Washington Comprehensive Assessment of Science

Test Design & Item Specifications

Grade 5

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 Applications of Science. Each domain has three-dimensional performance expectations that integrate science and engineering practices, disciplinary core ideas, and crosscutting concepts. The assessments will be administered in grades 5, 8, and 11 for federal and state accountability purposes beginning 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 first 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; the sample will continue to expand through the 2017–18 and 2018–19 school years until full PE coverage is achieved. Future item specifications drafts will include modification logs that will be updated at each subsequent publication, based on input from Washington educators.

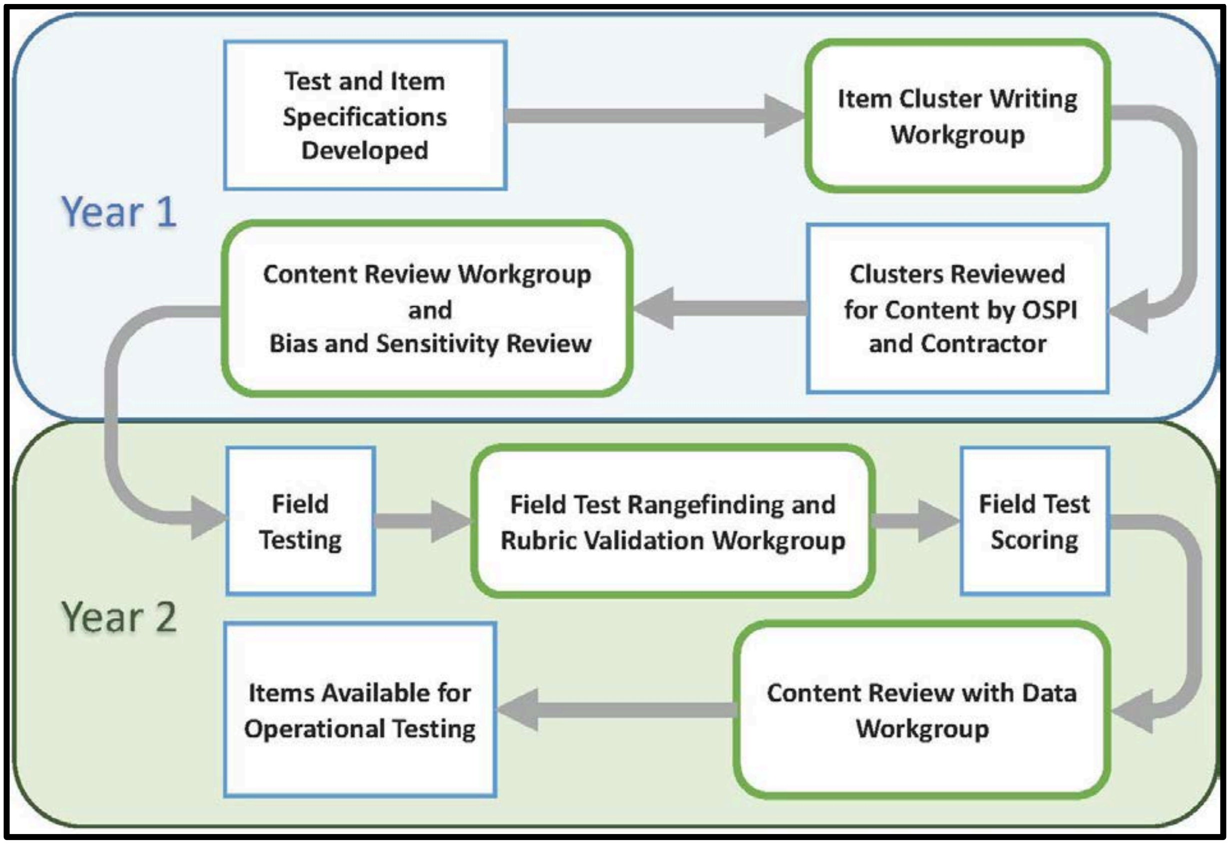
Assessment Development Cycle

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

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

Structure of the Test

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

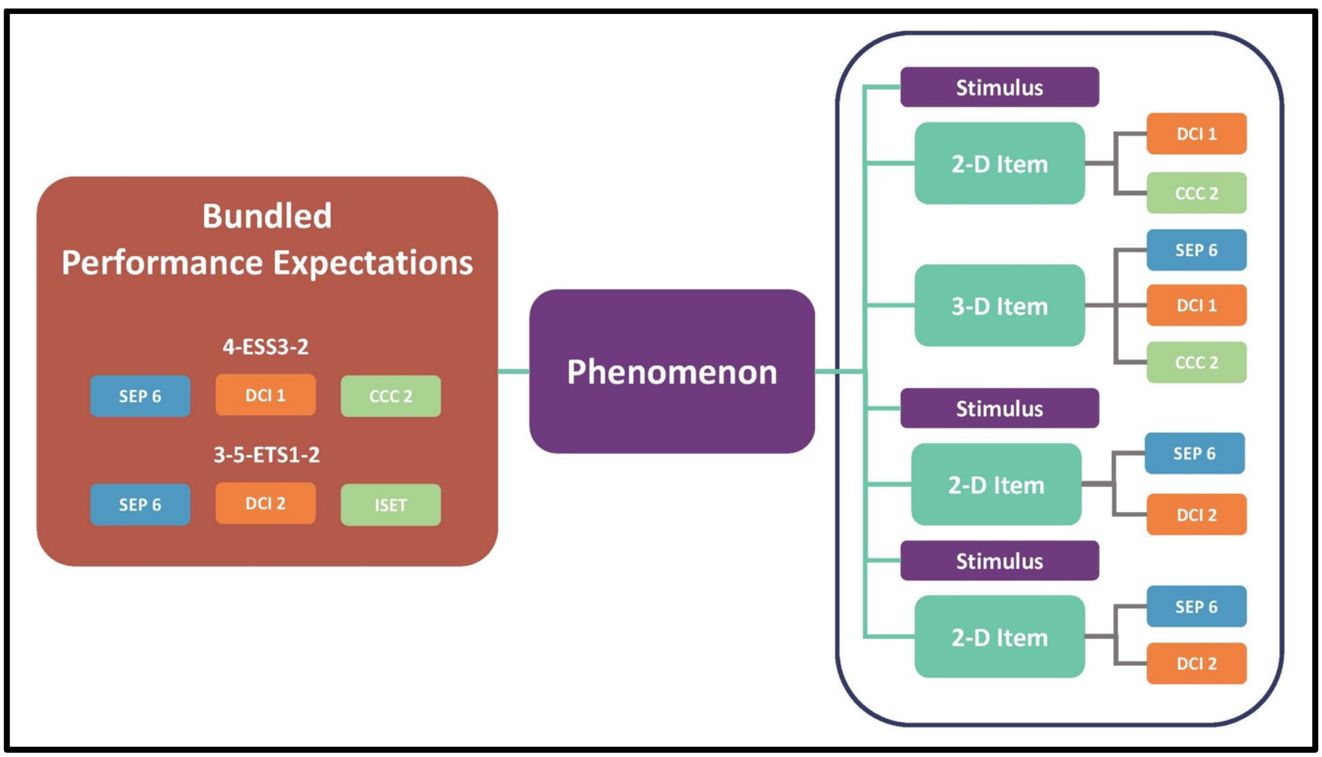
Item Clusters

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

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

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

Sample Item Cluster Map



Standalone Items

A standalone item is a focused measurement tool that uses a single item to address two or three dimensions of one PE.

Online Test Delivery

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

Collapsible Stimuli

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

Locking Items

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

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

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

Animation

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

Screen Display

Item clusters are displayed with a stimulus pane and an item pane on the same screen. The stimulus occupies 40% of the screen, while the item occupies 60% of the screen. However, by clicking expansion arrows, a student can expand either pane to a width of 90% of the screen. Standalone items are displayed on the entire width of the screen.

Item Types

The WCAS include several item types. Collectively, these item types enable measurement of understanding and core competencies in ways that support student engagement. The majority of the item types are represented on the WCAS Training Tests, which can be accessed on the Washington Comprehensive Assessment Program (WCAP) Portal beginning late 2017.

