete or partial models
  - using a model to describe a scientific principle
  - using a model to describe a process
  - using a model to make predictions

- A model may include, but is NOT limited to:
  - diagram
  - flow chart
  - food web
  - description

- Examples of life functions may include, but are NOT limited to:
  - body repair
  - growth
  - motion
  - maintaining warmth

- Examples of energy transfer among organisms and the sun may include, but are NOT limited to:
  - plants capture energy from sunlight to produce food
  - sun → grass → deer (arrows represent energy)
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science &amp; Engineering Practices</strong></td>
<td><strong>Disciplinary Core Ideas</strong></td>
</tr>
</tbody>
</table>
| **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. | **PS3.A: Definitions of Energy**  
• Energy can be moved from place to place by moving objects, or through sound, light, or electric currents.  

**PS3.B: Conservation of Energy and Energy Transfer**  
• Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.  
• Light also transfers energy from place to place.  
• Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. | **Energy and Matter**  
• Energy can be transferred in various ways and between objects. |

These item specifications were developed using the following reference materials:

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<td>Appendix E</td>
<td>Appendix G</td>
</tr>
<tr>
<td>Clarification Statement</td>
<td>A clarification statement is not provided for this PE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment Boundary</td>
<td>Assessment does not include quantitative measurements of energy.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Items may ask students to:

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<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-PS3-2.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Make observations</strong> to serve as evidence that energy can be transferred from place to place by sound, light, heat, electric currents, and/or colliding objects.</td>
</tr>
<tr>
<td>4-PS3-2.2</td>
<td>SEP-DCI</td>
<td>Due to a strong overlap between the DCI and the CCC, items are not coded 4-PS3-2.2.</td>
</tr>
<tr>
<td>4-PS3-2.3</td>
<td>DCI-CCC</td>
<td>Use the concept of <strong>energy transfer</strong> to connect energy flow by sound, light, heat, electric currents, and/or colliding objects.</td>
</tr>
<tr>
<td>4-PS3-2.4</td>
<td>SEP-CCC</td>
<td><strong>Make observations</strong> to serve as evidence that energy can be transferred in various ways and/or between objects.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Make observations** is expanded to include:
  - identifying relevant variables and/or data to be gathered in an investigation
  - describing appropriate methods and/or tools to collect data
  - collecting data that can be used to support an explanation, make comparisons, and/or make predictions

- Types of **evidence** of **energy transfer** may include, but are NOT limited to:
  - presence of sound by hearing or using a sound meter or other recording device
  - presence of light by seeing or using a light meter, photography, or other method of recording light
  - presence of heat by feeling or measuring temperature change
  - presence of electric current by observing the sound, light, heat, and/or kinetic energy output from devices in a circuit
  - motion of objects before and after a collision

- **Energy transfers** may include, but are NOT limited to:
  - the transfer of sound energy from a vibrating object to the surrounding air
  - the transfer of light energy from a source of light to an object that absorbs light
  - the transfer of electric energy to produce motion, sound, heat, and/or light
  - the transfer of heat energy from a source of heat to the surrounding air or to an object
  - the transfer of kinetic energy between colliding objects
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>4-PS3-3 Ask questions and predict outcomes about the changes in energy that occur when objects collide.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science &amp; Engineering Practices</strong></td>
<td><strong>Disciplinary Core Ideas</strong></td>
</tr>
<tr>
<td>Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.</td>
<td>• Energy can be moved from place to place by moving objects or through sound, light, or electric currents.</td>
</tr>
<tr>
<td>• Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.</td>
<td>PS3.B: Conservation of Energy and Energy Transfer</td>
</tr>
<tr>
<td></td>
<td>• Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.</td>
</tr>
<tr>
<td></td>
<td>PS3.C: Relationship Between Energy and Forces</td>
</tr>
<tr>
<td></td>
<td>• When objects collide, the contact forces transfer energy so as to change the objects’ motions.</td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

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<tbody>
<tr>
<td>NGSS Appendices</td>
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<td>Appendix E</td>
<td>Appendix G</td>
<td></td>
</tr>
<tr>
<td>Clarification Statement</td>
<td>Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment Boundary</td>
<td>Assessment does not include quantitative measurements of energy.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Items may ask students to:

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<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-PS3-3.1</td>
<td>SEP-DCI-CCC</td>
<td>Ask questions and/or <strong>predict</strong> outcomes about the <strong>transfers</strong> and/or changes in <strong>energy</strong> that occur when objects <strong>collide</strong>.</td>
</tr>
<tr>
<td>4-PS3-3.2</td>
<td>SEP-DCI</td>
<td>Ask questions and/or <strong>predict</strong> outcomes when objects <strong>collide</strong>.</td>
</tr>
<tr>
<td>4-PS3-3.3</td>
<td>DCI-CCC</td>
<td>Connect the changes in motion of objects to <strong>transfers</strong> and/or changes in <strong>energy</strong> that occur during <strong>collisions</strong> between objects.</td>
</tr>
<tr>
<td>4-PS3-3.4</td>
<td>SEP-CCC</td>
<td>Ask questions and/or <strong>predict</strong> outcomes about energy transfers.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Ask questions** is expanded to include:
  - asking questions about what would happen if a variable is changed
  - asking and/or identifying questions that can be answered through observation and/or investigation
  - predicting the outcome of questions that can be answered through observation and/or investigation
  - asking questions about observations, data, claims, and/or proposed designs
  - defining a simple design problem that can be solved through the development of an object, tool, process, and/or system
  - describing criteria for a successful solution
  - describing constraints on materials, time, and/or cost that could limit the success of a solution

- Examples of **questions** about **transfers** and/or changes in **energy** when objects **collide** may include, but are NOT limited to:
  - Does the motion energy of object 1 increase or decrease after object 1 collides with object 2?
  - Which object (object 2, object 3, object 4) transfers the most motion energy to object 1 during a collision?

- **Predictions** about **transfers** and/or changes in **energy** when objects **collide** may include, but are NOT limited to:
  - The speed of an object will increase due to a collision.
  - An object will reverse direction due to a collision.
  - Sound energy and/or heat will be transferred when two objects collide.
### Performance Expectation

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constructing Explanations and Designing Solutions</strong>&lt;br&gt;Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</td>
<td><strong>PS3.B: Conservation of Energy and Energy Transfer</strong>&lt;br&gt;• Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.</td>
<td><strong>Energy and Matter</strong>&lt;br&gt;• Energy can be transferred in various ways and between objects.</td>
</tr>
<tr>
<td></td>
<td><strong>PS3.D: Energy in Chemical Processes and Everyday Life</strong>&lt;br&gt;• The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use.</td>
<td><strong>Connections to Engineering, Technology, and Applications of Science</strong>&lt;br&gt;<strong>ETS1.A: Defining Engineering Problems</strong>&lt;br&gt;• Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (secondary)</td>
</tr>
</tbody>
</table>

### Dimensions

- **Energy and Matter**
- **Connections to Engineering, Technology, and Applications of Science**
- **Connections to Nature of Science**
- **Science is a Human Endeavor**

### Clarification Statement

Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.

### Assessment Boundary

Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.
## Item Specifications

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>4-PS3-4.1</td>
<td>SEP-DCI-CCC</td>
<td>Apply scientific ideas to solve a design problem that includes an energy conversion.</td>
</tr>
<tr>
<td>4-PS3-4.2</td>
<td>SEP-DCI</td>
<td>Apply scientific ideas to describe how well a proposed solution meets the specified criteria and/or constraints of a design problem.</td>
</tr>
<tr>
<td>4-PS3-4.3</td>
<td>DCI-CCC</td>
<td>Describe energy conversions in a system.</td>
</tr>
<tr>
<td>4-PS3-4.4</td>
<td>SEP-CCC</td>
<td>Apply scientific ideas to solve a design problem that involves energy.</td>
</tr>
</tbody>
</table>

### Details and Clarifications

- **Apply scientific ideas to solve a design problem** is expanded to include:
  - using measurements, observations, and/or patterns to support an explanation
  - using measurements, observations, and/or patterns to generate and/or compare solutions to a problem
  - using evidence to design a solution to a problem
  - comparing solutions to a problem as to how well they meet criteria for success
  - comparing solutions in terms of constraints that limit the success of the solution

- **Solve a design problem** includes, but is NOT limited to:
  - designing, testing, and/or refining a device

  Examples of **criteria** for a successful solution may include, but are NOT limited to:
  - relatively high degree of safety
  - relatively high effectiveness in solving specific aspects of the given problem
  - relatively low cost
  - readily available materials
  - relatively short time needed to implement

  Examples of **constraints** that could limit the success of a solution may include, but are NOT limited to:
  - relative lack of safety
  - relative deficiency in solving specific aspects of the given problem
  - relatively high cost
  - materials that are difficult to acquire
  - relatively long period of time to implement

  Examples of a device that includes an energy conversion may include, but are NOT limited to:
  - light bulb converting electrical energy to light energy
  - a motor converting electrical energy to energy of motion
  - brakes converting motion energy to thermal energy
  - a spinning turbine transforming energy of motion in water to electric currents
|--------------------------|----------------------------------|------------------------|-----------------------|
| **4-PS4-1** Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. | **Developing and Using Models**  
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.  
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle. | **PS4.A: Wave Properties**  
- Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach.  
(****Note: This grade band endpoint was moved from K–2.**)  
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). | **Patterns**  
- Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena. |

**Dimensions**

**Connections to Nature of Science**

**Scientific Knowledge is Based on Empirical Evidence**  
- Science findings are based on recognizing patterns.

---

These item specifications were developed using the following reference materials:

|----------------|-----------|-------------|-----------|
| **NGSS Appendices** | Appendix F  
**p. 6**  
Appendix H  
**p. 5** | Appendix E  
**p. 8** | Appendix G  
**pp. 3–5** |

**Clarification Statement**

Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.

**Assessment Boundary**

Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-PS4-1.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Develop</strong> and/or <strong>use</strong> a <strong>model</strong> of waves to describe <strong>similarities</strong> and/or <strong>differences</strong> in <strong>patterns</strong> of amplitude and/or wavelength, and/or that waves can cause objects to move.</td>
</tr>
<tr>
<td>4-PS4-1.2</td>
<td>SEP-DCI</td>
<td><strong>Develop</strong> and/or <strong>use</strong> a <strong>model</strong> of waves to show <strong>patterns</strong> in amplitude and/or wavelength, and/or that waves can cause objects to move.</td>
</tr>
<tr>
<td>4-PS4-1.3</td>
<td>DCI-CCC</td>
<td>Connect <strong>similarities</strong> and/or <strong>differences</strong> in <strong>patterns</strong> of amplitude and/or wavelength to waves causing objects to move.</td>
</tr>
<tr>
<td>4-PS4-1.4</td>
<td>SEP-CCC</td>
<td><strong>Develop</strong> and/or <strong>use</strong> a <strong>model</strong> to describe the similarities and/or differences in patterns.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Develop** and/or **use** a **model** is expanded to include:
  - revising a complete or partial model
  - comparing complete or partial models
  - using a model to describe a scientific principle
  - using a model to describe a process
  - using a model to make predictions

- **Models** may include, but are NOT limited to:
  - diagrams
  - tables
  - descriptions

