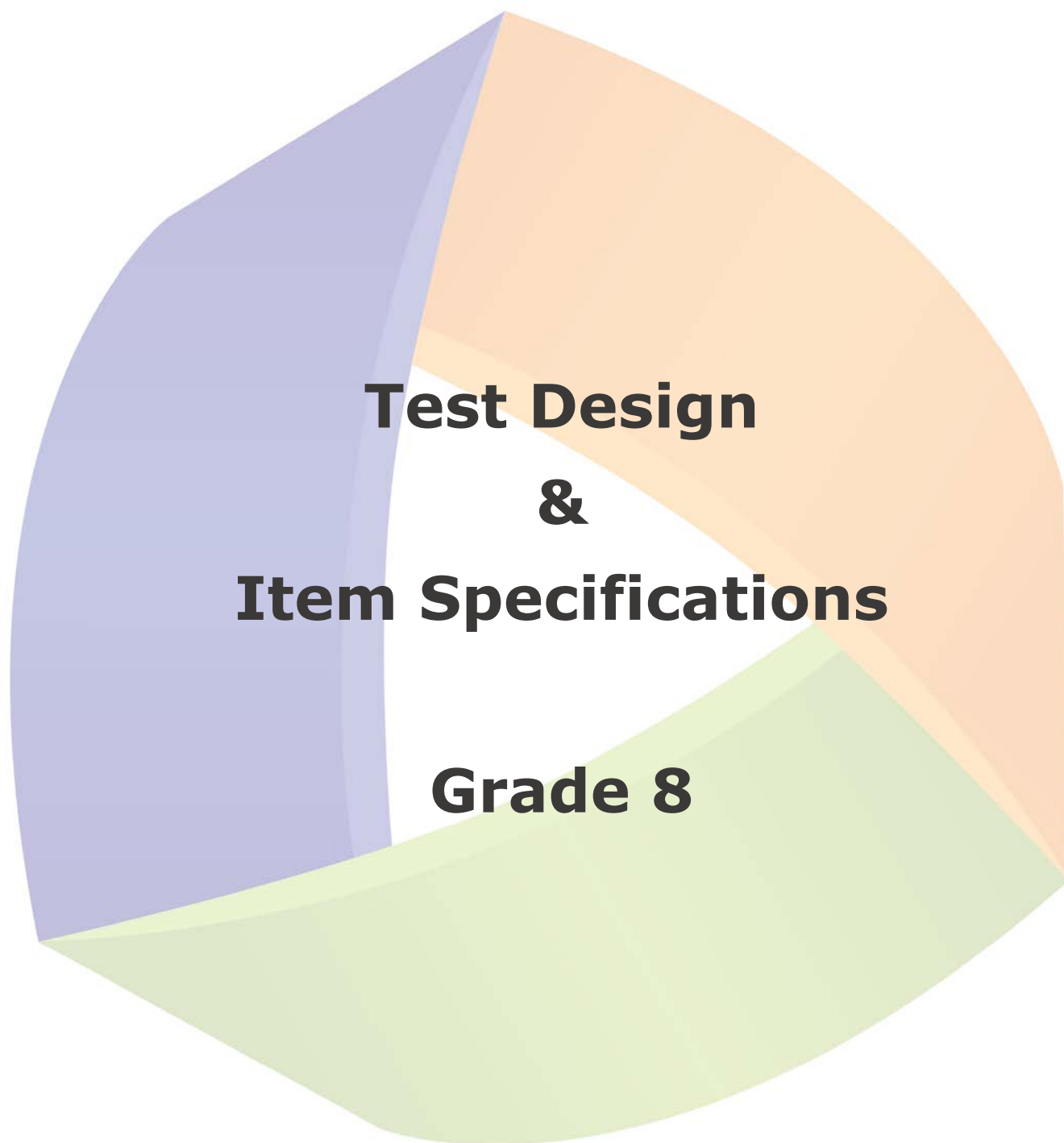


# **Washington Comprehensive Assessment of Science**



Office of Superintendent of Public Instruction



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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 current draft represents a small sample of PEs; full PE coverage should be achieved by the end of the 2018-19 school year. The 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.

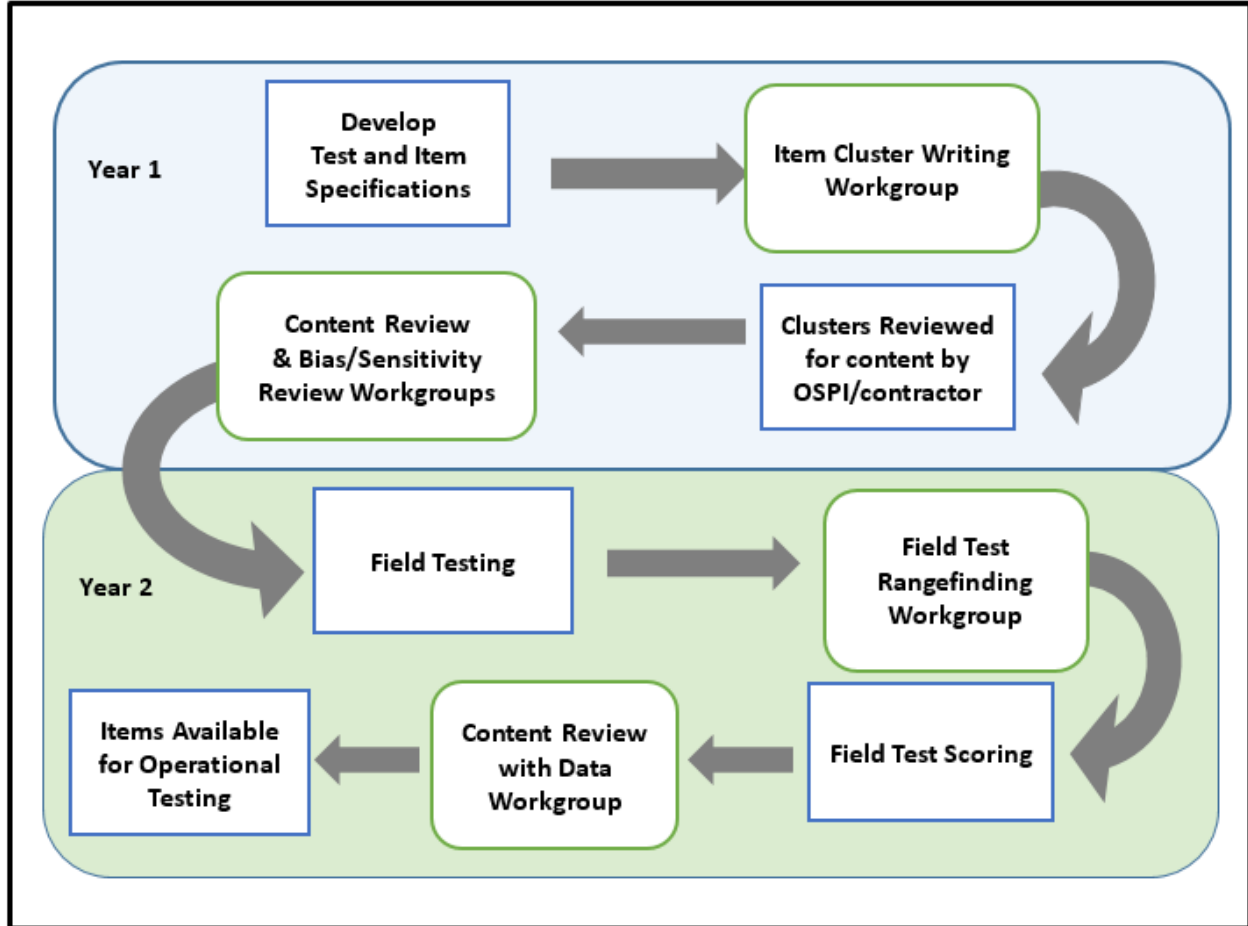
## Assessment Development Cycle

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.

## Science Assessment Development Cycle



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 Rangingfindng 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.

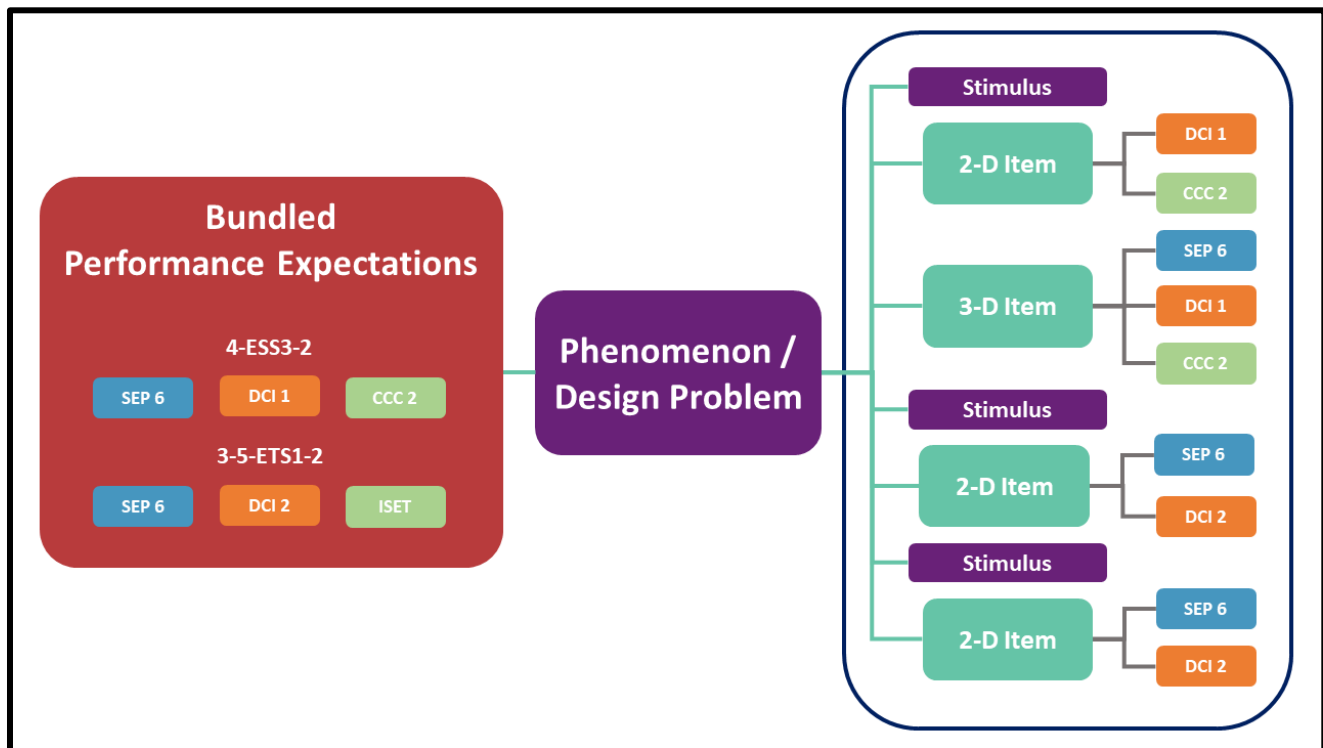
### Item Clusters

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 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
  - Students place arrows, symbols, labels, or other graphical elements into predesignated boxes on a background graphic.
  - The elements are designated as refreshable (able to be used multiple times) or non-refreshable (able to be used only one time).
- Hot Spot
  - 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 135-minute administration time includes 30 minutes for giving directions and distributing materials, 90 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.