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 or misunderstandings, naive preconceptions, 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 or misunderstandings, naive preconceptions, 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 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 standalone items will be field tested in a given administration. The field test items will not contribute to the student's score.

Testing Times

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

Online Calculator

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

Test Blueprint

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

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

Table 1 specifies the percentage and point ranges of the grade 5 WCAS in reference to the reporting claims.

Table 1

Reporting Claim	Percentage of PEs per Science Domain in the Standards	Percentage Range for the WCAS per Science Domain	Score Point Range for the WCAS per Science Domain
Practices and Crosscutting Concepts in Physical Sciences	40%	35–45%	12–16
Practices and Crosscutting Concepts in Life Sciences	29%	24–34%	8–12
Practices and Crosscutting Concepts in Earth and Space Sciences	31%	26–36%	9–13

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 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, and examples of expected DCI science vocabulary that might be employed in assessment of the PE. Items in the grade 5 WCAS use language targeted to a reading level of third grade or lower with the exception of the expected science terms. A list of expected SEP 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.

<table>
<tr><td>Performance Expectation</td><td colspan="3">4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.</td></tr>
<tr><td rowspan="2">Dimensions</td><td>Science & Engineering Practice</td><td>Disciplinary Core Idea</td><td>Crosscutting Concept</td></tr>
<tr><td>Engaging in Argument from Evidence
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).
• Construct an argument with evidence, data, and/or a model.</td><td>LS1.A: Structure and Function
• Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.</td><td>Systems and System Models
• A system can be described in terms of its components and their interactions.</td></tr>
<tr><td colspan="4">These item specifications were developed using the following reference materials:</td></tr>
<tr><td>K–12 Framework</td><td>pp. 71–74</td><td>pp. 143–145</td><td>pp. 91–94</td></tr>
<tr><td>NGSS Appendices</td><td>Appendix F
pp. 13–14</td><td>Appendix E
p. 4</td><td>Appendix G
pp. 7–8</td></tr>
<tr><td>Clarification Statement</td><td colspan="3">Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.</td></tr>
<tr><td>Assessment Boundary</td><td colspan="3">Assessment is limited to macroscopic structures within plant and animal systems.</td></tr>
<tr><td>Expected DCI Vocabulary</td><td colspan="3">behavior, function, growth, reproduction, structure, survival</td></tr>
</table>

Items may ask students to:

Code	Alignment	Item Specification
4-LS1-1.1	SEP-DCI-CCC	**Construct** an **argument** using **system models** to describe plants and/or animals in terms of their **structures** and how the structures interact to serve various survival, growth, behavioral, and/or reproductive **functions**.
4-LS1-1.2	SEP-DCI	**Construct** an **argument** to show that plant and/or animal **structures** serve various survival, growth, behavioral, and/or reproductive **function**s.
4-LS1-1.3	DCI-CCC	Connect the crosscutting concept of systems and **system models** to plant and/or animal **structures** that serve various survival, growth, behavioral, or reproductive **functions.**
4-LS1-1.4	SEP-CCC	**Construct** an **argument** that connects system components and interactions in a **system model**.

Details and Clarifications

- **Construct** an **argument** is expanded to include:
  - developing an argument based on evidence, data, or a simple model
  - distinguishing between observations and inferences in an explanation or argument
  - comparing and/or refining arguments based on evidence
  - providing feedback on an explanation or argument
  - using evidence to evaluate claims
- **Structures** and **functions** may include, but are NOT limited to structures that work together to support:
  - plants
    - obtaining water/sunlight/air
    - growing toward sunlight and/or water
    - defending against herbivores
    - attracting pollinators
  - animals
    - pumping blood/breathing/moving/digesting food
    - obtaining food
    - defending against predators
    - attracting mates
- **System models** may include, but are not limited to:
  - an entire organism (plant or animal)
  - a subsystem within a plant or animal
  - the interactions of structures working together within a plant or animal system or subsystem

Modification Log

Date	Comments

As stated earlier in this document, the item specifications that follow represent a small sample of PEs; the sample will continue to expand through the 2017–18 and 2018–19 school years until full PE coverage is achieved. Future item specifications drafts will include modification logs that will be updated at each subsequent publication, based on input from Washington educators.