- **Similarities** and/or **differences** in **patterns** may include, but are NOT limited to:
  - similarities and/or differences in amplitude among waves
  - similarities and/or differences in wavelength among waves
  - similarities and/or differences in speed among waves
  - similarities and/or differences in the forces used to produce various water waves
  - similarities and/or differences in the motion of floating objects in water as various waves travel
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>4-PS4-2 Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.</th>
</tr>
</thead>
</table>
| **Dimensions**          | **Science & Engineering Practices**  
Developing and Using Models  
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.  
• Develop a model to describe phenomena.  
**Disciplinary Core Ideas**  
PS4.B: Electromagnetic Radiation  
• An object can be seen when light reflected from its surface enters the eyes.  
**Crosscutting Concepts**  
Cause and Effect  
• Cause and effect relationships are routinely identified. |
| **These item specifications were developed using the following reference materials:** |
| NGSS Appendices | Appendix F | Appendix E p. 8 | Appendix G pp. 5–6 |
| Clarification Statement | A clarification statement is not provided for this PE. |
| Assessment Boundary | Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works. |
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-PS4-2.1</td>
<td>SEP-DCI-CCC</td>
<td>Develop and/or use a model to describe the cause and effect relationships that allow objects to be seen when light reflecting from objects enters the eye.</td>
</tr>
<tr>
<td>4-PS4-2.2</td>
<td>SEP-DCI</td>
<td>Develop and/or use a model to describe that objects are seen when light reflecting from objects enters the eye.</td>
</tr>
<tr>
<td>4-PS4-2.3</td>
<td>DCI-CCC</td>
<td>Use cause and effect relationships to connect light reflecting from objects, light entering the eye, and objects being seen.</td>
</tr>
<tr>
<td>4-PS4-2.4</td>
<td>SEP-CCC</td>
<td>Develop and/or use a model to describe cause and effect relationships.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Develop and/or use a model** is expanded to include:
  - revising a complete or partial model
  - comparing complete or partial models
  - using a model to describe a scientific principle
  - using a model to describe a process
  - using a model to make predictions

- Components of a model may include, but are NOT limited to:
  - light source
  - light
  - object(s)
  - path of light
  - eye

- **Cause and effect** relationships that allow an object to be seen may include, but are NOT limited to:
  - a light source (e.g., sun, light bulb) giving off light
  - light reflecting off an object and traveling toward the eye
  - light entering the eye and allowing an object to be seen
  - light being blocked from entering the eye and preventing an object from being seen
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>4-PS4-3 Generate and compare multiple solutions that use patterns to transfer information.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions</strong></td>
<td><strong>Science &amp; Engineering Practices</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Constructing Explanations and Designing Solutions</strong></td>
</tr>
<tr>
<td></td>
<td>Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</td>
</tr>
<tr>
<td></td>
<td>• Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Disciplinary Core Ideas**

**PS4.C: Information Technologies and Instrumentation**

- Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa.

**ETS1.C: Optimizing the Design Solution**

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (secondary)

**Crosscutting Concepts**

**Patterns**

- Similarities and differences in patterns can be used to sort and classify designed products.

**Connections to Engineering, Technology, and Applications of Science**

- Knowledge of relevant scientific concepts and research findings is important in engineering.

**Disciplinary Core Ideas**

**PS4.C: Information Technologies and Instrumentation**

- Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa.

**ETS1.C: Optimizing the Design Solution**

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (secondary)

**Crosscutting Concepts**

**Patterns**

- Similarities and differences in patterns can be used to sort and classify designed products.

**Connections to Engineering, Technology, and Applications of Science**

- Knowledge of relevant scientific concepts and research findings is important in engineering.

These item specifications were developed using the following reference materials:

- **K–12 Framework**
  - pp. 67–71
  - pp. 136–137
  - pp. 208–210
  - pp. 85–87
  - pp. 210–214

- **NGSS Appendices**
  - Appendix F
    - pp. 11–12
  - Appendix E
    - pp. 1–7
  - Appendix I
    - pp. 3–5

- **Clarification Statement**
  - Examples of solutions could include drums sending coded information through sound waves, using a grid of 1’s and 0’s representing black and white to send information about a picture, and using Morse code to send text.

- **Assessment Boundary**
  - An assessment boundary is not provided for this PE.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-PS4-3.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Generate</strong> and/or <strong>compare solutions</strong> that use <strong>patterns</strong> to <strong>transfer information</strong>.</td>
</tr>
<tr>
<td>4-PS4-3.2</td>
<td>SEP-DCI</td>
<td><strong>Generate</strong> and/or <strong>compare solutions</strong> that <strong>transfer information</strong>.</td>
</tr>
<tr>
<td>4-PS4-3.3</td>
<td>DCI-CCC</td>
<td>Connect the use of <strong>patterns</strong> to the <strong>transfer</strong> of <strong>information</strong>.</td>
</tr>
<tr>
<td>4-PS4-3.4</td>
<td>SEP-CCC</td>
<td><strong>Generate</strong> and/or <strong>compare solutions</strong> that involve patterns.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Generate** and/or **compare solutions** is expanded to include:
  - using measurements, observations, and/or patterns to support an explanation
  - using measurements, observations, and/or patterns to generate and/or compare solutions to a problem
  - using evidence to design a solution to a problem
  - comparing solutions to a problem as to how well they meet criteria for success
  - comparing solutions in terms of constraints that limit the success of the solution

- Examples of **patterns** used to **transfer information** may include, but are NOT limited to:
  - a pattern of light flashes communicating a message over a relatively short distance
  - cell phones converting sound waves into a pattern of digital signals (e.g., 1's and 0's) that travel over relatively long distances
  - a pattern of digital signals from satellites traveling over relatively long distances and being converted into an image
Life Sciences

Disciplinary Core Ideas:

- LS1 From Molecules to Organisms: Structures and Processes
- LS2 Ecosystems: Interactions, Energy, and Dynamics
- LS3 Heredity: Inheritance and Variation of Traits
- LS4 Biological Evolution: Unity and Diversity
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>3-LS1-1 Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.</th>
</tr>
</thead>
</table>
| Dimensions              | **Science & Engineering Practices**  
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.  
• Develop models to describe phenomena.  

**Connections to Nature of Science**  
Scientific Knowledge is Based on Empirical Evidence  
• Science findings are based on recognizing patterns.  

**Disciplinary Core Ideas**  
LS1.B: Growth and Development of Organisms  
• Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.  

**Crosscutting Concepts**  
Patterns  
• Patterns of change can be used to make predictions. |

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F</td>
<td>Appendix E</td>
<td>Appendix G</td>
</tr>
<tr>
<td></td>
<td>p. 6</td>
<td>p. 4</td>
<td>pp. 3–5</td>
</tr>
<tr>
<td></td>
<td>Appendix H</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>p. 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Clarification Statement
Changes organisms go through during their life form a pattern.

Assessment Boundary
Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.
Items may ask students to:

<table>
<thead>
<tr>
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<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-LS1-1.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Develop and/or use a model</strong> to show <strong>patterns</strong> in the <strong>life cycle stages</strong> of plants and/or animals, and/or use <strong>patterns</strong> of change in <strong>life cycle stages</strong> to make predictions.</td>
</tr>
<tr>
<td>3-LS1-1.2</td>
<td>SEP-DCI</td>
<td><strong>Develop and/or use a model</strong> to describe plant and/or animal <strong>life cycle stages</strong>.</td>
</tr>
<tr>
<td>3-LS1-1.3</td>
<td>DCI-CCC</td>
<td>Use <strong>patterns</strong> to connect similarities and/or differences among plant and/or animal <strong>life cycle stages</strong>, and/or make predictions about plant and/or animal <strong>life cycle stages</strong>.</td>
</tr>
<tr>
<td>3-LS1-1.4</td>
<td>SEP-CCC</td>
<td><strong>Develop and/or use a model</strong> to describe how patterns can be used to describe relationships and/or make predictions.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Develop and/or use a model** is expanded to include:
  - revising a complete or partial model
  - comparing complete or partial models
  - using a model to describe a scientific principle
  - using a model to describe a process
  - using a model to make predictions

- **Models** may include, but are NOT limited to:
  - a diagram and/or description of an organism’s life cycle that includes birth, growth, reproduction, and/or death
  - a diagram and/or description that compares life cycles of different types of organisms

- **Life cycle stages** for all organisms include birth, growth, reproduction, and/or death.

- **Patterns** in plant and/or animal **life cycles** may include, but are NOT limited to:
  - similarities and/or differences among life cycle stages for plants and/or animals
  - predictable characteristics at each life cycle stage for plants and/or animals
  - unique and/or diverse characteristics in each life cycle stage when considered across categories (plant, animal) or within a specific group of organisms
  - changes in one life cycle stage cause changes in other stages (e.g., if growth is disrupted, reproduction becomes less likely)
  - reproduction is essential to continued survival of an organism
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>4-LS1-1</th>
<th>Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td></td>
<td><strong>Science &amp; Engineering Practices</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Engaging in Argument from Evidence</strong></td>
</tr>
</tbody>
</table>
|                         |         | Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).  
  • Construct an argument with evidence, data, and/or a model. |
|                         |         | **Disciplinary Core Ideas**  
  LS1.A: Structure and Function  
  • Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. |
|                         |         | **Crosscutting Concepts**  
  Systems and System Models  
  • A system can be described in terms of its components and their interactions. |
|                         |         | These item specifications were developed using the following reference materials:                                                                                                              |
|                         |         | K–12 Framework **pp. 71–74**  
  pp. 143–145  
  pp. 91–94 |
|                         |         | NGSS Appendices **Appendix F**  
  **Appendix E**  
  p. 4  
  **Appendix G**  
  pp. 7–8 |
|                         |         | Clarification Statement Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.                                                                 |
|                         |         | Assessment Boundary Assessment is limited to macroscopic structures within plant and animal systems.                                                                                           |
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-LS1-1.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Construct an argument</strong> to describe plant <strong>systems</strong> and/or animal <strong>systems</strong> in terms of their <strong>structures</strong> and how the structures interact to serve various survival, growth, behavioral, and/or reproductive <strong>functions</strong>.</td>
</tr>
<tr>
<td>4-LS1-1.2</td>
<td>SEP-DCI</td>
<td><strong>Construct an argument</strong> to show that plant and/or animal <strong>structures</strong> serve various survival, growth, behavioral, and/or reproductive <strong>functions</strong>.</td>
</tr>
<tr>
<td>4-LS1-1.3</td>
<td>DCI-CCC</td>
<td>Use <strong>system models</strong> to show how plant and/or animal <strong>structures</strong> serve various survival, growth, behavioral, and/or reproductive <strong>functions</strong>.</td>
</tr>
<tr>
<td>4-LS1-1.4</td>
<td>SEP-CCC</td>
<td><strong>Construct an argument</strong> that connects system components and interactions in a system model.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Construct an argument** is expanded to include:
  - using evidence to support an argument and/or a claim
  - developing an argument and/or making a claim based on evidence, data, and/or a simple model
  - distinguishing between observations and inferences in an explanation and/or argument
  - comparing and/or refining arguments and/or claims based on evidence
  - using evidence to make a claim about the merit of a solution to a problem by describing how well the solution meets the criteria and/or the constraints of a problem

- **Structures** and **functions** may include, but are NOT limited to, structures that work together to support:
  - plants
    - obtaining water, sunlight, and/or air
    - growing toward sunlight and/or water
    - defending against herbivores
    - attracting pollinators
  - animals
    - pumping blood, breathing, moving, and/or digesting food
    - obtaining food
    - defending against predators
    - attracting mates

- **Systems** may include, but are NOT limited to:
  - an entire organism (plant or animal)
  - a subsystem within a plant or animal
  - the interactions of structures working together within a plant or animal system or subsystem
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.</th>
</tr>
</thead>
</table>
| **Dimensions**          | **Science & Engineering Practices**  
Engaging in Argument from Evidence  
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).  
• Support an argument with evidence, data, or a model.  

| **Disciplinary Core Ideas** | LS1.C: Organization for Matter and Energy Flow in Organisms  
• Plants acquire their material for growth chiefly from air and water.  

| **Crosscutting Concepts** | Energy and Matter  
• Matter is transported into, out of, and within systems. |

These item specifications were developed using the following reference materials:

- **K-12 Framework**  
  - pp. 71–74  
  - pp. 147–148  
  - pp. 94–96

- **NGSS Appendices**  
  - Appendix F  
    - pp. 13–14  
  - Appendix E  
    - p. 4  
  - Appendix G  
    - pp. 8–9

- **Clarification Statement**  
  Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.