A periodic table is embedded in the online platform for all items in the WCAS for grade 8 and high school. A printable version of the [periodic table](#) can be downloaded for classroom use on the [WCAP Portal](#).

## Test Blueprint

The total number of points for the WCAS at grade 8 will be 40 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. ETS points are not specified, and ETS PEs were not included when calculating the percentages.

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

**Table 1**

<b>Reporting Area</b>	<b>Percentage of PEs per Science Domain in the Standards</b>	<b>Percentage Range for the WCAS per Science Domain</b>	<b>Score Point Range for the WCAS per Science Domain</b>
Practices and Crosscutting Concepts in Physical Sciences	35%	30–40%	12–16
Practices and Crosscutting Concepts in Life Sciences	38%	33–43%	13–17
Practices and Crosscutting Concepts in Earth and Space Sciences	27%	22–32%	9–13

Two grade 8 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 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 middle 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.

## WCAS Item Specifications

The science assessment team at OSPI has been working with assessment research and development partners to create assessment item specifications that will 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 8 WCAS use language targeted to a sixth grade or lower reading level 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.

<b>Performance Expectation</b>	<b>4-LS1-1</b> Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Idea</b>	<b>Crosscutting Concept</b>
	<b>Engaging in Argument from Evidence</b> 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). <ul style="list-style-type: none"> <li>Construct an argument with evidence, data, and/or a model.</li> </ul>	<b>LS1.A: Structure and Function</b> <ul style="list-style-type: none"> <li>Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.</li> </ul>	<b>Systems and System Models</b> <ul style="list-style-type: none"> <li>A system can be described in terms of its components and their interactions.</li> </ul>
These item specifications were developed using the following reference materials:			
K–12 Framework	<a href="#">pp. 71–74</a>	<a href="#">pp. 143–145</a>	<a href="#">pp. 91–94</a>
NGSS Appendices	Appendix F <a href="#">pp. 13–14</a>	Appendix E <a href="#">p. 4</a>	Appendix G <a href="#">pp. 7–8</a>
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:

Code	Alignment	Item Specification
4-LS1-1.1	SEP-DCI-CCC	<b>Construct</b> an <b>argument</b> using <b>system models</b> to describe plants and/or animals in terms of their <b>structures</b> and how the structures interact to serve various survival, growth, behavioral, and/or reproductive <b>functions</b> .
4-LS1-1.2	SEP-DCI	<b>Construct</b> an <b>argument</b> to show that plant and/or animal <b>structures</b> serve various survival, growth, behavioral, and/or reproductive <b>functions</b> .
4-LS1-1.3	DCI-CCC	Use <b>system models</b> to show how plant and/or animal <b>structures</b> serve various survival, growth, behavioral, or reproductive <b>functions</b> .
4-LS1-1.4	SEP-CCC	<b>Construct</b> an <b>argument</b> that connects system components and interactions in a system model.
Details and Clarifications		
<ul style="list-style-type: none"> <li>• <b>Construct</b> an <b>argument</b> is expanded to include: <ul style="list-style-type: none"> <li>○ using evidence to support an argument and/or a claim</li> <li>○ developing an argument based on evidence, data, or a simple model</li> <li>○ distinguishing between observations and inferences in an explanation or argument</li> <li>○ comparing and/or refining arguments based on evidence</li> <li>○ providing feedback on an explanation, an argument, and/or a claim</li> </ul> </li> <li>• <b>Structures</b> and <b>functions</b> may include, but are NOT limited to structures that work together to support: <ul style="list-style-type: none"> <li>○ plants <ul style="list-style-type: none"> <li>• obtaining water/sunlight/air</li> <li>• growing toward sunlight and/or water</li> <li>• defending against herbivores</li> <li>• attracting pollinators</li> </ul> </li> <li>○ animals <ul style="list-style-type: none"> <li>• pumping blood/breathing/moving/digesting food</li> <li>• obtaining food</li> <li>• defending against predators</li> <li>• attracting mates</li> </ul> </li> </ul> </li> <li>• <b>System models</b> may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ an entire organism (plant or animal)</li> <li>○ a subsystem within a plant or animal</li> <li>○ the interactions of structures working together within a plant or animal system or subsystem</li> </ul> </li> </ul>		

As stated earlier in this document, the item specifications that follow represent a small sample of PEs; full PE coverage should be achieved by the end of the 2018-19 school year. The 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.

## Resources

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

## References

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# 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

The item specifications that follow represent a **sample** of PEs. The sample will continue to expand until this document contains all the PEs. The sample of PEs represents only a part of what could be assessed on the WCAS. The inclusion of a PE in this document does not indicate that PE will be assessed by an item on the WCAS, nor does the absence of a PE from this document indicate that the PE will not be assessed on the WCAS.

Future item specifications drafts will include modification logs that will be updated at each subsequent publication.



Performance Expectation	MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concept</b>
	<b>Developing and Using Models</b> Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. <ul style="list-style-type: none"> <li>Develop a model to predict and/or describe phenomena.</li> </ul>	<b>PS1.A: Structure and Properties of Matter</b> <ul style="list-style-type: none"> <li>Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.</li> <li>In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.</li> <li>The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.</li> </ul> <b>PS3.A: Definitions of Energy</b> <ul style="list-style-type: none"> <li>The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary)</li> <li>The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system’s material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system’s total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (secondary)</li> </ul>	<b>Cause and Effect</b> <ul style="list-style-type: none"> <li>Cause and effect relationships may be used to predict phenomena in natural or designed systems.</li> </ul>
These item specifications were developed using the following reference materials:			
K-12 Framework	<a href="#">pp. 56–59</a>	<a href="#">pp. 106–109</a> <a href="#">pp. 120–124</a>	<a href="#">pp. 87–89</a>
NGSS Appendices	Appendix F <a href="#">p. 6</a>	Appendix E <a href="#">p. 7</a>	Appendix G <a href="#">pp. 5–6</a>
Clarification Statement	Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.		
Assessment Boundary	An assessment boundary is not provided for this PE.		

Items may ask students to:

Code	Alignment	Item Specification
MS-PS1-4.1	SEP-DCI-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to predict and/or describe <b>cause and effect</b> relationships between <b>thermal energy transfers</b> into and/or out of a system and changes in the <b>state, particle motion, and/or temperature</b> of pure substances.
MS-PS1-4.2	SEP-DCI	<b>Develop</b> and/or <b>use</b> a <b>model</b> to predict and/or describe the <b>thermal energy</b> of a system in terms of changes in the <b>state, particle motion, and/or temperature</b> of pure substances.
MS-PS1-4.3	DCI-CCC	Use <b>cause and effect</b> relationships to predict and/or describe changes in the <b>state, particle motion, and/or temperature</b> of pure substances when <b>thermal energy</b> transfers into and/or out of a system.
MS-PS1-4.4	SEP-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to predict and/or describe cause and effect relationships in a system.
<b>Details and Clarifications</b>		
<ul style="list-style-type: none"> <li>• <b>Develop</b> and/or <b>use</b> a <b>model</b> is expanded to include:               <ul style="list-style-type: none"> <li>○ using a given complete or partial model to make predictions and/or describe phenomena</li> <li>○ using a model to show relationships among variables</li> <li>○ revising a given complete or partial model</li> <li>○ describing the limitations of a complete or partial model</li> <li>○ using a model to represent current understanding of a system</li> <li>○ using a model to aid in the development of questions and/or descriptions</li> </ul> </li> <li>• <b>Models</b> may include, but are NOT limited to:               <ul style="list-style-type: none"> <li>○ a diagram, simulation, and/or description of interactions among components in a system</li> <li>○ a diagram, simulation, and/or description of a state of matter and/or particle motion within a substance</li> </ul> </li> <li>• <b>Cause and effect</b> relationships related to <b>thermal energy transfers</b> and the <b>state, particle motion, and temperature</b> of substances may include, but are NOT limited to:               <ul style="list-style-type: none"> <li>○ adding thermal energy to a pure substance causes the average kinetic energy of the substance, the motion of the particles, the distance between particles, and/or the average temperature of the substance to increase</li> <li>○ removing thermal energy from a pure substance causes the average kinetic energy of the substance, the motion of the particles, the distance between particles, and/or the average temperature of the substance to decrease</li> <li>○ adding thermal energy to a substance causes the substance to change from a solid to a liquid and/or from a liquid to a gas</li> <li>○ removing thermal energy from a substance causes the substance to change from a gas to a liquid and/or from a liquid to a solid</li> </ul> </li> </ul>		

<b>Performance Expectation</b>	<b>MS-PS2-1</b> Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Idea</b>	<b>Crosscutting Concept</b>
	<b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. <ul style="list-style-type: none"> <li>• Apply scientific ideas or principles to design an object, tool, process or system.</li> </ul>	<b>PS2.A: Forces and Motion</b> <ul style="list-style-type: none"> <li>• For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton’s Third Law).</li> </ul>	<b>Systems and System Models</b> <ul style="list-style-type: none"> <li>• Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.</li> </ul> <b>Connections to Engineering, Technology, and Applications of Science</b>  <b>Influence of Science, Engineering, and Technology on Society and the Natural World</b> <ul style="list-style-type: none"> <li>• The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.</li> </ul>
These item specifications were developed using the following reference materials:			
K-12 Framework	<a href="#">pp. 67–71</a>	<a href="#">pp. 114–116</a>	<a href="#">pp. 91–94</a> <a href="#">pp. 212–214</a>
NGSS Appendices	Appendix F <a href="#">pp. 11–12</a>	Appendix E <a href="#">p. 7</a>	Appendix G <a href="#">pp. 7–8</a> Appendix J <a href="#">pp. 2–3</a>
Clarification Statement	Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.		
Assessment Boundary	Assessment is limited to vertical or horizontal interactions in one dimension.		