Resources

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

References

Council of Chief State School Officers (CCSSO). (2015). *Science Assessment Item Collaborative (SAIC) Assessment Framework*. Washington, DC: Council of Chief State School Officers.

National Research Council (NRC). (2012). *A framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, DC: National Academies Press.

National Research Council. (2014). *Developing Assessments for the Next Generation Science Standards*. Washington, DC: The National Academies.

Next Generation Science Standards (NGSS) Lead States. (2013). *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

Physical Sciences

Disciplinary Core Ideas:

- PS1 Matter and Its Interactions
- PS2 Motion and Stability: Forces and Interactions
- PS3 Energy
- PS4 Waves and Their Applications in Technologies for Information Transfer

<table>
<tr><td>Performance Expectation</td><td colspan="3">4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</td></tr>
<tr><td rowspan="2">Dimensions</td><td>Science & Engineering Practice</td><td>Disciplinary Core Ideas</td><td>Crosscutting Concept</td></tr>
<tr><td>Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
• Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.</td><td>PS3.A: Definitions of Energy
• Energy can be moved from place to place by moving objects, or through sound, light, or electric currents.

PS3.B: Conservation of Energy and Energy Transfer
• Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.
• Light also transfers energy from place to place.
• Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.</td><td>Energy and Matter
• Energy can be transferred in various ways and between objects.</td></tr>
<tr><td colspan="4">These item specifications were developed using the following reference materials:</td></tr>
<tr><td>K–12 Framework</td><td>pp. 59–61</td><td>pp. 120–124
pp. 124–126</td><td>pp. 94–96</td></tr>
<tr><td>NGSS Appendices</td><td>Appendix F
pp. 7–8</td><td>Appendix E
p. 7</td><td>Appendix G
pp. 8–9</td></tr>
<tr><td>Clarification Statement</td><td colspan="3">There is no clarification statement provided for this PE.</td></tr>
<tr><td>Assessment Boundary</td><td colspan="3">Assessment does not include quantitative measurements of energy.</td></tr>
<tr><td>Expected DCI Vocabulary</td><td colspan="3">collision, electric current, energy, heat energy, light energy, motion energy, sound energy, transfer</td></tr>
</table>

Items may ask students to:

Code	Alignment	Item Specification
4-PS3-2.1	SEP-DCI-CCC	**Make observations** to serve as **evidence** that **energy** can be **transferred** from place to place by sound, light, heat, electric currents, and/or colliding objects.
4-PS3-2.2	SEP-DCI	Due to a strong overlap between the DCI and the CCC, items are not coded 4-PS3-2.2.
4-PS3-2.3	DCI-CCC	Connect the crosscutting concept of **energy and matter** to the **transfer** of **energy** by sound, light, heat, electric currents, and/or colliding objects.
4-PS3-2.4	SEP-CCC	**Make observations** to serve as **evidence** that **energy** can be **transferred** in various ways and/or between objects.

Details and Clarifications

- **Make observations** is expanded to include:
    - identifying relevant variables and/or data to be gathered in an investigation
    - describing appropriate methods and/or tools to collect data
    - collecting data that can be used to support an explanation, make comparisons, and/or make predictions
- **Evidence** of energy transfer may include, but is NOT limited to:
    - presence of sound by hearing or using a sound meter or other recording device
    - presence of light by seeing or using a light meter, photography, or other method of recording light
    - presence of heat by feeling or measuring temperature change
    - presence of electric current by observing the sound, light, heat, and/or kinetic energy output from devices in a circuit
    - motion of objects before and after a collision
- Examples of **energy transfer** may include, but are NOT limited to:
    - the transfer of sound energy from a vibrating object to the surrounding air
    - the transfer of light energy from a source of light to an object that absorbs light
    - the transfer of electric energy to produce motion, sound, heat, or light
    - the transfer of heat energy from a source of heat to the surrounding air or to an object
    - the transfer of kinetic energy between colliding objects
- Note: The concept of energy conservation is beginning to develop in this PE by observing that noticeable forms of energy have transferred from other places. Energy conservation is not explicitly assessed in this PE.