- **Assessment Boundary**  
  An assessment boundary is not provided for this PE.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-LS1-1.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Support an argument</strong> that plants get the <strong>materials</strong> they need for <strong>growth</strong> chiefly by <strong>transporting</strong> air and/or water into, out of, and/or within systems.</td>
</tr>
<tr>
<td>5-LS1-1.2</td>
<td>SEP-DCI</td>
<td><strong>Support an argument</strong> that plants get the <strong>materials</strong> they need for <strong>growth</strong> chiefly from air and/or water.</td>
</tr>
<tr>
<td>5-LS1-1.3</td>
<td>DCI-CCC</td>
<td>Connect the <strong>transport</strong> of air and/or water into, out of, and/or within systems to the <strong>materials</strong> plants need for <strong>growth</strong>.</td>
</tr>
<tr>
<td>5-LS1-1.4</td>
<td>SEP-CCC</td>
<td><strong>Support an argument</strong> about matter being transported into, out of, and/or within a system.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Support an argument** is expanded to include:
  - using evidence to support an argument and/or a claim
  - developing an argument and/or a claim based on evidence, data, and/or a simple model
  - distinguishing between observations and inferences in an explanation and/or argument
  - comparing and/or refining arguments and/or claims based on evidence
  - using evidence to make a claim about the merit of a solution to a problem by describing how well the solution meets the criteria and/or the constraints of a problem

- Types of **evidence** may include, but are NOT limited to:
  - observed plant growth over time when air and/or water are provided
  - observations of changes in the mass of soil and/or water, compared to the mass of a growing plant over time
  - observations of plants that grow without soil

- **Materials** that are **transported** into, out of, and/or within a system for **growth** may include:
  - air
  - water
**Performance Expectation**

4-LS1-2 Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Science &amp; Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Developing and Using Models</strong></td>
<td><strong>LS1.D: Information Processing</strong></td>
<td><strong>Systems and System Models</strong></td>
</tr>
<tr>
<td></td>
<td>Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Use a model to test interactions concerning the functioning of a natural system.</td>
<td>• Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal’s brain. Animals are able to use their perceptions and memories to guide their actions.</td>
<td>• A system can be described in terms of its components and their interactions.</td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F</td>
<td>Appendix E</td>
<td>Appendix G</td>
</tr>
<tr>
<td>p. 6</td>
<td>p. 4</td>
<td>pp. 7–8</td>
<td></td>
</tr>
</tbody>
</table>

Clarification Statement: Emphasis is on systems of information transfer.

Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-LS1-2.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Develop</strong> and/or <strong>use a model</strong> to describe <strong>system components</strong> and <strong>interactions</strong> when an animal receives different types of information, processes the information, and/or responds to the information.</td>
</tr>
<tr>
<td>4-LS1-2.2</td>
<td>SEP-DCI</td>
<td><strong>Develop</strong> and/or <strong>use a model</strong> to describe how an animal receives different types of information, processes the information, and/or responds to the information.</td>
</tr>
<tr>
<td>4-LS1-2.3</td>
<td>DCI-CCC</td>
<td>Use <strong>system components</strong> and <strong>interactions</strong> to describe how an animal receives different types of information, processes the information, and/or responds to the information.</td>
</tr>
<tr>
<td>4-LS1-2.4</td>
<td>SEP-CCC</td>
<td><strong>Develop</strong> and/or <strong>use a model</strong> to describe components and interactions in a system.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Develop and/or use a model** is expanded to include:
  - revising a complete or partial model
  - comparing complete or partial models
  - using a model to describe a scientific principle
  - using a model to describe a process
  - using a model to make predictions

- **System components** may include, but are NOT limited to:
  - information inputs (e.g., sound, odor, temperature)
  - sense receptors
  - brain
  - memories
  - actions (e.g., run, blink)

- **Interactions** among **system components** may include, but are NOT limited to:
  - sense receptors detecting inputs from the surroundings (e.g., receptors in eyes detecting light, receptors in skin detecting heat, receptors in the nose detecting smell)
  - sense receptors sending information to the brain
  - brain processing information as perception and/or storing information as memory
  - organism responding to sensory input and/or processing
|-------------------------|---------------------------------|-------------------------|----------------------|
| 3-LS2-1                 | **Engaging in Argument from Evidence**  
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).  
- Construct an argument with evidence, data, and/or a model. | **LS2.D: Social Interactions and Group Behavior**  
- Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size *(Note: Moved from K–2).* | **Cause and Effect**  
- Cause and effect relationships are routinely identified and used to explain change. |

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
<th>K-12 Framework</th>
<th>NGSS Appendices</th>
<th>Clarification Statement</th>
<th>Assessment Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>pp. 71–74</td>
<td>pp. 13–14</td>
<td>A clarification statement is not provided for this PE.</td>
<td>An assessment boundary is not provided for this PE.</td>
</tr>
<tr>
<td>pp. 156–157</td>
<td>Appendix E p. 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pp. 87–89</td>
<td>Appendix G pp. 5–6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-LS2-1.1</td>
<td>SEP-DCI-CCC</td>
<td>Construct an argument using cause and effect relationships to describe how forming a group helps animals survive.</td>
</tr>
<tr>
<td>3-LS2-1.2</td>
<td>SEP-DCI</td>
<td>Construct an argument that forming a group helps animals survive.</td>
</tr>
<tr>
<td>3-LS2-1.3</td>
<td>DCI-CCC</td>
<td>Use cause and effect relationships to connect forming a group and animal survival.</td>
</tr>
<tr>
<td>3-LS2-1.4</td>
<td>SEP-CCC</td>
<td>Construct an argument that cause and effect relationships are used to describe relationships.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Construct an argument** is expanded to include:
  - using evidence to support an argument and/or a claim
  - developing an argument and/or making a claim based on evidence, data, and/or a simple model
  - distinguishing between observations and inferences in an explanation and/or argument
  - comparing and/or refining arguments and/or claims based on evidence
  - using evidence to make a claim about the merit of a solution to a problem by describing how well the solution meets the criteria and/or the constraints of a problem

- A **group** of animals may include, but is NOT limited to:
  - a group of equal individuals (e.g., copepods)
  - a group with dominant members (e.g., elephant herd)
  - small families (e.g., mountain lion mother and cubs)
  - a group of single or mixed gender (e.g., antelope herd)
  - a group composed of individuals similar in age (e.g., duckling crèche)
  - a group that is stable over long periods of time
  - a group with members moving in and/or out (e.g., dolphin pod)
  - a group that assigns specialized tasks to each member (e.g., bee colony, ant colony)
  - a group in which all members perform the same function or a similar range of functions (e.g., schooling anchovies)

- **Cause and effect** relationships that describe how being in a group helps animals may include, but are NOT limited to:
  - being in a group can cause individuals in the group to obtain more food than solitary individuals do
  - being in a group can cause individuals in the group to survive predation more frequently than solitary individuals do
  - being in a group can cause individuals in the group to survive environmental or ecological changes (e.g., seasons, climate, habitat disruption, species introduction) more frequently than solitary individuals do
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.</th>
</tr>
</thead>
</table>
| **Science & Engineering Practices** | Developing and Using Models  
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.  
- Develop a model to describe phenomena.  
**Connections to the Nature of Science**  
Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena  
- Science explanations describe the mechanisms for natural events. |
| **Disciplinary Core Ideas** | LS2.A: Interdependent Relationships in Ecosystems  
- The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as “decomposers.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem.  
**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems**  
- Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. |
| **Crosscutting Concepts** | Systems and System Models  
- A system can be described in terms of its components and their interactions. |

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F</td>
<td>p. 6</td>
<td>Appendix E</td>
<td>p. 5</td>
</tr>
<tr>
<td>Clarification Statement</td>
<td>Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment Boundary</td>
<td>Assessment does not include molecular explanations.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-LS2-1.1</td>
<td>SEP-DCI-CCC</td>
<td>Develop and/or use a model to describe system components and/or their interactions when matter moves among plants, animals, decomposers, and/or the environment.</td>
</tr>
<tr>
<td>5-LS2-1.2</td>
<td>SEP-DCI</td>
<td>Develop and/or use a model to describe how matter moves among plants, animals, decomposers, and/or the environment.</td>
</tr>
<tr>
<td>5-LS2-1.3</td>
<td>DCI-CCC</td>
<td>Use system components and/or their interactions to track the movement of matter among plants, animals, decomposers, and/or the environment.</td>
</tr>
<tr>
<td>5-LS2-1.4</td>
<td>SEP-CCC</td>
<td>Develop and/or use a model to describe system components and/or their interactions in a system.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Develop and/or use a model** is expanded to include:
  - revising a complete or partial model
  - comparing complete or partial models
  - using a model to describe a scientific principle
  - using a model to describe a process
  - using a model to make predictions

- **System components** may include, but are NOT limited to:
  - matter
  - plants
  - animals
  - decomposers (e.g., fungi, bacteria)
  - environment

- **Interactions** among system components that move matter may include, but are NOT limited to:
  - organisms obtaining matter from the environment
  - organisms releasing waste/matter to the environment
  - decomposers recycling matter to the environment
  - animals consuming plants and/or other animals
  - decomposers breaking down dead plants and/or animals
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions</strong></td>
<td><strong>Analyzing and Interpreting Data</strong>&lt;br&gt;Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.&lt;br&gt;- Analyze and interpret data to make sense of phenomena using logical reasoning.</td>
<td><strong>LS3.A: Inheritance of Traits</strong>&lt;br&gt;- Many characteristics of organisms are inherited from their parents.</td>
<td><strong>Patterns</strong>&lt;br&gt;- Similarities and differences in patterns can be used to sort and classify natural phenomena.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>LS3.B: Variation of Traits</strong>&lt;br&gt;- Different organisms vary in how they look and function because they have different inherited information.</td>
<td></td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

- **NGSS Appendices**: Appendix F, Appendix E, Appendix G
- **Clarification Statement**: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.
- **Assessment Boundary**: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-LS3-1.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Analyze</strong> and/or <strong>interpret data</strong> to provide evidence from patterns showing that plants and/or animals inherit traits from their parents and/or that a group of similar organisms can have variation in their traits.</td>
</tr>
<tr>
<td>3-LS3-1.2</td>
<td>SEP-DCI</td>
<td><strong>Analyze</strong> and/or <strong>interpret data</strong> to provide evidence that plants and/or animals inherit traits from their parents and/or that a group of similar organisms can have variation in their traits.</td>
</tr>
<tr>
<td>3-LS3-1.3</td>
<td>DCI-CCC</td>
<td>Use patterns to support that traits are inherited from their parents and/or that similar organisms can have variation in their traits.</td>
</tr>
<tr>
<td>3-LS3-1.4</td>
<td>SEP-CCC</td>
<td><strong>Analyze</strong> and/or <strong>interpret data</strong> to provide evidence from patterns to classify organisms.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Analyze** and/or **interpret data** is expanded to include:
  - recording observations
  - organizing data in a table or graphical display (e.g., chart, graph)
  - summarizing data to identify relationships between data sets
  - comparing and/or contrasting data collected by different groups

- **Data** may include, but are NOT limited to:
  - traits of plant and/or animal parents
  - traits of plant and/or animal offspring
  - similarities and/or differences in traits among offspring that are from the same parents

- Examples of **patterns** that provide evidence of inherited traits and/or variation in traits may include, but are NOT limited to:
  - all of the daisy plants in a flower bed having flowers with the same number of petals
  - a puppy having the coloration of its male parent and the ear shape of its female parent
  - plant offspring of one pair of parents having a range of heights
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science &amp; Engineering Practices</strong></td>
<td><strong>Disciplinary Core Ideas</strong></td>
</tr>
<tr>
<td>Constructing Explanations and Designing Solutions</td>
<td>LS3.A: Inheritance of Traits</td>
</tr>
<tr>
<td>Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</td>
<td>• Other characteristics result from individuals’ interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment.</td>
</tr>
<tr>
<td>• Use evidence (e.g., observations, patterns) to support an explanation.</td>
<td>LS3.B: Variation of Traits</td>
</tr>
<tr>
<td>• The environment also affects the traits that an organism develops.</td>
<td></td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Clarification Statement</strong></td>
<td>Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.</td>
</tr>
<tr>
<td><strong>Assessment Boundary</strong></td>
<td>An assessment boundary is not provided for this PE.</td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