Items may ask students to:

Code	Alignment	Item Specification
MS-PS2-1.1	SEP-DCI-CCC	<b>Apply</b> Newton's Third Law to <b>design</b> a <b>solution</b> to a problem involving the motion of two colliding objects <b>interacting</b> in a <b>system</b> .
MS-PS2-1.2	SEP-DCI	<b>Apply</b> Newton's Third Law, to <b>design</b> a <b>solution</b> to a problem involving the motion of two colliding objects.
MS-PS2-1.3	DCI-CCC	Use a <b>model</b> to connect Newton's Third Law to the motion of two colliding objects <b>interacting</b> in a <b>system</b> .
MS-PS2-1.4	SEP-CCC	<b>Design</b> a <b>solution</b> to a problem involving interactions within a system.
Details and Clarifications		
<ul style="list-style-type: none"> <li>• <b>Design a solution</b> is expanded to include: <ul style="list-style-type: none"> <li>○ using valid data, models, and/or scientific knowledge to construct, revise, and/or support an explanation and/or design a solution</li> <li>○ using qualitative and/or quantitative relationships between variables to predict and/or describe phenomena</li> <li>○ using models and/or evidence to support explanations</li> <li>○ applying scientific principles to design a tool, process, or system that meets specific criteria and/or constraints</li> </ul> </li> <li>• <b>Apply</b> Newton's Third Law may include, but is NOT limited to: <ul style="list-style-type: none"> <li>○ identifying the components involved in a collision</li> <li>○ calculating the forces exerted by each object involved in the collision</li> <li>○ identifying criteria for a successful design (e.g., reducing damage to colliding objects)</li> <li>○ identifying constraints that limit the success of a given design (e.g., relatively high cost)</li> <li>○ describing technologies used in the design</li> <li>○ identifying the value of the design</li> </ul> </li> <li>• <b>Interactions</b> in a <b>system</b> may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ the inputs and/or outputs of a system</li> <li>○ relationships between the components of a system</li> <li>○ processes occurring within a system</li> </ul> </li> </ul>		

<b>Performance Expectation</b>	<b>MS-PS2-5</b> Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Idea</b>	<b>Crosscutting Concept</b>
	<b>Planning and Carrying Out Investigations</b> Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. <ul style="list-style-type: none"> <li>Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.</li> </ul>	<b>PS2.B: Types of Interactions</b> <ul style="list-style-type: none"> <li>Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).</li> </ul>	<b>Cause and Effect</b> <ul style="list-style-type: none"> <li>Cause and effect relationships may be used to predict phenomena in natural or designed systems.</li> </ul>
These item specifications were developed using the following reference materials:			
K–12 Framework	<a href="#">pp. 59–61</a>	<a href="#">pp. 116–118</a>	<a href="#">pp. 87–89</a>
NGSS Appendices	Appendix F <a href="#">pp. 7–8</a>	Appendix E <a href="#">p. 7</a>	Appendix G <a href="#">pp. 5–6</a>
Clarification Statement	Examples of this phenomenon could include the interactions of magnets, electrically charged strips of tape, and electrically charged pith balls. Examples of investigations could include first-hand experiences or simulations.		
Assessment Boundary	Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.		

Items may ask students to:

Code	Alignment	Item Specification
MS-PS2-5.1	SEP-DCI-CCC	<b>Conduct</b> and/or <b>evaluate</b> an <b>investigation</b> to provide <b>evidence</b> of the <b>cause and effect</b> relationships between <b>forces</b> that can act at a distance and the <b>fields</b> that exist between objects.
MS-PS2-5.2	SEP-DCI	<b>Conduct</b> and/or <b>evaluate</b> an <b>investigation</b> to provide evidence that <b>forces</b> can act at a distance due to <b>fields</b> that exist between objects.
MS-PS2-5.3	DCI-CCC	Use <b>cause and effect</b> relationships to connect <b>forces</b> that act at a distance to <b>fields</b> between objects.
MS-PS2-5.4	SEP-CCC	<b>Conduct</b> and/or <b>evaluate</b> an <b>investigation</b> of cause and effect relationships.
Details and Clarifications		
<ul style="list-style-type: none"> <li>• <b>Conduct</b> and/or <b>evaluate</b> an <b>investigation</b> is expanded to include: <ul style="list-style-type: none"> <li>○ conducting an investigation to produce evidence</li> <li>○ identifying independent, dependent, and/or controlled variables</li> <li>○ making predictions about what would happen if a variable changes</li> <li>○ evaluating appropriate methods and/or tools for collecting and/or recording data</li> </ul> </li> <li>• <b>Fields</b> and <b>forces</b> may include: <ul style="list-style-type: none"> <li>○ electric fields and electric forces</li> <li>○ magnetic fields and magnetic forces</li> </ul> </li> <li>• <b>Evidence</b> of <b>cause and effect</b> relationships may include, but is NOT limited to: <ul style="list-style-type: none"> <li>○ observation of change in motion due to attraction or repulsion between magnets</li> <li>○ observation of change in motion due to attraction or repulsion between electric charges</li> <li>○ descriptions of how the force exerted by one magnetic object causes another magnetic object to move or change motion</li> <li>○ descriptions of how the force exerted by one charged object causes another charged object to move or change motion</li> </ul> </li> </ul>		

Performance Expectation	MS-PS3-3 Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concept</b>
	<b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. <ul style="list-style-type: none"> <li>• Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.</li> </ul>	<b>PS3.A: Definitions of Energy</b> <ul style="list-style-type: none"> <li>• Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.</li> </ul> <b>PS3.B: Conservation of Energy and Energy Transfer</b> <ul style="list-style-type: none"> <li>• Energy is spontaneously transferred out of hotter regions or objects and into colder ones.</li> </ul> <b>ETS1.A: Defining and Delimiting an Engineering Problem</b> <ul style="list-style-type: none"> <li>• The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary)</li> </ul> <b>ETS1.B: Developing Possible Solutions</b> <ul style="list-style-type: none"> <li>• A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary)</li> </ul>	<b>Energy and Matter</b> <ul style="list-style-type: none"> <li>• The transfer of energy can be tracked as energy flows through a designed or natural system.</li> </ul>
These item specifications were developed using the following reference materials:			
K-12 Framework	<a href="#">pp. 67–71</a>	<a href="#">pp. 120–126</a> <a href="#">pp. 204–208</a>	<a href="#">pp. 94–96</a>
NGSS Appendices	Appendix F <a href="#">pp. 11–12</a>	Appendix E <a href="#">p. 7</a> Appendix I <a href="#">pp. 1–7</a>	Appendix G <a href="#">pp. 8–9</a>
Clarification Statement	Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.		
Assessment Boundary	Assessment does not include calculating the total amount of thermal energy transferred.		

Items may ask students to:

Code	Alignment	Item Specification
MS-PS3-3.1	SEP-DCI-CCC	<b>Apply scientific</b> and <b>design principles</b> to design, construct, and/or test a <b>device</b> that either minimizes or maximizes <b>thermal energy transfer</b> .
MS-PS3-3.2	SEP-DCI	Due to strong overlap between the DCI and the CCC, items are not coded MS-PS3-3.2.
MS-PS3-3.3	DCI-CCC	Track <b>energy transfers</b> in a system that either minimizes or maximizes <b>thermal energy transfers</b> .
MS-PS3-3.4	SEP-CCC	<b>Apply scientific</b> and <b>design principles</b> to design, construct, and/or test a design that tracks energy transfer of through a system.
Details and Clarifications		
<ul style="list-style-type: none"> <li>• <b>Apply scientific principles</b> to design, test, and modify a <b>device</b> may be expanded to include:               <ul style="list-style-type: none"> <li>○ using valid data, models, and/or scientific knowledge to construct, revise, and/or support an explanation and/or design a solution</li> <li>○ using qualitative and/or quantitative relationships between variables to predict and/or describe phenomena</li> <li>○ using models and/or evidence to support explanations</li> <li>○ applying scientific principles to design a tool, process, or system that meets specific criteria and/or constraints</li> </ul> </li> <li>• <b>Apply design principles</b> may be expanded to include:               <ul style="list-style-type: none"> <li>○ describing criteria for a successful solution (e.g., the minimum or maximum difference in temperature the device is designed to maintain; the relative amount of time the device is required to maintain the minimum or maximum temperature; the relative durability, cost, and/or availability of the materials for the device; the relative rate at which the device transfers thermal energy)</li> <li>○ describing constraints that may limit the success of a solution (e.g., the cost and/or availability of the materials required for the design, the safety of the device, the time to manufacture the device)</li> <li>○ describing a test to use for evaluating how well a given solution meets criteria and/or constraints for a successful solution</li> </ul> </li> <li>• <b>Transfer of thermal energy</b> may include, but is NOT limited to:               <ul style="list-style-type: none"> <li>○ energy transferred from hotter areas to colder areas within and/or between systems</li> <li>○ energy transferred when two systems or objects are different temperatures</li> </ul> </li> </ul>		

<b>Performance Expectation</b>	<b>MS-PS4-2</b> Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.		
Dimensions	<b>Science &amp; Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts</b>
	<b>Developing and Using Models</b> Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. <ul style="list-style-type: none"> <li>• Develop and use a model to describe phenomena.</li> </ul>	<b>PS4.A: Wave Properties</b> <ul style="list-style-type: none"> <li>• A sound wave needs a medium through which it is transmitted.</li> </ul> <b>PS4.B: Electromagnetic Radiation</b> <ul style="list-style-type: none"> <li>• When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object’s material and the frequency (color) of the light.</li> <li>• The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.</li> <li>• A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.</li> <li>• However, because light can travel through space, it cannot be a matter wave, like sound or water waves.</li> </ul>	<b>Structure and Function</b> <ul style="list-style-type: none"> <li>• Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.</li> </ul>
These item specifications were developed using the following reference materials:			
K–12 Framework	<a href="#">pp. 56–59</a>	<a href="#">pp. 131–136</a>	<a href="#">pp. 96–98</a>
NGSS Appendices	Appendix F <a href="#">p. 6</a>	Appendix E <a href="#">p. 8</a>	Appendix G <a href="#">pp. 9–10</a>
Clarification Statement	Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.		
Assessment Boundary	Assessment is limited to qualitative applications pertaining to light and mechanical waves.		