Modification Log

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Performance Expectation	**5-PS1-1** Develop a model to describe that matter is made of particles too small to be seen.		
Dimensions	**Science & Engineering Practice**	**Disciplinary Core Idea**	**Crosscutting Concept**
	Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Use models to describe phenomena.	**PS1.A: Structure and Properties of Matter** • Matter of any type can be subdivided into particles that are too small to see, but even then, the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.	**Scale, Proportion, and Quantity** • Natural objects exist from the very small to the immensely large.
These item specifications were developed using the following reference materials:			
K–12 Framework	pp. 56–59	pp. 106–108	pp. 89–91
NGSS Appendices	Appendix F p. 6	Appendix E p. 7	Appendix G pp. 6–7
Clarification Statement	Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.		
Assessment Boundary	Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.		
Expected DCI Vocabulary	gas, liquid, matter, motion, particle, solid		

Items may ask students to:

Code	Alignment	Item Specification
5-PS1-1.1	SEP-DCI-CCC	**Develop** and/or **use** a **model** to provide **evidence** that **matter** can be subdivided into particles that are at a **scale** that is too small to be seen.
5-PS1-1.2	SEP-DCI	**Develop** and/or **use** a **model** to describe **evidence** of **matter** that can be subdivided into particles that are too small to be seen.
5-PS1-1.3	DCI-CCC	Connect the crosscutting concept of **scale and proportion** to **matter** that can be subdivided into particles that are too small to be seen.
5-PS1-1.4	SEP-CCC	**Develop** and/or **use** a **model** to describe the **scale and proportion of matter**.

Details and Clarifications

- **Develop** and/or **use** a model is expanded to include:
  - revising a complete or partial model
  - comparing complete or partial models
  - using a model to describe a scientific principle
  - using a model to describe a process
  - using a model to make predictions
- An example of a **model** that describes **evidence** of **matter** made up of particles too small to be seen may include, but is NOT limited to:
  - diagram, simulation, and/or description of solid material dissolving into a liquid
  - diagram, simulation, and/or description of how adding particles of gas can cause an increase in the volume of an elastic container
  - diagram, simulation, and/or description showing bulk matter is made up of much smaller particles
- **Scale and proportion** may include, but is NOT limited to:
  - observation that macroscopic scale matter can be very large
  - observation that microscopic scale matter or parts of larger matter can be too small to be seen
  - qualitative description of the proportions of particles at various scales

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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

Performance Expectation	**3-LS4-3** Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.		
Dimensions	**Science & Engineering Practice**	**Disciplinary Core Idea**	**Crosscutting Concept**
	Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Construct an argument with evidence.	**LS4.C: Adaptation** • For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change.
These item specifications were developed using the following reference materials:			
K–12 Framework	pp. 71–74	pp. 164–166	pp. 87–89
NGSS Appendices	Appendix F pp. 13–14	Appendix E p. 6	Appendix G pp. 5–6
Clarification Statement	Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.		
Assessment Boundary	An assessment boundary is not provided for this PE.		
Expected DCI Vocabulary	characteristic, environment, habitat, organism, survival		

Items may ask students to:

Code	Alignment	Item Specification
3-LS4-3.1	SEP-DCI-CCC	**Construct** an **argument**, using evidence, that establishes a **cause and effect** relationship between organism **characteristics** and **survival** in a particular habitat.
3-LS4-3.2	SEP-DCI	**Construct** an **argument**, using evidence**,** that organisms in a particular habitat can have different **characteristics** and can have differential levels of **survival**.
3-LS4-3.3	DCI-CCC	Connect the crosscutting concept of **cause and effect** to organism **characteristics** and **survival** in a particular habitat.
3-LS4-3.4	SEP-CCC	**Construct** an **argument,** using evidence, that explains change through a **cause and effect** relationship.