- **NGSS Appendices**: Appendix F, Appendix E, Appendix G
- **Clarification Statement**: pp. 11–12, p. 6, pp. 5–6
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
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</tr>
</thead>
<tbody>
<tr>
<td>3-LS3-2.1</td>
<td>SEP-DCI-CCC</td>
<td>Use evidence from cause and effect relationships to support the explanation that interactions with the environment influence traits.</td>
</tr>
<tr>
<td>3-LS3-2.2</td>
<td>SEP-DCI</td>
<td>Use evidence to support the explanation that interactions with the environment influence traits.</td>
</tr>
<tr>
<td>3-LS3-2.3</td>
<td>DCI-CCC</td>
<td>Use cause and effect relationships to connect interactions with the environment to observable traits.</td>
</tr>
<tr>
<td>3-LS3-2.4</td>
<td>SEP-CCC</td>
<td>Use evidence from cause and effect relationships to support an explanation about change.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Use evidence** is expanded to include:
  - using measurements, observations, and/or patterns to support an explanation
  - using measurements, observations, and/or patterns to generate and/or compare solutions to a problem
  - using evidence to design a solution to a problem
  - comparing solutions to a problem as to how well they meet criteria for success
  - comparing solutions in terms of constraints that limit the success of the solution

- Examples of **interactions** with the environment may include, but are NOT limited to:
  - an organism taking in food and/or water
  - an organism obtaining chemicals from soil, water, and/or food
  - a plant absorbing sunlight
  - an animal doing a physical activity

- Examples of **traits** may include, but are NOT limited to:
  - height and/or weight of a plant or animal
  - color and/or quantity of flowers on a plant
  - speed and/or distance that an animal can run

- Examples of **cause and effect** relationships may include, but are NOT limited to:
  - Plants that do not get enough sunlight are shorter than similar plants that do get enough sunlight.
  - Plants grown in nutrient-poor soil produce fewer berries than plants grown in nutrient-rich soil.
  - Horses that run every day can run faster and/or farther than similar horses that do not run regularly.
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>3-LS4-1</strong> Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.</td>
<td><strong>Analyzing and Interpreting Data</strong> Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena using logical reasoning.</td>
<td><strong>LS4.A: Evidence of Common Ancestry and Diversity</strong> • Some kinds of plants and animals that once lived on Earth are no longer found anywhere. <em>(Note: moved from K–2)</em> • Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.</td>
<td><strong>Scale, Proportion, and Quantity</strong> • Observable phenomena exist from very short to very long time periods. <strong>Connections to Nature of Science</strong> <strong>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</strong> • Science assumes consistent patterns in natural systems.</td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

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<tr>
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</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F p. 9</td>
<td>Appendix E p. 6</td>
<td>Appendix G pp. 6–7 Appendix H p. 6</td>
</tr>
</tbody>
</table>

**Clarification Statement**
Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.

**Assessment Boundary**
Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.
Items may ask students to:

<table>
<thead>
<tr>
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<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-LS4-1.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Analyze and/or interpret data</strong> from <strong>fossils</strong> to provide <strong>evidence</strong> of the <strong>organisms</strong> and/or the <strong>environments</strong> in which they lived long ago.</td>
</tr>
<tr>
<td>3-LS4-1.2</td>
<td>SEP-DCI</td>
<td><strong>Analyze and/or interpret data</strong> from <strong>fossils</strong> to provide <strong>evidence</strong> of the <strong>organisms</strong> and/or the <strong>environments</strong> in which they lived.</td>
</tr>
<tr>
<td>3-LS4-1.3</td>
<td>DCI-CCC</td>
<td>Connect <strong>patterns</strong> in <strong>fossil evidence</strong> to the <strong>organisms</strong> and/or the <strong>environments</strong> in which they lived long ago.</td>
</tr>
<tr>
<td>3-LS4-1.4</td>
<td>SEP-CCC</td>
<td><strong>Analyze and/or interpret data</strong> to provide evidence that organisms lived long ago.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Analyze and/or interpret data** is expanded to include:
  - recording observations
  - organizing data in a table or graphical display (e.g., chart, graph)
  - summarizing data to identify relationships between data sets
  - comparing and/or contrasting data collected by different groups

- **Data** from **fossils** may include, but are NOT limited to:
  - sizes
  - distributions
  - relative ages

- **Evidence** of **organisms** and/or their **environments** may include, but is NOT limited to:
  - Some organisms from long ago have modern counterparts.
  - Some organisms from long ago are extinct.
  - Shelled organisms found on dry land indicate that the area was once a marine environment (e.g., tropical plant fossils in Antarctica).
### Performance Expectation

**3-LS4-2** Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Science &amp; Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constructing Explanations and Designing Solutions</strong></td>
<td><strong>Constructing Explanations and Designing Solutions</strong></td>
<td><strong>LS4.B: Natural Selection</strong></td>
<td><strong>Cause and Effect</strong></td>
</tr>
<tr>
<td>Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</td>
<td>• Use evidence (e.g., observations, patterns) to construct an explanation.</td>
<td>• Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.</td>
<td>• Cause and effect relationships are routinely identified and used to explain change.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Reference Materials</th>
<th>K–12 Framework</th>
<th>NGSS Appendices</th>
<th>Clarification Statement</th>
<th>Assessment Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pp. 67–71</strong></td>
<td><strong>pp. 163–165</strong></td>
<td><strong>pp. 11–12</strong></td>
<td>Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.</td>
<td>An assessment boundary is not provided for this PE.</td>
</tr>
<tr>
<td><strong>pp. 87–89</strong></td>
<td><strong>Appendix E</strong></td>
<td><strong>Appendix G</strong></td>
<td><strong>pp. 5–6</strong></td>
<td></td>
</tr>
</tbody>
</table>

OSPI Working Draft, Grade 5
Last edited: August, 2019
Items may ask students to:

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</tr>
</thead>
<tbody>
<tr>
<td>3-LS4-2.1</td>
<td>SEP-DCI-CCC</td>
<td>Use <strong>evidence</strong> to construct an explanation about <strong>cause and effect</strong> relationships between <strong>variations in characteristics</strong> among individuals of the same species and <strong>advantages</strong> in surviving, finding mates, and/or reproducing.</td>
</tr>
<tr>
<td>3-LS4-2.2</td>
<td>SEP-DCI</td>
<td>Use <strong>evidence</strong> to construct an explanation about how <strong>variations in characteristics</strong> among individuals of the same species may provide <strong>advantages</strong> in surviving, finding mates, and/or reproducing.</td>
</tr>
<tr>
<td>3-LS4-2.3</td>
<td>DCI-CCC</td>
<td>Use <strong>cause and effect</strong> relationships to explain how <strong>variations in characteristics</strong> among individuals of the same species may provide <strong>advantages</strong> in surviving, finding mates, and/or reproducing.</td>
</tr>
<tr>
<td>3-LS4-2.4</td>
<td>SEP-CCC</td>
<td>Use <strong>evidence</strong> from cause and effect relationships to construct an explanation about change.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Use evidence** is expanded to include:
  - using measurements, observations, and/or patterns to support an explanation
  - using measurements, observations, and/or patterns to generate and/or compare solutions to a problem
  - using evidence to design a solution to a problem
  - comparing solutions to a problem as to how well they meet criteria for success
  - comparing solutions in terms of constraints that limit the success of the solution

- **Variations in characteristics** may include, but are NOT limited to, differences in:
  - coloration in plants and/or animals
  - sizes and/or shapes of specific physical features of plants and/or animals
  - growth rates of plants and/or animals

- **Advantages** may include, but are NOT limited to:
  - increased survival rate
  - increased likelihood of finding a mate
  - increased rate of reproduction

- **Examples of cause and effect relationships** may include, but are NOT limited to:
  - Dark-colored gypsy moths that are difficult for predators to see on tree bark are more likely to survive and/or reproduce than light-colored gypsy moths that are easy to see.
  - Chorus frogs with louder mating calls are more likely to attract mates more often than those with softer mating calls, and are therefore more likely to reproduce.
  - Sunflowers that grow quickly obtain more sunlight than sunflowers that grow slowly, and are therefore more likely to survive and/or reproduce.
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-LS4-3</td>
<td>Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engaging in Argument from Evidence</strong></td>
<td><strong>LS4.C: Adaptation</strong></td>
<td><strong>Cause and Effect</strong></td>
</tr>
<tr>
<td>Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</td>
<td>• For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.</td>
<td>• Cause and effect relationships are routinely identified and used to explain change.</td>
</tr>
</tbody>
</table>

| These item specifications were developed using the following reference materials: |
|------------------------|------------------------|------------------------|
| NGSS Appendices | Appendix F | Appendix E | Appendix G |
| pp. 13–14 | p. 6 | pp. 5–6 |

<table>
<thead>
<tr>
<th>Clarification Statement</th>
<th>Assessment Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.</td>
<td>An assessment boundary is not provided for this PE.</td>
</tr>
</tbody>
</table>
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-LS4-3.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Construct</strong> an <strong>argument</strong> with evidence that establishes a <strong>cause and effect</strong> relationship between organism <strong>characteristics</strong> and <strong>survival</strong> in a particular habitat.</td>
</tr>
<tr>
<td>3-LS4-3.2</td>
<td>SEP-DCI</td>
<td><strong>Construct</strong> an <strong>argument</strong> with evidence that organisms in a particular habitat can have different <strong>characteristics</strong> and/or different levels of <strong>survival</strong>.</td>
</tr>
<tr>
<td>3-LS4-3.3</td>
<td>DCI-CCC</td>
<td>Use <strong>cause and effect</strong> relationships to relate organism <strong>characteristics</strong> to <strong>survival</strong> in a particular habitat.</td>
</tr>
<tr>
<td>3-LS4-3.4</td>
<td>SEP-CCC</td>
<td><strong>Construct</strong> an <strong>argument</strong> with <strong>evidence</strong> about a cause and effect relationship.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Construct** an **argument** is expanded to include:
  - using evidence to support an argument and/or a claim
  - developing an argument and/or making a claim based on evidence, data, and/or a simple model
  - distinguishing between observations and inferences in an explanation and/or argument
  - comparing and/or refining arguments and/or claims based on evidence
  - using evidence to make a claim about the merit of a solution to a problem by describing how well the solution meets the criteria and/or the constraints of a problem

- Organism **characteristics** may include, but are NOT limited to:
  - physical characteristics
  - behaviors
  - resource needs

- Measures of **survival** in a particular habitat may include, but are NOT limited to:
  - average lifespan
  - overall health
  - ability to successfully reproduce
  - the size of a population

- **Cause and effect** relationships may include, but are NOT limited to:
  - relating changes in the availability of resources to changes in survival
  - relating changes in the number organisms with a specific characteristic to changes in survival
  - relating changes in survival to changes in habitat
### Performance Expectation