Items may ask students to:

Code	Alignment	Item Specification
MS-PS4-2.1	SEP-DCI-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe that <b>wave interactions</b> with materials can support the use of materials for certain <b>functions</b> .
MS-PS4-2.2	SEP-DCI	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe how <b>waves</b> and different materials <b>interact</b> .
MS-PS4-2.3	DCI-CCC	Use <b>wave interactions</b> with materials to support the use of materials for certain <b>functions</b> .
MS-PS4-2.4	SEP-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe how the structure of a material relates to the function of the material.

#### Details and Clarifications

- **Develop** and/or **use** a **model** is expanded to include:
  - using a given complete or partial model to make predictions and/or describe phenomena
  - using a model to show relationships among variables
  - revising a given complete or partial model
  - describing the limitations of a complete or partial model
  - using a model to represent current understanding of a system
  - using a model to aid in the development of questions and/or descriptions
- **Models** of the properties of **wave interactions** with materials may include, but are not limited to, a diagram, simulation, or written description of:
  - the amplitude, frequency, wavelength, and/or path of a mechanical wave propagating through a medium or interacting with a material
  - the amplitude, frequency, wavelength, and/or path of a light wave interacting with a material
  - properties of a medium (e.g., state of matter, temperature) through which a sound wave propagates
  - properties of a material (e.g., texture, color, transparency, hardness) that is interacting with a wave
  - changes in amplitude, frequency, wavelength, or direction of light or mechanical waves that result from interactions with materials
  - the reflection of waves by smooth surfaces
  - the absorption of waves by materials
  - the transmission of waves through materials
  - the bending of wave paths that pass from one material or medium to another
- **Structure and function** relationships between waves and materials may include, but are NOT limited to:
  - the functions of reflective, translucent, or opaque materials
  - the speed of waves through different materials
  - the use of lenses to bend light

# 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

The item specifications that follow represent a **sample** of PEs. The sample will continue to expand until this document contains all the PEs. The sample of PEs represents only a part of what could be assessed on the WCAS. The inclusion of a PE in this document does not indicate that PE will be assessed by an item on the WCAS, nor does the absence of a PE from this document indicate that the PE will not be assessed on the WCAS.

Future item specifications drafts will include modification logs that will be updated at each subsequent publication.



Performance Expectation	MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism		
Dimensions	Science & Engineering Practice	Disciplinary Core Ideas	Crosscutting Concept
	<b>Developing and Using Models</b> Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. <ul style="list-style-type: none"> <li>• Develop a model to describe unobservable mechanisms.</li> </ul>	<b>LS1.C: Organization for Matter and Energy Flow in Organisms</b> <ul style="list-style-type: none"> <li>• Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy.</li> </ul> <b>PS3.D: Energy in Chemical Processes and Everyday Life</b> <ul style="list-style-type: none"> <li>• Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary)</li> </ul>	<b>Energy and Matter</b> <ul style="list-style-type: none"> <li>• Matter is conserved because atoms are conserved in physical and chemical processes.</li> </ul>
These item specifications were developed using the following reference materials:			
K-12 Framework	<a href="#">pp. 56–59</a>	<a href="#">pp. 147–148</a> <a href="#">pp. 128–130</a>	<a href="#">pp. 94–96</a>
NGSS Appendices	Appendix F <a href="#">p. 6</a>	Appendix E <a href="#">p. 4</a> Appendix E <a href="#">p. 8</a>	Appendix G <a href="#">pp. 8–9</a>
Clarification Statement	Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.		
Assessment Boundary	Assessment does not include details of the chemical reactions for photosynthesis or respiration.		

Items may ask students to:

Code	Alignment	Item Specification
MS-LS1-7.1	SEP-DCI-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe how <b>matter</b> is <b>conserved</b> in <b>chemical reactions</b> that rearrange food molecules to form new molecules and/or release energy in organisms.
MS-LS1-7.2	SEP-DCI	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe <b>chemical reactions</b> that rearrange food molecules to form new molecules and/or release energy in organisms.
MS-LS1-7.3	DCI-CCC	Connect the <b>conservation</b> of <b>matter</b> to <b>chemical reactions</b> that rearrange food molecules to form new molecules and/or release energy in organisms.
MS-LS1-7.4	SEP-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe how matter is conserved in chemical processes.
Details and Clarifications		
<ul style="list-style-type: none"> <li>• <b>Develop</b> and/or <b>use</b> a <b>model</b> is expanded to include:               <ul style="list-style-type: none"> <li>○ using a given complete or partial model to make predictions and/or describe phenomena</li> <li>○ using a model to show relationships among variables</li> <li>○ revising a given complete or partial model</li> <li>○ describing the limitations of a complete or partial model</li> <li>○ using a model to represent current understanding of a system</li> <li>○ using a model to aid in the development of questions and/or descriptions</li> </ul> </li> <li>• <b>Models</b> that describe how <b>matter</b> is <b>conserved</b> in <b>chemical reactions</b> may include, but are NOT limited to:               <ul style="list-style-type: none"> <li>○ a diagram, simulation, and/or description that shows how food molecules are rearranged into new molecules during cellular respiration</li> <li>○ a diagram, simulation, and/or description that shows the release of energy when food molecules are broken down</li> <li>○ a chemical equation showing that the number and/or type of atoms before a chemical reaction is equal to the number and/or type of atoms after a chemical reaction</li> </ul> </li> </ul>		

Performance Expectation	MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Idea</b>	<b>Crosscutting Concept</b>
	<b>Analyzing and Interpreting Data</b> Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. <ul style="list-style-type: none"> <li>Analyze and interpret data to provide evidence for phenomena.</li> </ul>	<b>LS2.A: Interdependent Relationships in Ecosystems</b> <ul style="list-style-type: none"> <li>Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.</li> <li>In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.</li> <li>Growth of organisms and population increases are limited by access to resources.</li> </ul>	<b>Cause and Effect</b> <ul style="list-style-type: none"> <li>Cause and effect relationships may be used to predict phenomena in natural or designed systems.</li> </ul>
These item specifications were developed using the following reference materials:			
K-12 Framework	<a href="#">pp. 61–63</a>	<a href="#">pp. 150–152</a>	<a href="#">pp. 87–89</a>
NGSS Appendices	Appendix F <a href="#">p. 9</a>	Appendix E <a href="#">p. 5</a>	Appendix D <a href="#">pp. 5–6</a>
Clarification Statement	Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.		
Assessment Boundary	An assessment boundary is not provided for this PE.		

Items may ask students to:

Code	Alignment	Item Specification
MS-LS2-1.1	SEP-DCI-CCC	<b>Analyze</b> and <b>interpret data</b> to make predictions based on <b>evidence</b> from <b>cause and effect</b> relationships between the availability of <b>resources</b> and the growth and reproduction of <b>organisms</b> and/or <b>populations of organisms</b> in an ecosystem.
MS-LS2-1.2	SEP-DCI	<b>Analyze</b> and <b>interpret data</b> to provide <b>evidence</b> that the growth and reproduction of <b>organisms</b> and/or <b>populations of organisms</b> depend on the availability of <b>resources</b> in an <b>ecosystem</b> .
MS-LS2-1.3	DCI-CCC	Use <b>cause and effect</b> relationships between the availability of <b>resources</b> and the growth and reproduction of <b>organisms</b> and/or <b>populations of organisms</b> in an <b>ecosystem</b> to make predictions.
MS-LS2-1.4	SEP-CCC	<b>Analyze</b> and <b>interpret data</b> to make predictions based on evidence from cause and effect relationships.

#### Details and Clarifications

- **Analyze** and/or **interpret data** is expanded to include:
  - organizing and/or interpreting data
  - identifying similarities and/or differences in findings
  - using patterns in data to distinguish between causal and/or correlational relationships and/or to draw conclusions based on data
- **Data** may include, but are NOT limited to:
  - observations
  - measurements
  - tables
  - graphs
  - diagrams
  - models
  - statistical information (e.g., mean, median, mode, variability)
- Types of **evidence** may include, but are NOT limited to:
  - population size and/or growth rate
  - reproduction rate
  - individual size and/or growth rate
  - type, amount, distribution, and/or concentration of an available resource
  - distributions of species that compete for resources
- **Cause and effect** relationships between the availability of **resources** and the growth and reproduction of **organisms** and/or **populations of organisms** may include, but are NOT limited to:
  - the growth of an individual organism changes as a function of resource availability (e.g., food, water, space)
  - the reproduction rate of a population changes as a function of resource availability (e.g., food, water, space)
  - resource availability affects interactions between organisms (e.g., competition)
  - competition and mutually beneficial relationships affect population sizes or growth rates
  - newly introduced species reduce available resources in an ecosystem

Performance Expectation	MS-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Idea</b>	<b>Crosscutting Concept</b>
	<b>Developing and Using Models</b> Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. <ul style="list-style-type: none"> <li>• Develop a model to describe phenomena.</li> </ul>	<b>LS2.B: Cycle of Matter and Energy Transfer in Ecosystems</b> <ul style="list-style-type: none"> <li>• Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.</li> </ul>	<b>Energy and Matter</b> <ul style="list-style-type: none"> <li>• The transfer of energy can be tracked as energy flows through a natural system.</li> </ul> <b>Connections to Nature of Science</b>  <b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b> <ul style="list-style-type: none"> <li>• Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.</li> </ul>
These item specifications were developed using the following reference materials:			
K-12 Framework	<a href="#">pp. 56–59</a>	<a href="#">pp. 152–154</a>	<a href="#">pp. 94–96</a>
NGSS Appendices	Appendix F <a href="#">p. 6</a>	Appendix E <a href="#">p. 5</a>	Appendix G <a href="#">pp. 8–9</a> Appendix H <a href="#">p. 6</a>
Clarification Statement	Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.		
Assessment Boundary	Assessment does not include the use of chemical reactions to describe the processes.		