Details and Clarifications

- **Constructing** an **argument** is expanded to include:
  - developing an argument based on evidence, data, or a simple model
  - distinguishing between observations and inferences in an explanation or argument
  - comparing and/or refining arguments based on evidence
  - providing feedback on an explanation or argument
  - using evidence to support a claim
- Examples of organism **characteristics** may include, but are NOT limited to:
  - physical characteristics
  - behavior
  - resource needs
- Measures of **survival** in the particular habitat include, but are NOT limited to:
  - average lifespan
  - overall health
  - ability to successfully reproduce
  - the size of a population
- Examples of **cause and effect** relationships may include, but are NOT limited to:
  - relating changes in the availability of resources to changes in survival
  - relating changes in the number organisms with a specific characteristic to changes in survival
  - relating changes in survival to changes in habitat

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Performance Expectation	**4-LS1-1** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.		
Dimensions	**Science & Engineering Practice**	**Disciplinary Core Idea**	**Crosscutting Concept**
	Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Construct an argument with evidence, data, and/or a model.	**LS1.A: Structure and Function** • Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.	**Systems and System Models** • A system can be described in terms of its components and their interactions.
These item specifications were developed using the following reference materials:			
K–12 Framework	pp. 71–74	pp. 143–145	pp. 91–94
NGSS Appendices	Appendix F pp. 13–14	Appendix E p. 4	Appendix G pp. 7–8
Clarification Statement	Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.		
Assessment Boundary	Assessment is limited to macroscopic structures within plant and animal systems.		
Expected DCI Vocabulary	behavior, function, growth, reproduction, structure, survival		

Items may ask students to:

Code	Alignment	Item Specification
4-LS1-1.1	SEP-DCI-CCC	**Construct** an **argument** using **system models** to describe plants and/or animals in terms of their **structures** and how the structures interact to serve various survival, growth, behavioral, and/or reproductive **functions**.
4-LS1-1.2	SEP-DCI	**Construct** an **argument** to show that plant and/or animal **structures** serve various survival, growth, behavioral, and/or reproductive **functions**.
4-LS1-1.3	DCI-CCC	Connect the crosscutting concept of systems and **system models** to plant and/or animal **structures** that serve various survival, growth, behavioral, or reproductive **functions.**
4-LS1-1.4	SEP-CCC	**Construct** an **argument** that connects system components and interactions in a **system model**.

Details and Clarifications

- **Construct** an **argument** is expanded to include:
  - developing an argument based on evidence, data, or a simple model
  - distinguishing between observations and inferences in an explanation or argument
  - comparing and/or refining arguments based on evidence
  - providing feedback on an explanation or argument
  - using evidence to evaluate claims
- **Structures** and **functions** may include, but are NOT limited to, structures that work together to support:
  - plants
    - obtaining water/sunlight/air
    - growing toward sunlight and/or water
    - defending against herbivores
    - attracting pollinators
  - animals
    - pumping blood/breathing/moving/digesting food
    - obtaining food
    - defending against predators
    - attracting mates
- **System models** may include, but are not limited to:
  - an entire organism (plant or animal)
  - a subsystem within a plant or animal
  - the interactions of structures working together within a plant or animal system or subsystem

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Earth and Space Sciences

Disciplinary Core Ideas:

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

Performance Expectation	**4-ESS1-1** Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.		
Dimensions	**Science & Engineering Practice**	**Disciplinary Core Idea**	**Crosscutting Concept**
	Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Identify the evidence that supports particular points in an explanation.	**ESS1.C: The History of Planet Earth** • Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.	**Patterns** • Patterns can be used as evidence to support an explanation. **Connections to Nature of Science** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes consistent patterns in natural systems.
These item specifications were developed using the following reference materials:			
K–12 Framework	pp. 67–71	pp. 177–179	pp. 85–87
NGSS Appendices	Appendix F pp. 11–12	Appendix E p. 2	Appendix G pp. 3–5 Appendix H pp. 4–6
Clarification Statement	Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.		
Assessment Boundary	Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.		
Expected DCI Vocabulary	earthquake, force, fossil, rock formation, rock layer		

Items may ask students to:

Code	Alignment	Item Specification
4-ESS1-1.1	SEP-DCI-CCC	**Identify evidence** from **patterns** in rock formations and/or fossils in rock layers that supports an explanation of **change over time** due to **earth forces**.
4-ESS1-1.2	SEP-DCI	**Identify evidence** that supports an explanation of **change over time** due to **earth forces**.
4-ESS1-1.3	DCI-CCC	Connect the crosscutting concept of **patterns** to rock formations and/or fossils in rock layers to support an explanation of **change over time** due to **earth forces**.
4-ESS1-1.4	SEP-CCC	**Identify evidence,** in the form of **patterns,** that supports an explanation.