**3-LS4-4** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Science &amp; Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Engaging in Argument from Evidence</td>
<td>LS2.C: Ecosystem Dynamics, Functioning, and Resilience</td>
<td>Systems and System Models</td>
</tr>
<tr>
<td></td>
<td>Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</td>
<td>• When the environment changes in ways that affect a place’s physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.</td>
<td>• A system can be described in terms of its components and their interactions.</td>
</tr>
<tr>
<td></td>
<td>• Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.</td>
<td>LS4.D: Biodiversity and Humans</td>
<td>Connections to Engineering, Technology, and Applications of Science</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Populations live in a variety of habitats, and change in those habitats affects the organisms living there.</td>
<td>• Knowledge of relevant scientific concepts and research findings is important in engineering.</td>
</tr>
</tbody>
</table>

| These item specifications were developed using the following reference materials: |
|---|---|---|
| NGSS Appendices | Appendix F pp. 13–14 | Appendix E p. 5 | Appendix G pp. 7–8, Appendix J pp. 3–4 |
| Clarification Statement | Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms. |
| Assessment Boundary | Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change. |
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-LS4-4.1</td>
<td>SEP-DCI-CCC</td>
<td>Make a claim about the merit of a solution to a problem caused when the environment in a given system changes, which may result in changes to the types of plants and/or animals in that system.</td>
</tr>
<tr>
<td>3-LS4-4.2</td>
<td>SEP-DCI</td>
<td>Make a claim about the merit of a solution to a problem caused when an environmental change causes changes to the types of plants and/or animals.</td>
</tr>
<tr>
<td>3-LS4-4.3</td>
<td>DCI-CCC</td>
<td>Connect changes to the types of plants and/or animals in a system to changes in the environment of the system.</td>
</tr>
<tr>
<td>3-LS4-4.4</td>
<td>SEP-CCC</td>
<td>Make a claim about the merit of a solution to a problem caused by interactions among the components of a system.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Make a claim** is expanded to include:
  - using evidence to support an argument and/or a claim
  - developing an argument and/or a making a claim based on evidence, data, and/or a simple model
  - distinguishing between observations and inferences in an explanation and/or argument
  - comparing and/or refining arguments and/or claims based on evidence
  - using evidence to make a claim about the merit of a solution to a problem by describing how well the solution meets the criteria and/or the constraints of a problem

- The **merit of a solution** may include, but is NOT limited to:
  - how well a solution meets given criteria
  - constraints on the success of a given solution
  - how well a solution reduces the impact of the problem

- A **change** in the environment of a given system may include, but is NOT limited to:
  - a change in the size, shape, and/or distribution of local landscape features
  - a change in the quality of the air, water, and/or soil
  - a change in the availability of air, water, food, and/or shelter
  - a change in temperature
  - a change caused by human activity (e.g., mining, pollution, habitat destruction)

- A **change** in the plants and/or animals of a given system may include, but is NOT limited to:
  - a decrease in the population of a particular plant or animal species within the system
  - migration of organisms into or out of a given system
  - migration of invasive species into a given system
Earth and Space Sciences

Disciplinary Core Ideas:

- ESS1 Earth’s Place in the Universe
- ESS2 Earth’s Systems
- ESS3 Earth and Human Activity
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>4-ESS1-1 Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.</th>
</tr>
</thead>
</table>
| Science & Engineering Practices | **Constructing Explanations and Designing Solutions**  
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.  
- Identify the evidence that supports particular points in an explanation. |
| Disciplinary Core Ideas | **ESS1.C: The History of Planet Earth**  
- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. |
| Crosscutting Concepts | **Patterns**  
- Patterns can be used as evidence to support an explanation.  
**Connections to Nature of Science**  
**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**  
- Science assumes consistent patterns in natural systems. |
| These item specifications were developed using the following reference materials: | |
| NGSS Appendices | Appendix F | Appendix E | Appendix G  
pp. 3–5 | Appendix H  
p. 6 |
| Clarification Statement | Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock. |
| Assessment Boundary | Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time. |
Items may ask students to:

<table>
<thead>
<tr>
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<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-ESS1-1.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Identify evidence</strong> from <strong>patterns</strong> in rock formations and/or fossils in rock layers to support an explanation of <strong>change over time</strong>.</td>
</tr>
<tr>
<td>4-ESS1-1.2</td>
<td>SEP-DCI</td>
<td><strong>Identify evidence</strong> that supports an explanation of <strong>change over time</strong>.</td>
</tr>
<tr>
<td>4-ESS1-1.3</td>
<td>DCI-CCC</td>
<td>Use <strong>patterns</strong> in rock formations and/or <strong>patterns</strong> in the fossils in rock layers to support an explanation of <strong>change over time</strong>.</td>
</tr>
<tr>
<td>4-ESS1-1.4</td>
<td>SEP-CCC</td>
<td><strong>Identify evidence</strong> from patterns to support an explanation.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Identify evidence** is expanded to include:
  - using measurements, observations, and/or patterns to support an explanation
  - using measurements, observations, and/or patterns to generate and/or compare solutions to a problem
  - using evidence to design a solution to a problem
  - comparing solutions to a problem as to how well they meet criteria for success
  - comparing solutions in terms of constraints that limit the success of the solution

- Types of **evidence** may include, but are NOT limited to:
  - vertical ordering of rock layers
  - presence or absence of rock layers
  - presence or absence of fossils in rock layers
  - types of fossils in rock layers

- **Changes over time** may include, but are NOT limited to:
  - changes in a landscape and/or fossils due to changing climate
  - changes in a landscape due to weathering, erosion, and/or deposition
  - changes in a landscape due to tectonic forces and/or earthquakes

- **Patterns** used as evidence may include, but are NOT limited to:
  - sequence of fossils in rock layers
  - sequence of rock types in rock layers
  - presence, absence, or thickness of rock formations
  - presence, absence, or abundance of fossil types across rock layers
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>5-ESS1-1 Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Dimensions</th>
<th><strong>Science &amp; Engineering Practices</strong></th>
<th><strong>Disciplinary Core Ideas</strong></th>
<th><strong>Crosscutting Concepts</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Engaging in Argument from Evidence</em></td>
<td><em>ESS1.A: The Universe and its Stars</em></td>
<td><em>Scale, Proportion, and Quantity</em></td>
</tr>
<tr>
<td></td>
<td>Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</td>
<td>The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.</td>
<td>Natural objects exist from the very small to the immensely large.</td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F</td>
<td>Appendix E</td>
<td>Appendix G</td>
</tr>
<tr>
<td></td>
<td>pp. 13–14</td>
<td>p. 2</td>
<td>pp. 6–7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clarification Statement</th>
<th>A clarification statement is not provided for this PE.</th>
</tr>
</thead>
</table>

| Assessment Boundary | Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage). |
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-ESS1-1.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Support an argument</strong> that stars closer to Earth have different scales of apparent size and/or apparent brightness than those of stars farther from Earth.</td>
</tr>
<tr>
<td>5-ESS1-1.2</td>
<td>SEP-DCI</td>
<td><strong>Support an argument</strong> that stars closer to Earth appear larger and/or brighter than stars that are farther from Earth.</td>
</tr>
<tr>
<td>5-ESS1-1.3</td>
<td>DCI-CCC</td>
<td>Use the concept of scale to connect the apparent sizes and/or brightnesses of stars to their distances from Earth.</td>
</tr>
<tr>
<td>5-ESS1-1.4</td>
<td>SEP-CCC</td>
<td><strong>Support an argument</strong> that objects exist at different scales.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Support an argument** is expanded to include:
  - using evidence to support an argument and/or a claim
  - developing an argument and/or making a claim based on evidence, data, and/or a simple model
  - distinguishing between observations and inferences in an explanation and/or argument
  - comparing and/or refining arguments and/or claims based on evidence
  - using evidence to make a claim about the merit of a solution to a problem by describing how well the solution meets the criteria and/or the constraints of a problem

- Descriptions of **stars** may include, but are NOT limited to:
  - the sun
  - visible stars in the night sky

- Descriptions of **scale** may include, but are NOT limited to:
  - apparent sizes (e.g., large, small) of the sun and other stars
  - apparent brightnesses (e.g., bright, dim) of the sun and other stars
  - relative distances of the sun and other stars relative to Earth (e.g., closer to, farther away from)
  - comparisons of relative brightnesses, sizes, and distances of lit objects (e.g., bulbs, candles) in an investigation
### Performance Expectation

| 5-ESS1-2 | Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. |

| Dimensions |

<table>
<thead>
<tr>
<th>Science &amp; Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
</table>
| Analyzing and Interpreting Data | **ESS1.B: Earth and the Solar System**  
- The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. | **Patterns**  
- Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena. |
| Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.  
- Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. | |

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**These item specifications were developed using the following reference materials:**

- **K-12 Framework**: pp. 61–63, pp. 175–176, pp. 85–87
- **NGSS Appendices**: Appendix F, Appendix E, Appendix G
- **Clarification Statement**: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.
- **Assessment Boundary**: Assessment does not include causes of seasons.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-ESS1-2.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Represent data</strong> to show <strong>patterns</strong> of daily changes in length and/or direction of shadows, day and/or night, and/or the seasonal appearance of some stars in the night sky caused by Earth’s <strong>rotation</strong> on its axis and/or <strong>orbital relationships</strong> among Earth, the sun, and/or the moon.</td>
</tr>
<tr>
<td>5-ESS1-2.2</td>
<td>SEP-DCI</td>
<td><strong>Represent data</strong> to show changes in length and/or direction of shadows, day and/or night, and/or the appearance of some stars in the night sky caused by Earth’s <strong>rotation</strong> on its axis and/or <strong>orbital relationships</strong> among Earth, the sun, and/or the moon.</td>
</tr>
<tr>
<td>5-ESS1-2.3</td>
<td>DCI-CCC</td>
<td>Use <strong>patterns</strong> to connect the daily changes in length and/or direction of shadows, day and/or night, and/or the seasonal appearance of some stars in the night sky caused by Earth’s <strong>rotation</strong> on its axis and/or <strong>orbital relationships</strong> among Earth, the sun, and/or the moon.</td>
</tr>
<tr>
<td>5-ESS1-2.4</td>
<td>SEP-CCC</td>
<td><strong>Represent data</strong> to show similarities and/or differences in patterns.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Represent data** is expanded to include:
  - recording observations
  - organizing data in a table and/or graphical display (e.g., chart, graph)
  - summarizing data to identify relationships between data sets
  - comparing and/or contrasting data collected by different groups

- **Data** may include, but are NOT limited to, graphical displays of:
  - hours of daylight
  - length and/or direction of shadows
  - presence or absence of stars and/or constellations
  - phases of the moon

- **Rotational** and/or **orbital relationships** may include, but are NOT limited to:
  - Earth completes a single rotation on its axis once a day.
  - Earth completes a single orbit around the sun once a year.
  - Earth’s moon completes a single orbit around Earth about once a month.

- **Patterns** in day and/or night may include, but are NOT limited to:
  - seasonal patterns in the duration of daylight
  - daily patterns of change in the length and/or direction of shadows
  - patterns of sunrise and/or sunset
  - patterns of appearance for stars and/or constellations
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>3-ESS2-1 Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td><strong>Science &amp; Engineering Practices</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Analyzing and Interpreting Data</strong></td>
</tr>
<tr>
<td></td>
<td>Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.</td>
</tr>
<tr>
<td></td>
<td>• Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships.</td>
</tr>
<tr>
<td></td>
<td><strong>Disciplinary Core Ideas</strong></td>
</tr>
<tr>
<td></td>
<td><strong>ESS2.D: Weather and Climate</strong></td>
</tr>
<tr>
<td></td>
<td>• Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.</td>
</tr>
<tr>
<td></td>
<td><strong>Crosscutting Concepts</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Patterns</strong></td>
</tr>
<tr>
<td></td>
<td>• Patterns of change can be used to make predictions.</td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F</td>
<td>Appendix E</td>
<td>Appendix G</td>
</tr>
<tr>
<td></td>
<td>p. 9</td>
<td>p. 3</td>
<td>pp. 3–5</td>
</tr>
</tbody>
</table>

Clarification Statement

Examples of data could include average temperature, precipitation, and wind direction.