Items may ask students to:

Code	Alignment	Item Specification
MS-LS2-3.1	SEP-DCI-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe the <b>cycling</b> of <b>matter</b> and/or <b>flow</b> of <b>energy</b> among the <b>living</b> and <b>nonliving parts</b> of an ecosystem.
MS-LS2-3.2	SEP-DCI	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe the <b>cycling</b> of <b>matter</b> among the <b>living</b> and <b>nonliving parts</b> of an ecosystem.
MS-LS2-3.3	DCI-CCC	Track the <b>cycling</b> of <b>matter</b> and/or <b>flow</b> of <b>energy</b> among the <b>living</b> and <b>nonliving parts</b> of an ecosystem.
MS-LS2-3.4	SEP-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to track the flow of energy through a natural system.

#### Details and Clarifications

- **Develop** and/or **use** a **model** is expanded to include:
  - using a given complete or partial model to make predictions and/or describe phenomena
  - using a model to show relationships among variables
  - revising a given complete or partial model
  - describing the limitations of a complete or partial model
  - using a model to represent current understanding of a system
  - using a model to aid in the development of questions and/or descriptions
- **Models** may include, but are NOT limited to, a diagram, simulation, or description of:
  - interacting parts of an ecosystem
  - energy flow through the living and/or nonliving parts of an ecosystem
  - the boundaries of an ecosystem
  - a food web
- **Living parts** of an ecosystem may include, but are NOT limited to:
  - producers (e.g., grass, trees)
  - consumers (e.g., rabbits, deer)
  - decomposers (e.g., mushrooms, bacteria)
- **Nonliving parts** of an ecosystem may include, but are NOT limited to:
  - water
  - nutrients
  - air
  - sunlight
  - soil
- The **flow** of **energy** and/or **cycling** of **matter** may include, but is NOT limited to:
  - decomposers using matter and/or energy obtained from the breakdown of producers and/or consumers
  - producers using matter and/or energy to make food
  - atoms cycling among the living and/or nonliving parts of an ecosystem
  - matter being conserved as it cycles in and/or out of the physical environment

<b>Performance Expectation</b>	<b>MS-LS2-4</b> Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.		
Dimensions	<b>Science &amp; Engineering Practices</b>	<b>Disciplinary Core Idea</b>	<b>Crosscutting Concept</b>
	<b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). <ul style="list-style-type: none"> <li>Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.</li> </ul> <b>Connections to Nature of Science</b>  <b>Scientific Knowledge is Based on Empirical Evidence</b> <ul style="list-style-type: none"> <li>Science disciplines share common rules of obtaining and evaluating empirical evidence.</li> </ul>	<b>LS2.C: Ecosystem Dynamics, Functioning, and Resilience</b> <ul style="list-style-type: none"> <li>Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.</li> </ul>	<b>Stability and Change</b> <ul style="list-style-type: none"> <li>Small changes in one part of a system might cause large changes in another part.</li> </ul>
These item specifications were developed using the following reference materials:			
K–12 Framework	<a href="#">pp. 71–74</a>	<a href="#">pp. 154–156</a>	<a href="#">pp. 98–101</a>
NGSS Appendices	Appendix F <a href="#">pp. 13–14</a> Appendix H <a href="#">pp. 1–10</a>	Appendix E <a href="#">p. 5</a>	Appendix G <a href="#">pp. 10–11</a>
Clarification Statement	Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.		
Assessment Boundary	There is no assessment boundary provided for this PE.		

Items may ask students to:

Code	Alignment	Item Specification
MS-LS2-4.1	SEP-DCI-CCC	<b>Construct</b> an <b>argument</b> supported by evidence that small physical or biological <b>disruptions</b> might cause large <b>changes</b> in <b>populations</b> .
MS-LS2-4.2	SEP-DCI	<b>Construct</b> an <b>argument</b> supported by evidence that physical or biological <b>disruptions</b> might shift <b>populations</b> .
MS-LS2-4.3	DCI-CCC	Connect small physical or biological <b>disruptions</b> in an ecosystem to large <b>changes</b> in <b>populations</b> .
MS-LS2-4.4	SEP-CCC	<b>Construct</b> an <b>argument</b> supported by evidence that a small change in one factor might cause a large change in a second factor.
Details and Clarifications		
<ul style="list-style-type: none"> <li>• <b>Construct</b> an <b>argument</b> is expanded to include:               <ul style="list-style-type: none"> <li>○ making a claim based on observations, data, and/or models</li> <li>○ using evidence and/or scientific reasoning to support an explanation or model</li> <li>○ identifying flaws in explanations, procedures, or models</li> <li>○ modifying arguments</li> </ul> </li> <li>• <b>Disruptions</b> may include:               <ul style="list-style-type: none"> <li>○ changes in physical conditions in an ecosystem (e.g., rainfall, fire, pollution)</li> <li>○ changes in biological conditions in an ecosystem (e.g., predator removal, species introduction)</li> </ul> </li> <li>• <b>Changes</b> in <b>populations</b> may include, but are NOT limited to:               <ul style="list-style-type: none"> <li>○ the migration of species into or out of an area</li> <li>○ the extinction of species</li> <li>○ the formation of a new species</li> <li>○ differences in the types and/or total numbers of organisms in one or more populations</li> </ul> </li> </ul>		

<b>Performance Expectation</b>	<b>MS-LS3-1</b> Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concept</b>
	<b>Developing and Using Models</b> Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. <ul style="list-style-type: none"> <li>Develop and use a model to describe phenomena.</li> </ul>	<b>LS3.A: Inheritance of Traits</b> <ul style="list-style-type: none"> <li>Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.</li> </ul> <b>LS3.B: Variation of Traits</b> <ul style="list-style-type: none"> <li>In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism.</li> </ul>	<b>Structure and Function</b> <ul style="list-style-type: none"> <li>Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.</li> </ul>
These item specifications were developed using the following reference materials:			
K-12 Framework	<a href="#">pp. 56–59</a>	<a href="#">pp. 158–159</a> <a href="#">pp. 160–161</a>	<a href="#">pp. 96–98</a>
NGSS Appendices	Appendix F <a href="#">p. 6</a>	Appendix E <a href="#">p. 6</a>	Appendix G <a href="#">pp. 9–10</a>
Clarification Statement	Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.		
Assessment Boundary	Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.		

Items may ask students to:

Code	Alignment	Item Specification
MS-LS3-1.1	SEP-DCI-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe how <b>structural changes</b> to genes (mutations) may affect the <b>structure</b> and/or <b>function</b> of proteins and may result in harmful, beneficial, and/or neutral effects to the <b>structure</b> and/or <b>function</b> of the organism.
MS-LS3-1.2	SEP-DCI	<b>Develop</b> and/or <b>use</b> a <b>model</b> to show that genes are located on chromosomes and/or to show how information flows from genes to proteins to traits.
MS-LS3-1.3	DCI-CCC	Connect <b>structural changes</b> to genes (mutations) to the <b>structure</b> and/or <b>function</b> of proteins and/or to the harmful, beneficial, and/or neutral effects to the <b>structure</b> and/or <b>function</b> of the organism.
MS-LS3-1.4	SEP-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe how complex structures can be analyzed to determine how they function.

#### Details and Clarifications

- **Develop** and/or **use** a **model** is expanded to include:
  - using a given complete or partial model to make predictions and/or describe phenomena
  - using a model to show relationships among variables
  - revising a given complete or partial model
  - describing the limitations of a complete or partial model
  - using a model to represent current understanding of a system
  - using a model to aid in the development of questions and/or descriptions
- **Models** that show how **structural changes** to genes affect the **structure** and **function** of other components may include, but are NOT limited to, a diagram, simulation, or description of:
  - structural and/or functional relationships between chromosomes, genes, proteins, traits, and/or organisms
  - how a mutation changes the structure and/or function of genes and/or proteins
- **Structure** and **function** relationships between genes, proteins, traits, and/or organisms may include, but are NOT limited to:
  - the structure of a gene determines the structure of a protein
  - protein structure influences protein function
  - protein structure influences the expression of a trait
  - a mutation changes the structure and/or function of a gene
  - a mutation may affect the structure and/or function of a protein
  - a mutation may affect the structure and/or function of an organism in a beneficial, neutral, or harmful way

Performance Expectation	MS-LS3-2 Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concept</b>
	<b>Developing and Using Models</b> Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena.	<b>LS1.B: Growth and Development of Organisms</b> • Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary)  <b>LS3.A: Inheritance of Traits</b> • Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.  <b>LS3.B: Variation of Traits</b> • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.	<b>Cause and Effect</b> • Cause and effect relationships may be used to predict phenomena in natural systems.
These item specifications were developed using the following reference materials:			
K-12 Framework	<a href="#">pp. 56–59</a>	<a href="#">pp. 145–147</a> <a href="#">pp. 158–160</a> <a href="#">pp. 160–161</a>	<a href="#">pp. 87–89</a>
NGSS Appendices	Appendix F <a href="#">p. 6</a>	Appendix E <a href="#">p. 4</a> Appendix E <a href="#">p. 6</a>	Appendix G <a href="#">pp. 5–6</a>
Clarification Statement	Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.		
Assessment Boundary	An assessment boundary is not provided for this PE.		