Details and Clarifications

- **Identify** evidence is expanded to include:
  - using observations to construct an explanation for natural phenomena
  - supporting an explanation using measurements, observations, or patterns as evidence
- **Evidence** may include, but is NOT limited to:
  - vertical ordering of rock layers
  - presence or absence of rock layers
  - presence or absence of fossils in rock layers
  - types of fossils in rock layers
- **Changes over time** due to **earth forces** may include, but are not limited to:
  - changes in a landscape and/or fossils due to changing climate
  - changes in rock layers or a landscape due to weathering, erosion, and/or deposition
  - changes in rock layers or a landscape due to tectonic forces and/or earthquakes
- **Patterns** used as evidence may include, but are NOT limited to:
  - sequence of fossils in rock layers
  - sequence of rock types in rock layers
  - presence, absence, or thickness of rock formations
  - presence, absence, or abundance of fossil types across rock layers

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Performance Expectation	**5-ESS2-2** Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.		
Dimensions	**Science & Engineering Practice**	**Disciplinary Core Idea**	**Crosscutting Concept**
	Using Mathematics and Computational Thinking Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Describe and graph quantities such as area and volume to address scientific questions.	**ESS2.C: The Roles of Water in Earth's Surface Processes** • Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.	**Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight and volume.
These item specifications were developed using the following reference materials:			
K–12 Framework	pp. 64–67	pp. 184–186	pp. 89–91
NGSS Appendices	Appendix F p. 10	Appendix E p. 3	Appendix G pp. 6–7
Clarification Statement	There is no clarification statement provided for this PE.		
Assessment Boundary	Assessment is limited to oceans, lakes, rivers, glaciers, groundwater, and polar ice caps, and does not include the atmosphere.		
Expected DCI Vocabulary	fresh water, glacier, groundwater, polar ice cap, reservoir, salt water, wetland		

Items may ask students to:

Code	Alignment	Item Specification
5-ESS2-2.1	SEP-DCI-CCC	Use **standard units** to **describe** and/or **graph quantities** that show that Earth's **available water** is distributed in various **reservoirs**.
5-ESS2-2.2	SEP-DCI	**Describe** and/or **graph quantities** that show that Earth's **available water** is distributed in various **reservoirs**.
5-ESS2-2.3	DCI-CCC	Connect the crosscutting concept of scale, proportion, and quantity to measurements and/or descriptions, in **standard units**, of how Earth's **available water** is distributed in various **reservoirs**.
5-ESS2-2.4	SEP-CCC	**Describe** and/or **graph quantities** using **standard units**.

Details and Clarifications

- **Describe** and/or **graph quantities** is expanded to include:
    - using mathematics to represent variables and their relationships
    - measuring, comparing, and/or organizing quantitative attributes (e.g., area, volume, mass) to reveal patterns that suggest relationships
    - graphing quantities to address scientific questions and/or problems
- **Reservoirs** containing Earth's **available water** include:
    - glaciers
    - groundwater
    - lakes
    - oceans
    - polar ice caps
    - rivers
- A **description** of Earth's **available water** may include, but is NOT limited to:
    - comparison of the relative amounts of fresh water and/or salt water available on Earth
    - quantitative statements of the differences in amount and/or type of water in two or more reservoirs
- A **graph** of Earth's **available water** may include, but is NOT limited to:
    - a graph showing amounts of fresh water and/or salt water in two or more reservoirs
    - a graph showing relative amounts of fresh water and/or salt water in two or more reservoirs
- **Standard units** may include, but are NOT limited to:
    - cubic meters
    - kilograms
    - liters

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Expected Vocabulary Specific to the Science & Engineering Practices and Crosscutting Concepts

- cause
- change
- claim
- constraints
- criteria
- data
- effect
- energy
- evidence
- explanation
- function
- graph
- interaction
- investigation
- limitations
- mass
- matter
- model
- pattern
- proportion
- quantity
- scale
- solution
- stability
- structure
- system
- system model
- volume