Assessment Boundary

Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-ESS2-1.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Represent data</strong> to show <strong>patterns of change</strong> in <strong>weather conditions</strong> across different seasons and/or locations that can be used to make <strong>predictions</strong>.</td>
</tr>
<tr>
<td>3-ESS2-1.2</td>
<td>SEP-DCI</td>
<td><strong>Represent data</strong> of <strong>weather conditions</strong> across different seasons and/or locations.</td>
</tr>
<tr>
<td>3-ESS2-1.3</td>
<td>DCI-CCC</td>
<td>Use <strong>patterns of change</strong> in <strong>weather conditions</strong> across different seasons and/or locations to make <strong>predictions</strong>.</td>
</tr>
<tr>
<td>3-ESS2-1.4</td>
<td>SEP-CCC</td>
<td><strong>Represent data</strong> to show patterns of change that can be used to make predictions.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Represent data** is expanded to include:
  - recording observations
  - organizing data in a table and/or graphical display (e.g., chart, graph)
  - summarizing data to identify relationships between data sets
  - comparing and/or contrasting data collected by different groups

- **Data** may include, but are NOT limited to:
  - average temperature
  - amount and/or type of precipitation
  - wind direction and/or speed

- **Patterns of change in weather conditions** may include, but are NOT limited to:
  - average precipitation, temperature, and/or wind direction experienced in a location for several seasons and/or during the same season over several years
  - weather data recorded in different locations during the same season

- **Weather predictions** based on a **pattern** may include, but are NOT limited to:
  - the most likely temperature (e.g., high, low) during a future season and/or in a particular location
  - the most likely type and/or amount of precipitation in a future season and/or in a particular location
|--------------------------|---------------------------------|------------------------|-----------------------|
| **4-ESS2-1** Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. | Planning and Carrying Out Investigations  
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.  
• Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. | ESS2.A: Earth Materials and Systems  
• Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. | Cause and Effect  
• Cause and effect relationships are routinely identified, tested, and used to explain change. |

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F pp. 7–8</td>
<td>Appendix E p. 2 Appendix E p. 3</td>
<td>Appendix G pp. 5–6</td>
</tr>
</tbody>
</table>

Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.

Assessment Boundary: Assessment is limited to a single form of weathering or erosion.
Items may ask students to:

<table>
<thead>
<tr>
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<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-ESS2-1.1</td>
<td>SEP-DCI-CCC</td>
<td>Make observations and/or measurements to provide evidence of the effects of weathering and/or the rate of erosion by water, ice, wind, and/or vegetation on the physical characteristics of Earth materials.</td>
</tr>
<tr>
<td>4-ESS2-1.2</td>
<td>SEP-DCI</td>
<td>Make observations and/or measurements to provide evidence of weathering and/or erosion by water, ice, wind, and/or vegetation and/or changes in the physical characteristics of Earth materials.</td>
</tr>
<tr>
<td>4-ESS2-1.3</td>
<td>DCI-CCC</td>
<td>Use cause and effect relationships to connect weathering and/or the rate of erosion by water, ice, wind, and/or vegetation to changes in the physical characteristics of Earth materials.</td>
</tr>
<tr>
<td>4-ESS2-1.4</td>
<td>SEP-CCC</td>
<td>Make observations and/or measurements to provide evidence of cause and effect relationships used to explain change.</td>
</tr>
</tbody>
</table>

Details and Clarifications

- **Make observations and/or measurements** is expanded to include:
  - identifying relevant variables and/or data to be gathered in an investigation
  - describing appropriate methods and/or tools to collect data
  - collecting data that can be used to support an explanation, make comparisons, and/or make predictions

- **Observations and/or measurements** that provide evidence may include, but are NOT limited to:
  - relative slope of an angle for the downhill movement of water
  - relative frequency of freezing and/or thawing of water
  - relative amount of soil and/or sediment carried by water
  - relative water and/or wind speed
  - relative changes in the shape of Earth materials
  - type and/or amount of vegetation

- **Cause and effect** relationships that explain changes to physical characteristics may include, but are NOT limited to:
  - animal behavior (e.g., eating plants, building nests/dams) alters the physical environment
  - movement of wind, water, and/or ice breaks down rocks and/or changes the shape of landforms
  - movement of wind and/or water erodes rocks and/or removes vegetation

- **Earth materials** include, but are NOT limited to:
  - rocks
  - soil
  - water
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.</th>
</tr>
</thead>
</table>
| Dimensions               | *Science & Engineering Practices*  
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.  
• Develop a model using an example to describe a scientific principle.  

*Disciplinary Core Ideas*  
**ESS2.A: Earth Materials and Systems**  
• Earth’s major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth’s surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.  

*Crosscutting Concepts*  
**Systems and System Models**  
• A system can be described in terms of its components and their interactions.  

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These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F p. 6</td>
<td>Appendix E p. 2</td>
<td>Appendix G pp. 7–8</td>
</tr>
</tbody>
</table>

**Clarification Statement**  
Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.

**Assessment Boundary**  
Assessment is limited to the interactions of two systems at a time.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-ESS2-1.1</td>
<td>SEP-DCI-CCC</td>
<td>Develop and/or use a model to describe interactions within and/or between Earth systems: the geosphere, the biosphere, the hydrosphere, and/or the atmosphere.</td>
</tr>
<tr>
<td>5-ESS2-1.2</td>
<td>SEP-DCI</td>
<td>Develop and/or use a model of the geosphere, the biosphere, the hydrosphere, and/or the atmosphere.</td>
</tr>
<tr>
<td>5-ESS2-1.3</td>
<td>DCI-CCC</td>
<td>Connect interactions within and/or between Earth systems: the geosphere, the biosphere, the hydrosphere, and/or the atmosphere.</td>
</tr>
<tr>
<td>5-ESS2-1.4</td>
<td>SEP-CCC</td>
<td>Develop and/or use a model to describe interactions within and/or between the components of a system.</td>
</tr>
</tbody>
</table>

Details and Clarifications

- **Develop and/or use a model** is expanded to include:
  - revising a complete or partial model
  - comparing complete or partial models
  - using a model to describe a scientific principle
  - using a model to describe a process
  - using a model to make predictions

- **Models** may include, but are NOT limited to:
  - diagrams
  - simulations
  - descriptions of interactions

- Components of **Earth systems** may include, but are NOT limited to:
  - geosphere: rock, soil, sediments
  - biosphere: living things
  - hydrosphere: water, ice
  - atmosphere: air, wind

- Examples of **interactions** between two **Earth systems** may include, but are NOT limited to:
  - wind shaping the land
  - organisms producing soil
  - landforms influencing weather conditions
  - the ocean affecting climate
  - water moving rocks, soil, and/or sediment
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3-ESS2-2</td>
<td>Obtain and combine information to describe climates in different regions of the world.</td>
<td>ESS2.D: Weather and Climate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Obtaining, Evaluating, and Communicating Information</td>
<td>• Climate describes a range of an area’s typical weather conditions and the extent to which those conditions vary over years.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.</td>
<td>Patterns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Obtain and combine information from books and other reliable media to explain phenomena.</td>
<td>• Patterns of change can be used to make predictions.</td>
<td></td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
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<tbody>
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<td>Appendix E</td>
<td>Appendix G</td>
</tr>
<tr>
<td>Clarification Statement</td>
<td>p. 15</td>
<td>p. 3</td>
<td>pp. 3–5</td>
</tr>
<tr>
<td>Assessment Boundary</td>
<td>A clarification statement is not provided for this PE.</td>
<td></td>
<td></td>
</tr>
<tr>
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</thead>
<tbody>
<tr>
<td>3-ESS2-2.1</td>
<td>SEP-DCI-CCC</td>
<td>Obtain and/or combine information to describe climate patterns in different regions of the world.</td>
</tr>
<tr>
<td>3-ESS2-2.2</td>
<td>SEP-DCI</td>
<td>Obtain and/or combine information to describe climates in different regions of the world.</td>
</tr>
<tr>
<td>3-ESS2-2.3</td>
<td>DCI-CCC</td>
<td>Use patterns to describe climates in different regions of the world.</td>
</tr>
<tr>
<td>3-ESS2-2.4</td>
<td>SEP-CCC</td>
<td>Obtain and/or combine information to make claims based on patterns.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Obtain** and/or combine information is expanded to include:
  - summarizing information to describe a scientific concept and/or support a scientific claim
  - comparing information to describe a scientific concept and/or support a scientific claim

- **Information** formats may include, but are NOT limited to:
  - text
  - diagrams
  - graphs
  - tables
  - models
  - animations

- Examples of climate patterns may include, but are NOT limited to:
  - average temperatures
  - amounts and/or types of precipitation
  - seasonal variation of conditions within one or more regions
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>4-ESS2-2</th>
<th>Analyze and interpret data from maps to describe patterns of Earth’s features.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science &amp; Engineering Practices</strong></td>
<td><strong>Disciplinary Core Ideas</strong></td>
<td><strong>Crosscutting Concepts</strong></td>
</tr>
<tr>
<td>Analyzing and Interpreting Data</td>
<td>ESS2.B: Plate Tectonics and Large-Scale System Interactions</td>
<td>Patterns</td>
</tr>
<tr>
<td>Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.</td>
<td>• The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.</td>
<td>• Patterns can be used as evidence to support an explanation.</td>
</tr>
<tr>
<td>• Analyze and interpret data to make sense of phenomena using logical reasoning.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| These item specifications were developed using the following reference materials: |
| NGSS Appendices | Appendix F | Appendix E | Appendix G |
| Clarification Statement | Maps can include topographic maps of Earth’s land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes. |
| Assessment Boundary | An assessment boundary is not provided for this PE. |
Items may ask students to:

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<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-ESS2-2.1</td>
<td>SEP-DCI-CCC</td>
<td>Analyze and/or interpret data from maps to describe patterns in the locations of Earth’s features.</td>
</tr>
<tr>
<td>4-ESS2-2.2</td>
<td>SEP-DCI</td>
<td>Analyze and/or interpret data from maps to describe the locations of Earth’s features.</td>
</tr>
<tr>
<td>4-ESS2-2.3</td>
<td>DCI-CCC</td>
<td>Use patterns to connect Earth’s features to locations.</td>
</tr>
<tr>
<td>4-ESS2-2.4</td>
<td>SEP-CCC</td>
<td>Analyze and/or interpret data from patterns to support a description and/or explanation.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- Analyze and/or interpret data is expanded to include:
  - recording observations
  - organizing data in a table or a graphical display (e.g., chart, graph)
  - summarizing data to identify relationships between data sets
  - comparing and/or contrasting data collected by different groups

- Data may include, but are NOT limited to:
  - locations of volcanoes
  - locations of deep ocean trenches and/or other ocean floor features
  - records of earthquake events

- Examples of Earth’s features may include, but are NOT limited to:
  - boundaries between continents
  - mountain ranges
  - deep ocean trenches
  - volcanoes

- Examples of patterns in Earth’s features may include, but are NOT limited to:
  - volcanoes occurring on continents and/or the ocean floor
  - earthquakes occurring deep below Earth’s surface
  - mountain ranges forming within a continent and/or near the edges of continents
  - mountains, earthquakes, and/or volcanoes occurring near deep ocean trenches
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>5-ESS2-2 Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions</strong></td>
<td><strong>Science &amp; Engineering Practice</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Using Mathematics and Computational Thinking</strong> Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Describe and graph quantities such as area and volume to address scientific questions.</td>
</tr>
<tr>
<td></td>
<td><strong>Disciplinary Core Idea</strong> <strong>ESS2.C: The Roles of Water in Earth’s Surface Processes</strong> • Nearly all of Earth’s available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.</td>
</tr>
<tr>
<td></td>
<td><strong>Crosscutting Concept</strong> <strong>Scale, Proportion, and Quantity</strong> • Standard units are used to measure and describe physical quantities such as weight and volume.</td>
</tr>
<tr>
<td></td>
<td><strong>These item specifications were developed using the following reference materials:</strong></td>
</tr>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F</td>
</tr>
<tr>
<td></td>
<td>p. 10</td>
</tr>
<tr>
<td>Clarification Statement</td>
<td>A clarification statement is not provided for this PE.</td>
</tr>
<tr>
<td>Assessment Boundary</td>
<td>Assessment is limited to oceans, lakes, rivers, glaciers, groundwater, and polar ice caps, and does not include the atmosphere.</td>
</tr>
</tbody>
</table>
Items may ask students to:

<table>
<thead>
<tr>
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<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-ESS2-2.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Describe</strong> and/or <strong>graph quantities</strong> using <strong>standard units</strong> to show that Earth’s <strong>available water</strong> is distributed in various <strong>reservoirs</strong>.</td>
</tr>
<tr>
<td>5-ESS2-2.2</td>
<td>SEP-DCI</td>
<td><strong>Describe</strong> and/or <strong>graph quantities</strong> to show that Earth’s <strong>available water</strong> is distributed in various <strong>reservoirs</strong>.</td>
</tr>
<tr>
<td>5-ESS2-2.3</td>
<td>DCI-CCC</td>
<td><strong>Use standard units</strong> to describe the quantities of Earth’s <strong>available water</strong> distributed in various <strong>reservoirs</strong>.</td>
</tr>
<tr>
<td>5-ESS2-2.4</td>
<td>SEP-CCC</td>
<td><strong>Describe</strong> and/or <strong>graph quantities</strong> using standard units.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Describe** and/or **graph quantities** is expanded to include:
  - using mathematics to represent variables and their relationships
  - measuring, comparing, and/or organizing quantitative attributes (e.g., area, volume, mass) to reveal patterns that suggest relationships
  - graphing quantities to address scientific questions and/or problems

- **Reservoirs** containing Earth’s **available water** include:
  - glaciers
  - groundwater
  - lakes
  - oceans
  - polar ice caps
  - rivers

- Descriptions of Earth’s **available water** may include, but are NOT limited to:
  - comparison of the relative amounts of fresh water and/or salt water available on Earth
  - quantitative statements of the differences in amount and/or type of water in two or more reservoirs

- **Graphs** of Earth’s **available water** may include, but are NOT limited to:
  - graphs showing amounts of fresh water and/or salt water in two or more reservoirs
  - graphs showing relative amounts of fresh water and/or salt water in two or more reservoirs

- **Standard units** may include, but are NOT limited to:
  - cubic meters
  - kilograms
  - liters
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>3-ESS3-1 Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science &amp; Engineering Practices</strong></td>
<td><strong>Disciplinary Core Ideas</strong></td>
</tr>
<tr>
<td>Engaging in Argument from Evidence</td>
<td>ESS3.B: Natural Hazards</td>
</tr>
<tr>
<td>Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</td>
<td>• A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. <em>(Note: This Disciplinary Core Idea is also addressed by 4-ESS3-2.)</em></td>
</tr>
<tr>
<td>• Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.</td>
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<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F pp. 13–14</td>
<td>Appendix E p. 3</td>
<td>Appendix G pp. 5–6, Appendix J pp. 3–4, Appendix H p. 6</td>
</tr>
</tbody>
</table>

Clarification Statement
Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lighting rods.

Assessment Boundary
An assessment boundary is not provided for this PE.
Items may ask students to:

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</tr>
</thead>
<tbody>
<tr>
<td>3-ESS3-1.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Make a claim</strong>, using <strong>cause and effect</strong> relationships, about the merit of a <strong>design solution</strong> that reduces the impact of a <strong>weather-related natural hazard</strong>.</td>
</tr>
<tr>
<td>3-ESS3-1.2</td>
<td>SEP-DCI</td>
<td><strong>Make a claim</strong> about the merit of a <strong>design solution</strong> that reduces the impact of a <strong>weather-related natural hazard</strong>.</td>
</tr>
<tr>
<td>3-ESS3-1.3</td>
<td>DCI-CCC</td>
<td>Use <strong>cause and effect</strong> relationships to connect a <strong>weather-related natural hazard</strong> to the impacts of that hazard.</td>
</tr>
<tr>
<td>3-ESS3-1.4</td>
<td>SEP-CCC</td>
<td><strong>Make a claim</strong>, using cause and effect relationships, about the merit of a design solution.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Make a claim** is expanded to include:
  - using evidence to support an argument and/or a claim
  - developing an argument and/or making a claim based on evidence, data, and/or a simple model
  - distinguishing between observations and inferences in an explanation and/or argument
  - comparing and/or refining arguments and/or claims based on evidence
  - using evidence to make a claim about the merit of a solution to a problem by describing how well the solution meets the criteria and/or the constraints of a problem

- Examples of a **design solution** may include, but are NOT limited to:
  - a dam or levee
  - a lightning rod
  - a change to the structure of a building
  - a coastal barrier

- **Weather-related natural hazards** may include, but are NOT limited to:
  - heavy rain and/or snow
  - lightning
  - low-pressure weather systems

- **Cause and effect** relationships may include, but are NOT limited to:
  - heavy rain or snow causing flooding and/or coastal erosion
  - lightning causing a forest fire or damage due to electrical energy
  - low-pressure weather systems causing tornadoes and/or hurricanes
  - a dam or levee controlling flooding in a town
  - a lightning rod reducing the chance of fire resulting from a lightning strike
  - changing the structure of a building to reduce wind or water damage
  - adding a coastal barrier to protect roads and/or buildings from high waves
|-------------------------|---------------------------------|------------------------|----------------------|
| 4-ESS3-1                | Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. | ESS3.A: Natural Resources  
- Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. | Cause and Effect  
- Cause and effect relationships are routinely identified and used to explain change.  
Connections to Engineering, Technology, and Applications of Science  
Interdependence of Science, Engineering, and Technology  
- Knowledge of relevant scientific concepts and research findings is important in engineering.  
Influence of Engineering, Technology, and Science on Society and the Natural World  
- Over time, people's needs and wants change, as do their demands for new and improved technologies. |

These item specifications were developed using the following reference materials:

| K-12 Framework | pp. 74–77 | pp. 191–192 | pp. 87–89  
pp. 210–212  
pp. 212–214 |
|----------------|-----------|-------------|-------------|
| NGSS Appendices | Appendix F p. 15 | Appendix E p. 3 | Appendix G pp. 5–6  
Appendix J pp. 3–4 |
| Clarification Statement | Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels. |
| Assessment Boundary | An assessment boundary is not provided for this PE. |
Items may ask students to:

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<th>Item Specification</th>
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</thead>
<tbody>
<tr>
<td>4-ESS3-1.1</td>
<td>SEP-DCI-CCC</td>
<td>Obtain and combine information to describe how human use of energy and/or fuels derived from renewable and/or non-renewable resources can cause changes to the environment.</td>
</tr>
<tr>
<td>4-ESS3-1.2</td>
<td>SEP-DCI</td>
<td>Obtain and combine information to describe the human use of energy and/or fuels derived from renewable and/or non-renewable resources.</td>
</tr>
<tr>
<td>4-ESS3-1.3</td>
<td>DCI-CCC</td>
<td>Use cause and effect relationships to connect the human use of energy and/or fuels derived from renewable and/or non-renewable resources to changes to the environment.</td>
</tr>
<tr>
<td>4-ESS3-1.4</td>
<td>SEP-CCC</td>
<td>Obtain and combine information to identify cause and effect relationships.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Obtain and combine information** is expanded to include:
  - summarizing information to describe a scientific concept and/or support a scientific claim
  - comparing information to describe a scientific concept and/or support a scientific claim

- **Information** formats may include, but are NOT limited to:
  - text
  - diagrams
  - graphs
  - tables
  - models
  - animations

- **Renewable resources** may include, but are NOT limited to:
  - wind
  - water behind dams
  - sunlight
  - waves

- **Non-renewable resources** may include, but are NOT limited to:
  - fossil fuels
  - nuclear energy

- **Cause and effect** relationships may include, but are NOT limited to:
  - use of a natural resource decreases the availability of that resource
  - use of nonrenewable fuel resources decreases available habitats
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td><strong>Science &amp; Engineering Practices</strong>&lt;br&gt;<strong>Obtaining, Evaluating, and Communicating Information</strong>&lt;br&gt;Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.&lt;br&gt;• Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.</td>
</tr>
<tr>
<td></td>
<td><strong>Disciplinary Core Ideas</strong>&lt;br&gt;<strong>ESS3.C: Human Impacts on Earth Systems</strong>&lt;br&gt;• Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth’s resources and environments.</td>
</tr>
<tr>
<td></td>
<td><strong>Crosscutting Concepts</strong>&lt;br&gt;<strong>Systems and System Models</strong>&lt;br&gt;• A system can be described in terms of its components and their interactions.</td>
</tr>
<tr>
<td></td>
<td><strong>Crosscutting Concepts</strong>&lt;br&gt;<strong>Connections to Nature of Science</strong>&lt;br&gt;<strong>Science Addresses Questions About the Natural and Material World</strong>&lt;br&gt;• Science findings are limited to questions that can be answered with empirical evidence.</td>
</tr>
</tbody>
</table>

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</tr>
</tbody>
</table>

Clarification Statement<br>A clarification statement is not provided for this PE.

Assessment Boundary<br>An assessment boundary is not provided for this PE.
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<tbody>
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<td>5-ESS3-1.1</td>
<td>SEP-DCI-CCC</td>
<td>Obtain and/or combine information about the components of and/or interactions between Earth’s resources and/or environments and the ways individual communities use science ideas to protect them from the effects of human activities.</td>
</tr>
<tr>
<td>5-ESS3-1.2</td>
<td>SEP-DCI</td>
<td>Obtain and/or combine information about the effects of human activities on Earth’s resources and/or environments.</td>
</tr>
<tr>
<td>5-ESS3-1.3</td>
<td>DCI-CCC</td>
<td>Connect the components of and/or interactions between Earth’s resources and/or environments and the ways individual communities use science ideas to protect them from the effects of human activities.</td>
</tr>
<tr>
<td>5-ESS3-1.4</td>
<td>SEP-CCC</td>
<td>Obtain and/or combine information about the components of and/or interactions within a system.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Obtain** and/or combine information is expanded to include:
  - summarizing information to describe a scientific concept and/or support a scientific claim
  - comparing information to describe a scientific concept and/or support a scientific claim

- **Information** formats may include, but are NOT limited to:
  - text
  - diagrams
  - graphs
  - tables
  - models
  - animations

- Ways to **protect** Earth’s resources and/or environments may include, but are NOT limited to:
  - reusing and/or recycling materials to reduce trash
  - developing and/or choosing alternative sources of energy and/or fuels
  - developing technologies that preserve ecosystems
  - protecting areas to prevent future habitat loss

- **Effects** of human activities on Earth’s resources and/or environments may include, but are NOT limited to:
  - modifying bodies of water affects the quality, availability, and/or distribution of Earth’s water
  - use of forest land for development disrupts ecosystems
  - some industries decrease air quality
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>4-ESS3-2</th>
<th>Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science &amp; Engineering Practices</strong></td>
<td><strong>Disciplinary Core Ideas</strong></td>
<td><strong>Crosscutting Concepts</strong></td>
</tr>
<tr>
<td>Constructing Explanations and Designing Solutions</td>
<td>ESS3.B: Natural Hazards</td>
<td></td>
</tr>
<tr>
<td>Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</td>
<td>• A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. <em>(Note: This Disciplinary Core Idea can also be found in 3.WC.)</em></td>
<td></td>
</tr>
<tr>
<td>• Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.</td>
<td>ETS1.B: Designing Solutions to Engineering Problems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Testing a solution involves investigating how well it performs under a range of likely conditions. <em>(secondary)</em></td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>Cause and Effect</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Cause and effect relationships are routinely identified, tested, and used to explain change.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connections to Engineering, Technology, and Applications of Science</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands.</td>
<td></td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

- **K-12 Framework**
  - pp. 67–71
  - pp. 192–194
  - pp. 206–208
  - pp. 87–89

- **NGSS Appendices**
  - Appendix F
  - pp. 11–12
  - Appendix E
  - p. 3
  - Appendix I
  - pp. 1–7

- **Clarification Statement**
  - Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.