Items may ask students to:

Code	Alignment	Item Specification
MS-LS3-2.1	SEP-DCI-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe <b>cause and effect</b> relationships between the type of <b>reproduction</b> by parents ( <b>sexual</b> and/or <b>asexual</b> ) and <b>genetic variation</b> in offspring.
MS-LS3-2.2	SEP-DCI	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe the <b>genetic variation</b> in offspring for <b>sexual</b> and/or <b>asexual reproduction</b> by parents.
MS-LS3-2.3	DCI-CCC	Use <b>cause and effect</b> relationships to connect the type of <b>reproduction</b> by parents ( <b>sexual</b> and/or <b>asexual</b> ) to <b>genetic variation</b> in offspring.
MS-LS3-2.4	SEP-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe cause and effect relationships.
Details and Clarifications		
<ul style="list-style-type: none"> <li>• <b>Develop</b> and/or <b>use</b> a <b>model</b> is expanded to include: <ul style="list-style-type: none"> <li>○ using a given complete or partial model to make predictions and/or describe phenomena</li> <li>○ using a model to show relationships among variables</li> <li>○ revising a given complete or partial model</li> <li>○ describing the limitations of a complete or partial model</li> <li>○ using a model to represent current understanding of a system</li> <li>○ using a model to aid in the development of questions and/or descriptions</li> </ul> </li> <li>• <b>Models</b> that describes <b>cause and effect</b> relationships between the type of <b>reproduction</b> and <b>genetic variation</b> may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ a diagram or simulation showing combinations of alleles inherited by offspring</li> <li>○ a diagram, simulation, or description of a combination of alleles from parents</li> </ul> </li> <li>• <b>Cause and effect</b> relationships involving <b>variation</b> of <b>inherited traits</b> in <b>sexual reproduction</b> may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ two sets of chromosomes, one from each parent, combine, resulting in unique chromosome pairs in offspring</li> <li>○ one allele for each of many genes is inherited from each parent, resulting in genetic variation in offspring</li> </ul> </li> <li>• A <b>cause and effect</b> relationship involving <b>variation</b> of <b>inherited traits</b> in <b>asexual reproduction</b> may include, but is NOT limited to: <ul style="list-style-type: none"> <li>○ offspring receive a set of chromosomes from one parent, with the same number and type of chromosomes as the parent, resulting in minimal genetic variation</li> </ul> </li> </ul>		

<b>Performance Expectation</b>	<b>MS-LS4-4</b> Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Idea</b>	<b>Crosscutting Concept</b>
	<b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. <ul style="list-style-type: none"> <li>Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena.</li> </ul>	<b>LS4.B: Natural Selection</b> <ul style="list-style-type: none"> <li>Natural selection leads to the predominance of certain traits in a population, and the suppression of others.</li> </ul>	<b>Cause and Effect</b> <ul style="list-style-type: none"> <li>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.</li> </ul>
These item specifications were developed using the following reference materials:			
K–12 Framework	<a href="#">pp. 67–71</a>	<a href="#">pp. 163–164</a>	<a href="#">pp. 87–89</a>
NGSS Appendices	Appendix F <a href="#">pp. 11–12</a>	Appendix E <a href="#">p. 6</a>	Appendix G <a href="#">pp. 5–6</a>
Clarification Statement	Emphasis is on using simple probability statements and proportional reasoning to construct explanations.		
Assessment Boundary	An assessment boundary is not provided for this PE.		

Items may ask students to:

Code	Alignment	Item Specification
MS-LS4-4.1	SEP-DCI-CCC	<b>Construct</b> an <b>explanation</b> that includes <b>cause and effect</b> relationships among <b>natural selection</b> , the variation of <b>traits</b> in a population, and the probability of survival and/or reproduction in a specific environment.
MS-LS4-4.2	SEP-DCI	<b>Construct</b> an <b>explanation</b> of how <b>natural selection</b> leads to the variation of <b>traits</b> in a population and the probability of survival and/or reproduction in a specific environment.
MS-LS4-4.3	DCI-CCC	Use <b>cause and effect</b> relationships to connect <b>natural selection</b> and the variation of <b>traits</b> in a population to the probability of survival and/or reproduction in a specific environment.
MS-LS4-4.4	SEP-CCC	<b>Construct</b> an <b>explanation</b> of cause and effect relationships using probability.
Details and Clarifications		
<ul style="list-style-type: none"> <li>• <b>Construct</b> an <b>explanation</b> is expanded to include: <ul style="list-style-type: none"> <li>○ using valid data, models, and/or scientific knowledge to construct, revise, and/or support an explanation and/or design a solution</li> <li>○ using qualitative and/or quantitative relationships between variables to predict and/or describe phenomena</li> <li>○ using models and/or evidence to support explanations</li> <li>○ applying scientific principles to design a tool, process, or system that meets specific criteria and/or constraints</li> </ul> </li> <li>• Examples of <b>traits</b> may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ morphological traits (e.g., body shape, wing pattern, bone structure)</li> <li>○ physiological traits (e.g., disease resistance, heart rate, photosynthesis)</li> <li>○ behavioral traits (e.g., feeding, mating, defense)</li> </ul> </li> <li>• Evidence of <b>cause and effect</b> relationships due to <b>natural selection</b> may include, but is NOT limited to: <ul style="list-style-type: none"> <li>○ specific traits that increase or decrease over time in a species after a change in the environment</li> <li>○ specific traits that confer advantages to organisms in a particular environment and increase the probability of survival and/or reproduction</li> <li>○ the increase in the proportion of organisms with advantageous traits from generation to generation</li> <li>○ the decrease in the proportion of organisms with disadvantageous traits from generation to generation</li> </ul> </li> </ul>		

<b>Performance Expectation</b>	<b>MS-LS4-5</b> Gather and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Idea</b>	<b>Crosscutting Concept</b>
	<b>Obtaining, Evaluating, and Communicating Information</b> Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. <ul style="list-style-type: none"> <li>Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.</li> </ul>	<b>LS4.B: Natural Selection</b> <ul style="list-style-type: none"> <li>In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring.</li> </ul>	<b>Cause and Effect</b> <ul style="list-style-type: none"> <li>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.</li> </ul> <b>Connections to Engineering, Technology, and Applications of Science</b> <b>Interdependence of Science, Engineering, and Technology</b> <ul style="list-style-type: none"> <li>Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems.</li> </ul> <b>Connections to Nature of Science</b> <b>Science Addresses Questions About the Natural and Material World</b> <ul style="list-style-type: none"> <li>Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.</li> </ul>
These item specifications were developed using the following reference materials:			
K-12 Framework	<a href="#">pp. 74–77</a>	<a href="#">pp. 163–164</a>	<a href="#">pp. 87–89</a> <a href="#">pp. 210–212</a>
NGSS Appendices	Appendix F <a href="#">p. 15</a>	Appendix E <a href="#">p. 6</a>	Appendix G <a href="#">pp. 5–6</a> Appendix J <a href="#">p. 3</a> Appendix H <a href="#">p. 6</a>
Clarification Statement	Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.		
Assessment Boundary	An assessment boundary is not provided for this PE.		

Items may ask students to:

Code	Alignment	Item Specification
MS-LS4-5.1	SEP-DCI-CCC	<b>Gather</b> and <b>synthesize information</b> to describe <b>cause and effect</b> relationships associated with the human use of <b>artificial selection</b> technologies that influence the <b>inheritance</b> of <b>desired traits</b> in organisms.
MS-LS4-5.2	SEP-DCI	<b>Gather</b> and <b>synthesize information</b> to describe how the human use of <b>artificial selection</b> technologies influences the <b>inheritance</b> of <b>desired traits</b> in organisms.
MS-LS4-5.3	DCI-CCC	Use <b>cause and effect</b> relationships to connect the human use of <b>artificial selection</b> technologies and the <b>inheritance</b> of <b>desired traits</b> in organisms.
MS-LS4-5.4	SEP-CCC	<b>Gather</b> and <b>synthesize information</b> to describe cause and effect relationships.
Details and Clarifications		
<ul style="list-style-type: none"> <li>• <b>Gather</b> and <b>synthesize information</b> is expanded to include: <ul style="list-style-type: none"> <li>○ using patterns in and/or evidence from information to support a claim and/or describe a scientific phenomenon</li> <li>○ evaluating the credibility, accuracy, and/or bias of claims from different sources</li> </ul> </li> <li>• <b>Information</b> formats may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ text</li> <li>○ diagrams</li> <li>○ graphs</li> <li>○ tables</li> <li>○ models</li> <li>○ animations</li> </ul> </li> <li>• <b>Cause and effect</b> relationships associated with <b>artificial selection</b> technologies that influence the <b>inheritance</b> of <b>desired traits</b> may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ allowing only plants with desirable characteristics to reproduce causes desirable characteristics to show up in the offspring</li> <li>○ transplanting normal genes into cells in place of missing or defective ones can correct genetic disorders</li> <li>○ using genetic engineering can produce desirable traits in crops</li> </ul> </li> </ul>		

# Earth and Space Sciences

## Disciplinary Core Ideas:

- ESS1 Earth's Place in the Universe
- ESS2 Earth's Systems
- ESS3 Earth and Human Activity

The item specifications that follow represent a **sample** of PEs. The sample will continue to expand until this document contains all the PEs. The sample of PEs represents only a part of what could be assessed on the WCAS. The inclusion of a PE in this document does not indicate that PE will be assessed by an item on the WCAS, nor does the absence of a PE from this document indicate that the PE will not be assessed on the WCAS.

Future item specifications drafts will include modification logs that will be updated at each subsequent publication.



<b>Performance Expectation</b>	<b>MS-ESS1-1</b> Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concept</b>
	<b>Developing and Using Models</b> Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. <ul style="list-style-type: none"> <li>• Develop and use a model to describe phenomena.</li> </ul>	<b>ESS1.A: The Universe and Its Stars</b> <ul style="list-style-type: none"> <li>• Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.</li> </ul> <b>ESS1.B: Earth and the Solar System</b> <ul style="list-style-type: none"> <li>• This model of the solar system can explain eclipses of the sun and the moon. Earth’s spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.</li> </ul>	<b>Patterns</b> <ul style="list-style-type: none"> <li>• Patterns can be used to identify cause-and-effect relationships.</li> </ul> <b>Connections to Nature of Science</b>  <b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b> <ul style="list-style-type: none"> <li>• Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation</li> </ul>
These item specifications were developed using the following reference materials:			
K-12 Framework	<a href="#">pp. 56–59</a>	<a href="#">pp. 173–174</a> <a href="#">pp. 175–176</a>	<a href="#">pp. 85–87</a>
NGSS Appendices	Appendix F <a href="#">p. 6</a>	Appendix E <a href="#">p. 2</a>	Appendix G <a href="#">pp. 3–5</a> Appendix H <a href="#">p. 6</a>
Clarification Statement	Examples of models can be physical, graphical, or conceptual.		
Assessment Boundary	An assessment boundary is not provided for this PE.		

Items may ask students to:

Code	Alignment	Item Specification
MS-ESS1-1.1	SEP-DCI-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe <b>cyclic patterns</b> that can be used to identify <b>relationships</b> within the <b>Earth-sun-moon system</b> that <b>cause lunar phases, eclipses, and seasons</b> .
MS-ESS1-1.2	SEP-DCI	<b>Develop</b> and/or <b>use</b> a <b>model</b> of the <b>Earth-sun-moon system</b> to describe <b>lunar phases, eclipses, and/or seasons</b> .
MS-ESS1-1.3	DCI-CCC	Use the <b>cyclic patterns</b> in <b>lunar phases, eclipses, and/or seasons</b> to describe the <b>relationships</b> within the <b>Earth-sun-moon system</b> that <b>cause lunar phases, eclipses, and seasons</b> .
MS-ESS1-1.4	SEP-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe patterns that can be used to identify cause-and-effect relationships.
Details and Clarifications		
<ul style="list-style-type: none"> <li>• <b>Develop</b> and/or <b>use</b> a <b>model</b> is expanded to include: <ul style="list-style-type: none"> <li>○ using a given complete or partial model to make predictions and/or describe phenomena</li> <li>○ using a model to show relationships among variables</li> <li>○ revising a given complete or partial model</li> <li>○ describing the limitations of a complete or partial model</li> <li>○ using a model to represent current understanding of a system</li> <li>○ using a model to aid in the development of questions and/or descriptions</li> </ul> </li> <li>• <b>Models</b> may include, but are NOT limited to a table, diagram, simulation, and/or description of: <ul style="list-style-type: none"> <li>○ components in a system (e.g., Earth, sun, moon)</li> <li>○ interactions among components in a system (e.g., motions, orbits, rotations, revolutions, relative distances, relative sizes)</li> </ul> </li> <li>• <b>Cyclic patterns</b> that can be used to identify <b>relationships</b> within the <b>Earth-sun-moon system</b> that cause <b>lunar phases</b> may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ half of the moon is always lit by solar energy from the sun</li> <li>○ the portion of the lit half of the moon seen from Earth changes in a regular pattern as the moon orbits Earth</li> <li>○ the moon rotates at the same rate at which the moon orbits Earth, so the side of the moon that faces Earth is always the same side</li> </ul> </li> <li>• <b>Patterns</b> that can be used to identify <b>relationships</b> within the <b>Earth-sun-moon system</b> that cause <b>eclipses</b> may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ during solar eclipses, the moon moves between the sun and Earth, and the moon casts a shadow on Earth</li> <li>○ during lunar eclipses, the moon moves to the opposite side of Earth from the sun, and Earth casts a shadow on the moon</li> </ul> </li> <li>• <b>Cyclic patterns</b> that can be used to identify <b>relationships</b> within the <b>Earth-sun-moon system</b> that cause <b>seasons</b> may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ seasons change as Earth orbits the sun, and the part of Earth tilted toward the sun changes</li> <li>○ seasons are determined by the orientation and position of Earth's tilt in its orbit around the sun and/or by the resulting intensity of sunlight on different latitudes</li> </ul> </li> </ul>		

Performance Expectation	MS-ESS1-3 Analyze and interpret data to determine scale properties of objects in the solar system.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Idea</b>	<b>Crosscutting Concept</b>
	<b>Analyzing and Interpreting Data</b> Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine similarities and differences in findings.	<b>ESS1.B: Earth and the Solar System</b> • The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.	<b>Scale, Proportion, and Quantity</b> • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.  <b>Connections to Engineering, Technology, and Applications of Science</b>  <b>Interdependence of Science, Engineering, and Technology</b> • Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems.
These item specifications were developed using the following reference materials:			
K–12 Framework	<a href="#">pp. 61–63</a>	<a href="#">pp. 175–176</a>	<a href="#">pp. 89–91</a>
NGSS Appendices	Appendix F <a href="#">p. 9</a>	Appendix E <a href="#">p. 2</a>	Appendix G <a href="#">pp. 6–7</a>  Appendix J <a href="#">pp. 1–6</a>
Clarification Statement	Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.		
Assessment Boundary	Assessment does not include recalling facts about properties of the planets and other solar system bodies.		

Items may ask students to:

Code	Alignment	Item Specification
MS-ESS1-3.1	SEP-DCI-CCC	<b>Analyze</b> and/or <b>interpret data</b> that describe the <b>features</b> of <b>objects</b> in the solar system at various <b>scales</b> .
MS-ESS1-3.2	SEP-DCI	<b>Analyze</b> and/or <b>interpret data</b> that describe the <b>features</b> of <b>objects</b> in the solar system.
MS-ESS1-3.3	DCI-CCC	Use the concept of <b>scale</b> to determine the <b>features</b> of <b>objects</b> in the solar system.
MS-ESS1-3.4	SEP-CCC	<b>Analyze</b> and/or <b>interpret data</b> observed at various scales.
Details and Clarifications		
<ul style="list-style-type: none"> <li>• <b>Analyze</b> and/or <b>interpret data</b> is expanded to include: <ul style="list-style-type: none"> <li>○ organizing and/or interpreting data</li> <li>○ identifying similarities and/or differences in findings</li> <li>○ using patterns in data to distinguish between causal and/or correlational relationships and/or to draw conclusions based on data</li> </ul> </li> <li>• <b>Data</b> may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ observations</li> <li>○ measurements</li> <li>○ tables</li> <li>○ graphs</li> <li>○ diagrams</li> <li>○ models</li> <li>○ statistical information (e.g., mean, median, mode, variability)</li> </ul> </li> <li>• <b>Features</b> of objects in the solar system may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ location relative to other objects</li> <li>○ orbital shape and/or size</li> <li>○ the relative or absolute measurements of overall size</li> <li>○ the presence, absence, arrangement, abundance, or sizes of surface features</li> <li>○ physical composition and/or makeup</li> </ul> </li> <li>• <b>Objects</b> in the solar system may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ the sun</li> <li>○ planets</li> <li>○ moons</li> <li>○ asteroids, meteors, comets</li> </ul> </li> <li>• <b>Scale</b> may include, but is NOT limited to: <ul style="list-style-type: none"> <li>○ mathematical relationships among features of objects</li> <li>○ absolute measurements of features of objects</li> <li>○ model scales that represent features of objects</li> <li>○ the proportional relationship between the size of a feature and the distance from which the feature was observed</li> </ul> </li> </ul>		

<b>Performance Expectation</b>	<b>MS-ESS2-4</b> Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Idea</b>	<b>Crosscutting Concept</b>
	<b>Developing and Using Models</b> Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. <ul style="list-style-type: none"> <li>• Develop a model to describe unobservable mechanisms.</li> </ul>	<b>ESS2.C: The Roles of Water in Earth's Surface Processes</b> <ul style="list-style-type: none"> <li>• Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.</li> <li>• Global movements of water and its changes in form are propelled by sunlight and gravity.</li> </ul>	<b>Energy and Matter</b> <ul style="list-style-type: none"> <li>• Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.</li> </ul>
These item specifications were developed using the following reference materials:			
K–12 Framework	<a href="#">pp. 56–59</a>	<a href="#">pp. 184–186</a>	<a href="#">pp. 94–96</a>
NGSS Appendices	Appendix F <a href="#">p. 6</a>	Appendix E <a href="#">p. 3</a>	Appendix G <a href="#">pp. 8–9</a>
Clarification Statement	Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.		
Assessment Boundary	A quantitative understanding of the latent heats of vaporization and fusion is not assessed.		

Items may ask students to:

Code	Alignment	Item Specification
MS-ESS2-4.1	SEP-DCI-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe how <b>transfers of energy</b> drive the <b>processes</b> that result in the cycling of water among <b>reservoirs</b> .
MS-ESS2-4.2	SEP-DCI	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe <b>processes</b> that result in the cycling of water among <b>reservoirs</b> .
MS-ESS2-4.3	DCI-CCC	Use the concept of <b>energy transfer</b> to connect the cycling of water among <b>reservoirs</b> to processes that drive the cycling.
MS-ESS2-4.4	SEP-CCC	<b>Develop</b> and/or <b>use</b> a <b>model</b> to describe the transfers of energy that drive the cycling of matter within a system.
Details and Clarifications		
<ul style="list-style-type: none"> <li>• <b>Develop</b> and/or <b>use</b> a <b>model</b> is expanded to include:               <ul style="list-style-type: none"> <li>○ using a given complete or partial model to make predictions or describe phenomena</li> <li>○ using a model to show relationships among variables</li> <li>○ revising a given complete or partial model</li> <li>○ describing the limitations of a complete or partial model</li> <li>○ using a model to represent current understanding of a system</li> <li>○ using a model to aid in the development of questions and/or descriptions</li> </ul> </li> <li>• <b>Model</b> may include, but are NOT limited to:               <ul style="list-style-type: none"> <li>○ a description of a process that drives a global motion of water and/or a phase change in water</li> <li>○ a description of energy transfers that drive the hydrologic cycle</li> </ul> </li> <li>• <b>Processes</b> that result in the cycling of water may include, but are NOT limited to:               <ul style="list-style-type: none"> <li>○ the transformation of water from liquid to vapor by living things</li> <li>○ surface waters releasing water vapor into the air</li> <li>○ water vapor forming clouds, fog, or frost</li> <li>○ liquid surface water forming ice sheets</li> <li>○ falling rain, snow, or ice</li> <li>○ the flow of liquid water or glacial ice toward lower elevations</li> </ul> </li> <li>• <b>Reservoirs</b> may include, but are NOT limited to:               <ul style="list-style-type: none"> <li>○ living things</li> <li>○ groundwater</li> <li>○ rivers, streams, lakes, ponds, and/or oceans</li> <li>○ clouds, fog, or water vapor</li> <li>○ glacial ice, ice sheets, or snow</li> </ul> </li> <li>• <b>Transfers of energy</b> may include, but are NOT limited to:               <ul style="list-style-type: none"> <li>○ the gravity-driven downward motion of liquid water or ice over a sloped surface</li> <li>○ the gravity-driven downward fall of various forms of water from the atmosphere</li> <li>○ thermal energy transfer to water that drives a phase change (e.g., melting)</li> </ul> </li> </ul>		

Performance Expectation	<b>MS-ESS3-1</b> Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.		
Dimensions	<b>Science &amp; Engineering Practice</b>	<b>Disciplinary Core Idea</b>	<b>Crosscutting Concept</b>
	<b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. <ul style="list-style-type: none"> <li>Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</li> </ul>	<b>ESS3.A: Natural Resources</b> <ul style="list-style-type: none"> <li>Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.</li> </ul>	<b>Cause and Effect</b> <ul style="list-style-type: none"> <li>Cause and effect relationships may be used to predict phenomena in natural or designed systems.</li> </ul> <b>Connections to Engineering, Technology, and Applications of Science</b>  <b>Influence of Science, Engineering, and Technology on Society and the Natural World</b> <ul style="list-style-type: none"> <li>All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.</li> </ul>
These item specifications were developed using the following reference materials:			
K-12 Framework	<a href="#">pp. 67–71</a>	<a href="#">pp. 191–192</a>	<a href="#">pp. 87–89</a> <a href="#">pp. 212–214</a>
NGSS Appendices	Appendix F <a href="#">pp. 11–12</a>	Appendix E <a href="#">p. 3</a>	Appendix G <a href="#">pp. 5–6</a> Appendix J <a href="#">pp. 3–4</a>
Clarification Statement	Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).		
Assessment Boundary	An assessment boundary is not provided for this PE.		