- **Assessment Boundary**
  - Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-ESS3-2.1</td>
<td>SEP-DCI-CCC</td>
<td>Generate and/or compare solutions, using cause and effect relationships, to reduce the impacts of natural hazards on humans.</td>
</tr>
<tr>
<td>4-ESS3-2.2</td>
<td>SEP-DCI</td>
<td>Generate and/or compare solutions to reduce the impacts of natural hazards on humans.</td>
</tr>
<tr>
<td>4-ESS3-2.3</td>
<td>DCI-CCC</td>
<td>Use cause and effect relationships to connect human solutions to the reduction of impacts from natural hazards.</td>
</tr>
<tr>
<td>4-ESS3-2.4</td>
<td>SEP-CCC</td>
<td>Generate and/or compare multiple solutions to a problem, using cause and effect relationships.</td>
</tr>
</tbody>
</table>

Details and Clarifications

- **Generate** and/or compare solutions is expanded to include:
  - using measurements, observations, and/or patterns to support an explanation
  - using measurements, observations, and/or patterns to generate and/or compare solutions to a problem
  - using evidence to design a solution to a problem
  - comparing solutions to a problem as to how well they meet criteria for success
  - comparing solutions in terms of constraints that limit the success of the solution

- **Solutions** may include, but are NOT limited to:
  - reducing the impact of a hazard through engineering of materials, structures, and/or landscapes
  - restricting humans from living in hazard-prone areas
  - monitoring and/or early warning systems

- **Impacts** of natural hazards may include, but are NOT limited to:
  - damage to or destruction of property
  - ecological changes (e.g., loss of habitat)
  - disruption of human activities

- **Natural hazards** resulting from natural processes include:
  - earthquakes
  - floods
  - tsunamis
  - volcanic eruptions

- **Cause and effect** relationships may include, but are NOT limited to:
  - an early warning system gives humans more time to evacuate an area
  - sandbags reduce water damage from a flood
  - tsunami evacuation routes allow people to move quickly to safe locations
Engineering, Technology, and Applications of Science

Disciplinary Core Ideas:

- ETS1 Engineering Design
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science &amp; Engineering Practices</strong></td>
<td><strong>Disciplinary Core Ideas</strong></td>
</tr>
<tr>
<td><strong>Asking Questions and Defining Problems</strong></td>
<td>ETS1.A: Defining and Delimiting Engineering Problems</td>
</tr>
<tr>
<td>Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.</td>
<td>• Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.</td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F</td>
<td>Appendix I</td>
<td>Appendix J</td>
</tr>
<tr>
<td>pp. 4–5</td>
<td>pp. 1–7</td>
<td>pp. 3–4</td>
<td></td>
</tr>
</tbody>
</table>

**Clarification Statement**
A clarification statement is not provided for this PE.

**Assessment Boundary**
An assessment boundary is not provided for this PE.
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-5-ETS1-1.1</td>
<td>SEP-DCI-CCC</td>
<td><strong>Define</strong> a simple design <strong>problem</strong> reflecting a need and/or a want that</td>
</tr>
<tr>
<td></td>
<td></td>
<td>includes specified <strong>criteria</strong> for a successful solution and/or <strong>constraints</strong> on</td>
</tr>
<tr>
<td></td>
<td></td>
<td>materials, time, and/or cost that could limit the success of a solution.</td>
</tr>
<tr>
<td>3-5-ETS1-1.2</td>
<td>SEP-DCI</td>
<td><strong>Define</strong> a simple design <strong>problem</strong> that includes specified <strong>criteria</strong> for a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>successful solution and/or <strong>constraints</strong> on materials, time, and/or cost that</td>
</tr>
<tr>
<td></td>
<td></td>
<td>could limit the success of a solution.</td>
</tr>
<tr>
<td>3-5-ETS1-1.3</td>
<td>DCI-CCC</td>
<td>Connect <strong>criteria</strong> for a successful solution and/or <strong>constraints</strong> on materials,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>time, and/or cost that could limit the success of a solution to a design <strong>problem</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>that reflects a need and/or a want.</td>
</tr>
<tr>
<td>3-5-ETS1-1.4</td>
<td>SEP-CCC</td>
<td><strong>Define</strong> a simple design <strong>problem</strong> that reflects a need and/or a want.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Define** a simple design **problem** is expanded to include:
  - asking questions about what would happen if a variable is changed
  - asking and/or identifying questions that can be answered through observation and/or investigation
  - predicting the outcome of questions that can be answered through observation and/or investigation
  - asking questions about observations, data, claims, and/or proposed designs
  - describing criteria for a successful solution
  - describing constraints on materials, time, and/or cost that could limit the success of a solution

- **Criteria** for a successful solution may include, but are NOT limited to:
  - relatively high degree of safety
  - relatively high effectiveness in solving specific aspects of the given problem
  - relatively low cost
  - relatively short time needed to implement
  - readily available materials

- **Constraints** that could limit the success of a solution may include, but are NOT limited to:
  - relative lack of safety
  - relative deficiency in solving specific aspects of the given problem
  - relatively high cost
  - relatively long period of time to implement
  - materials that are difficult to acquire
<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td><strong>Science &amp; Engineering Practices</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Constructing Explanations and Designing Solutions</strong> Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.</td>
</tr>
<tr>
<td></td>
<td><strong>Disciplinary Core Ideas</strong> <strong>ETS1.B: Developing Possible Solutions</strong> • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.</td>
</tr>
<tr>
<td></td>
<td><strong>Crosscutting Concepts</strong> <strong>Influence of Science, Engineering, and Technology on Society and the Natural World</strong> • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.</td>
</tr>
<tr>
<td></td>
<td>These item specifications were developed using the following reference materials:</td>
</tr>
<tr>
<td></td>
<td><strong>NGSS Appendices</strong> Appendix F Appendix I Appendix J</td>
</tr>
<tr>
<td></td>
<td><strong>Clarification Statement</strong> A clarification statement is not provided for this PE.</td>
</tr>
<tr>
<td></td>
<td><strong>Assessment Boundary</strong> An assessment boundary is not provided for this PE.</td>
</tr>
<tr>
<td>Code</td>
<td>Alignment</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------</td>
</tr>
<tr>
<td>3-5-ETS1-2.1</td>
<td>SEP-DCI-CCC</td>
</tr>
<tr>
<td>3-5-ETS1-2.2</td>
<td>SEP-DCI</td>
</tr>
<tr>
<td>3-5-ETS1-2.3</td>
<td>DCI-CCC</td>
</tr>
<tr>
<td>3-5-ETS1-2.4</td>
<td>SEP-CCC</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Compare solutions** is expanded to include:
  - using measurements, observations, and/or patterns to support an explanation
  - using measurements, observations, and/or patterns to generate and/or compare solutions to a problem
  - using evidence to design a solution to a problem
  - comparing solutions to a problem as to how well they meet criteria for success
  - comparing solutions in terms of constraints that limit the success of the solution

- **Criteria** for a successful solution may include, but are NOT limited to:
  - relatively high degree of safety
  - relatively high effectiveness in solving specific aspects of the given problem
  - relatively low cost
  - relatively short time needed to implement
  - readily available materials

- **Constraints** that could limit the success of a solution may include, but are NOT limited to:
  - relative lack of safety
  - relative deficiency in solving specific aspects of the given problem
  - relatively high cost
  - relatively long period of time to implement
  - materials that are difficult to acquire

- **Research** and/or **test results** may include, but are NOT limited to:
  - Internet research
  - market research
  - experimental results
  - field observations

- **Improvements** of a solution to increase **benefits**, decrease **risks**, and/or meet **societal demands** may include, but are NOT limited to:
  - decreasing costs required to implement a solution
  - increasing the safety, resilience, and/or reliability of a solution
  - increasing the efficiency of a solution
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions</strong></td>
<td>Planning and Carrying Out Investigations</td>
<td>ETS1.B: Developing Possible Solutions</td>
<td>ETS1.C: Optimizing the Design Solution</td>
</tr>
<tr>
<td></td>
<td>Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.</td>
<td>• Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.</td>
<td>• Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.</td>
</tr>
<tr>
<td></td>
<td>• Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These item specifications were developed using the following reference materials:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>NGSS Appendices</td>
<td>Appendix F</td>
<td>Appendix I</td>
<td>pp. 1–7</td>
</tr>
<tr>
<td>Clarification Statement</td>
<td>A clarification statement is not provided for this PE.</td>
<td></td>
<td></td>
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<tr>
<td>Assessment Boundary</td>
<td>An assessment boundary is not provided for this PE.</td>
<td></td>
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</tbody>
</table>
Items may ask students to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Alignment</th>
<th>Item Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-5-ETS1-3.1</td>
<td>SEP-DCI-CCC</td>
<td>Due to the lack of a CCC, items are not coded 3-5-ETS1-3.1.</td>
</tr>
<tr>
<td>3-5-ETS1-3.2</td>
<td>SEP-DCI</td>
<td><strong>Plan and/or carry out fair tests</strong> in which variables are controlled and/or <strong>failure points</strong> are considered to identify <strong>aspects</strong> of a <strong>model</strong> and/or <strong>prototype</strong> that can be improved.</td>
</tr>
<tr>
<td>3-5-ETS1-3.3</td>
<td>DCI-CCC</td>
<td>Due to the lack of a CCC, items are not coded 3-5-ETS1-3.3.</td>
</tr>
<tr>
<td>3-5-ETS1-3.4</td>
<td>SEP-CCC</td>
<td>Due to the lack of a CCC, items are not coded 3-5-ETS1-3.4.</td>
</tr>
</tbody>
</table>

**Details and Clarifications**

- **Plan and/or carry out fair tests** is expanded to include:
  - identifying relevant variables and/or data to be gathered in an investigation
  - describing appropriate methods and/or tools to collect data
  - collecting data that can be used to support an explanation, make comparisons, and/or make predictions

- Examples of **failure points** may include, but are NOT limited to:
  - not meeting one or more criteria for a successful solution
  - having one or more constraints that limit the success of a solution

- Examples of **aspects** of a **model** and/or **prototype** may include, but are NOT limited to:
  - inputs, outputs, and/or flow of energy and/or matter in a device
  - physical characteristics of a device
  - steps in a process
SEP, DCI, and CCC Vocabulary Used in Assessment Items at Grade 5

Items use language targeted to the previous grade level or lower readability with the exception of the required SEP, DCI, and CCC terms in the following list.

a
- advantage
- amplitude
- angle
- attract
- axis

b
- balanced force
- behavior
- biosphere

c
- camouflage
- cause
- characteristic
- charge
- claim
- classify
- climate
- collide
- collision
- compare
- conclusion
- conductivity
- conserve
- constraint
- continent
- criteria

d
- data
- decomposer
- decrease
- deep ocean trench
- defend
- demonstration
- describe
- design
- development
- device

- diagram
- digital signal
- direction
- disadvantage
- disease
- distance

e
- earthquake
- ecosystem
- effect
- electric current
- electric force
- electrical energy
- electricity
- electromagnet
- energy
- engineer
- environment
- erosion
- eruption
- evaporate
- evidence
- exert
- extinct

f
- factor
- fault
- food web
- force
- fossil
- fossil fuel
- function
- fungi

- graph
- gravitational force
- gravity
- groundwater

h
- habitat
- hazard
- heat energy
- hydrosphere

i
- impact
- increase
- information
- inherit
- input
- interaction
- investigation

l
- landform
- life cycle
- light energy
- limitation
- liquid

m
- magnet
- magnetic
- magnetic force
- marine
- mass
- mate
- material
- matter
- measure
- mineral
- model
- motion
- motion energy
n
nonrenewable

o
object
observation
offspring
orbit
organism
output

p
particle
pattern
physical property
planet
polar ice cap
pole (of a magnet)
pollution
population
precipitation
predator
predict
prediction
process
property

q
quantity

r
recycle
reduce
reflect
relationship
renewable
repel
reproduction
research
resource
response
result
rock formation
rock layer
rotate

runoff
wind energy

s
scientist
sediment
sense
sense receptor
similarity
simulation
solar energy
solid
solution (to a problem)
sound energy
species
speed
stability
state (of matter)
structure
substance
subsystem
support
surface
survive
system

r
technology
temperature
trait
transfer
tsunami

u
unbalanced force

v
variable
volcano
volume

w
wave
wavelength
weathering
wetland