Items may ask students to:

Code	Alignment	Item Specification
MS-ESS3-1.1	SEP-DCI-CCC	<b>Construct a scientific explanation</b> that includes <b>cause and effect</b> relationships between the <b>uneven distribution</b> of <b>Earth's</b> mineral, energy, and/or groundwater <b>resources</b> and past and/or current <b>geologic processes</b> .
MS-ESS3-1.2	SEP-DCI	<b>Construct a scientific explanation</b> for the <b>uneven distribution</b> of <b>Earth's</b> mineral, energy, and/or groundwater <b>resources</b> due to past and/or current <b>geologic processes</b> .
MS-ESS3-1.3	DCI-CCC	Use <b>cause and effect</b> relationships to connect the <b>uneven distribution</b> of Earth's mineral, energy, and/or groundwater <b>resources</b> to past and/or current <b>geologic processes</b> .
MS-ESS3-1.4	SEP-CCC	<b>Construct a scientific explanation</b> based on cause and effect relationships in a system.
Details and Clarifications		
<ul style="list-style-type: none"> <li>• <b>Construct a scientific explanation</b> is expanded to include: <ul style="list-style-type: none"> <li>○ using valid data, models, and/or scientific knowledge to construct, revise, and/or support an explanation and/or design a solution</li> <li>○ using qualitative and/or quantitative relationships between variables to predict and/or describe phenomena</li> <li>○ using models and/or evidence to support explanations</li> <li>○ applying scientific principles to design a tool, process, or system that meets specific criteria and/or constraints</li> </ul> </li> <li>• Past and/current <b>geologic processes</b> may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ volcanic eruptions</li> <li>○ earthquakes</li> <li>○ erosion</li> <li>○ weathering</li> <li>○ resource extraction</li> </ul> </li> <li>• <b>Cause and effect</b> relationships between the <b>uneven distribution</b> of <b>Earth's resources</b> and past and/or present <b>geologic processes</b> may include, but are NOT limited to: <ul style="list-style-type: none"> <li>○ copper deposits in Earth's crust are the result of volcanic activities</li> <li>○ abundant petroleum resources in certain areas resulted when shifting tectonic plates "trapped" vast amounts of decayed organic matter in a deep basin</li> </ul> </li> </ul>		

# Engineering, Technology, and Applications of Science

## Disciplinary Core Ideas:

- ETS1 Engineering Design

The item specifications that follow represent a **sample** of PEs. The sample will continue to expand until this document contains all the PEs. The sample of PEs represents only a part of what could be assessed on the WCAS. The inclusion of a PE in this document does not indicate that PE will be assessed by an item on the WCAS, nor does the absence of a PE from this document indicate that the PE will not be assessed on the WCAS.

Future item specifications drafts will include modification logs that will be updated at each subsequent publication.



Performance Expectation	<b>MS-ETS1-3</b> Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		
Dimensions	Science & Engineering Practice	Disciplinary Core Ideas	Crosscutting Concept
	<b>Analyzing and Interpreting Data</b> Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. <ul style="list-style-type: none"> <li>Analyze and interpret data to determine similarities and differences in findings.</li> </ul>	<b>ETS1.B: Developing Possible Solutions</b> <ul style="list-style-type: none"> <li>There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.</li> <li>Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.</li> </ul> <b>ETS1.C: Optimizing the Design Solution</b> <ul style="list-style-type: none"> <li>Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.</li> </ul>	
These item specifications were developed using the following reference materials:			
K-12 Framework	<a href="#">pp. 61–63</a>	<a href="#">pp. 206–208</a> <a href="#">pp. 208–210</a>	
NGSS Appendices	Appendix F <a href="#">p. 9</a>	Appendix I <a href="#">p. 4</a>	
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:

Code	Alignment	Item Specification
MS-ETS1-3.1	SEP-DCI-CCC	Due to the lack of a CCC, items are not coded MS-ETS1-3.1.
MS-ETS1-3.2	SEP-DCI	<b>Analyze</b> and/or <b>interpret data</b> from tests to identify similarities and differences among design solutions to identify the best characteristics of each that can be <b>combined</b> into a new solution to better meet the <b>criteria</b> and/or <b>constraints</b> for success.
MS-ETS1-3.3	DCI-CCC	Due to the lack of a CCC, items are not coded MS-ETS1-3.3.
MS-ETS1-3.4	SEP-CCC	Due to the lack of a CCC, items are not coded MS-ETS1-3.4.

#### Details and Clarifications

- **Analyze** and **interpret data** is expanded to include:
  - organizing and/or interpreting data
  - identifying similarities and/or differences in findings
  - using patterns in data to distinguish between causal and/or correlational relationships and/or to draw conclusions based on data
- **Data** may include, but are NOT limited to:
  - observations
  - measurements
  - tables
  - graphs
  - diagrams
  - models
  - statistical information (e.g., mean, median, mode, variability)
- Examples of ways that characteristics could be **combined** for a new solution may include, but are NOT limited to:
  - changing the components of a design (e.g., changing material, adding reinforcement, removing parts)
  - rearranging or repositioning the components of a design
  - changing the way the components of a design interact
  - reordering the steps of a process
- **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
- **Constraints** that could limit the success of a solution may include, but are NOT limited to:
  - relative lack of safety
  - relative deficiencies in solving specific aspects of the given problem
  - relatively high cost
  - materials that are difficult to acquire
  - relatively long time to implement

## SEP, DCI, and CCC Vocabulary Used in Assessment Items at Grade 8

The following list is based on the item specifications included in the December 2018 draft of the Test Design and Item Specifications document. The list will be updated in the next draft of the document which is expected to be published late spring 2019.

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. Appropriate science vocabulary allowed for the grade 5 WCAS may also be used on the grade 8 WCAS. Vocabulary words from Grade 5 are included in the following list.

<b>a</b>	conclusion	electric force
<u>Used in grade 5:</u>	conserve	electricity
advantage	constraint	electromagnet
amplitude	criteria	energy
angle		energy transfer
atmosphere	<u>Used in grade 8:</u>	engineer
attract	cell	environment
axis	cellular respiration	erosion
	chemical reaction	evaporate
<u>Used in grade 8:</u>	chromosome	evidence
absorb	condensation	exert
adaptation	conservation	extinct
acceleration	consumer	
allele	continental crust	<u>Used in grade 8:</u>
analog	correlation	eclipse
artificial selection	crystallization	electric circuit
asexual reproduction		electric field
atom	<b>d</b>	embryo
	<u>Used in grade 5:</u>	evolution
<b>b</b>	device	
<u>Used in grade 5:</u>	data	<b>f</b>
balanced force	decomposer	<u>Used in grade 5:</u>
behavior	decrease	factor
biosphere	defend	food web
	demonstration	force
<u>Used in grade 8:</u>	describe	fossil
biodiversity	design	fossil fuel
boundary	diagram	function
	disadvantage	
<b>c</b>	disease	<u>Used in grade 8:</u>
<u>Used in grade 5:</u>	distance	frequency
camouflage		
cause	<u>Used in grade 8:</u>	<b>g</b>
characteristic	density	<u>Used in grade 5:</u>
charge	digital	gas
claim		geosphere
classify	<b>e</b>	glacier
climate	<u>Used in grade 5:</u>	graph
collide	earthquake	gravity
collision	ecosystem	groundwater
compare	effect	
	electric current	

Used in grade 8:  
gene  
genetic variation  
geologic process  
gravitational force

## **h**

Used in grade 5:  
habitat  
hazard  
heat energy  
hydrosphere

## **i**

Used in grade 5:  
impact  
increase  
inherited  
input  
interaction  
investigation

Used in grade 8:  
identical

## **k**

Used in grade 8:  
kinetic energy

## **l**

Used in grade 5:  
landform  
life cycle  
light energy  
limitation  
liquid

Used in grade 8:  
lava  
light intensity  
lunar

## **m**

Used in grade 5:  
magnet  
magnetic  
magnetic force  
marine  
mass  
material

matter  
measure  
mineral  
model  
motion energy

Used in grade 8:  
magma  
magnetic field  
medium (of a wave)  
molecule  
mutation  
mutually beneficial

## **n**

Used in grade 5:  
nonrenewable

Used in grade 8:  
natural selection  
nutrient

## **o**

Used in grade 5:  
object  
observation  
offspring  
orbit  
organism  
output

Used in grade 8:  
orbital radius

## **p**

Used in grade 5:  
particle  
pattern  
physical property  
polar ice cap  
pole (of a magnet)  
pollution  
population  
precipitation  
predator  
predict  
prediction  
process  
property

Used in grade 8:  
percentage  
photosynthesis  
pixel  
prey  
probability  
producer  
product  
protein

## **q**

Used in grade 5:  
quantity

## **r**

Used in grade 5:  
recycle  
reduce  
relationship  
renewable  
repel  
reproduction  
research  
resource  
result  
rock formation  
rock layer  
rotate  
runoff

Used in grade 8:  
reactant  
reflect  
refract  
reservoir

## **s**

Used in grade 5:  
scientist  
sediment  
similarity  
simulation  
solar energy  
solid  
solution (to a problem)  
sound energy  
species  
speed  
stability  
state (of matter)

structure  
substance  
subsystem  
support  
surface  
survive  
system

Used in grade 8:

scale  
sexual reproduction  
solar system  
solution (chemical)

**t**

Used in grade 5:

technology  
temperature  
trait  
tsunami

Used in grade 8:

tectonic plate  
thermal energy  
transform  
transmit  
transpiration  
trend

**u**

Used in grade 5:

unbalanced force

**v**

Used in grade 5:

variable  
volcanic eruption  
volume

**w**

Used in grade 5:

wave  
wavelength  
weathering  
wetland  
wind energy

