Washington Comprehensive Assessment of Science

Test Design & Item Specifications

Grade 8

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.

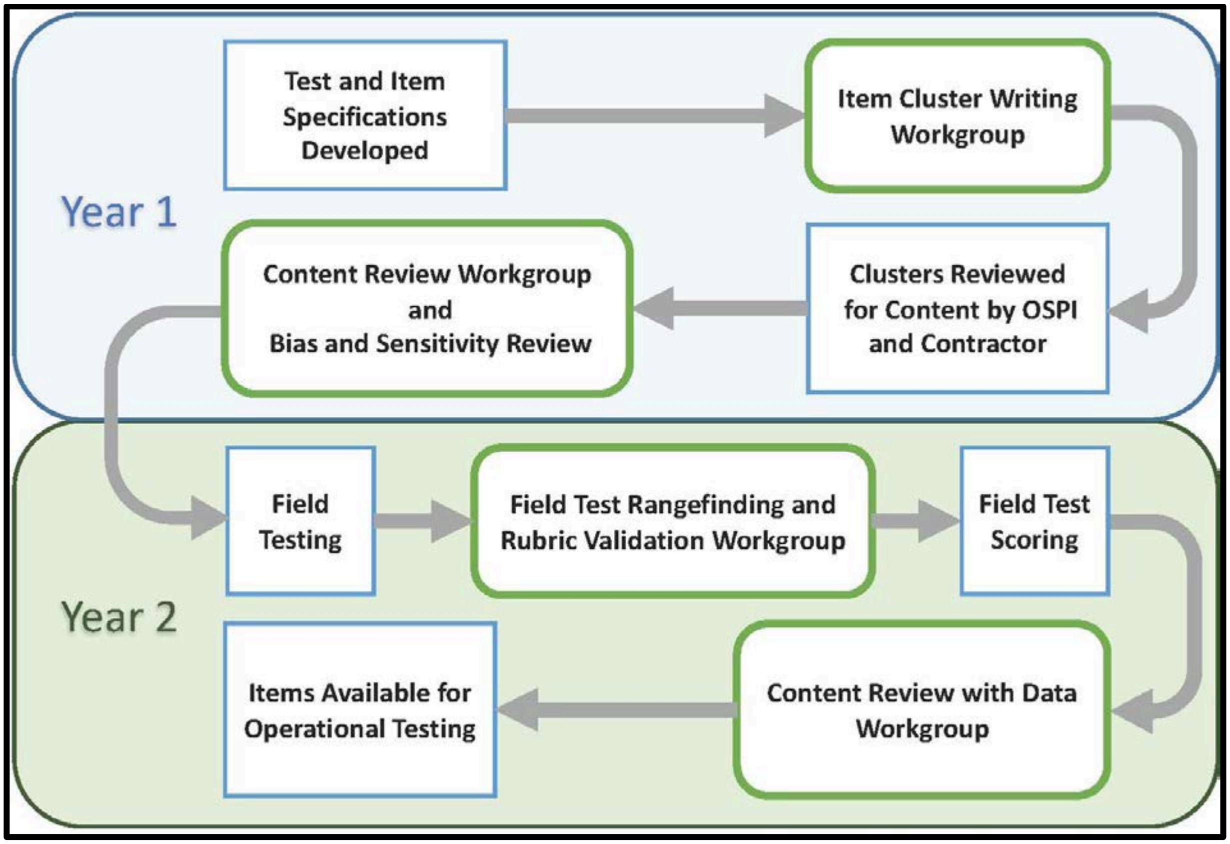
Assessment Development Cycle

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.

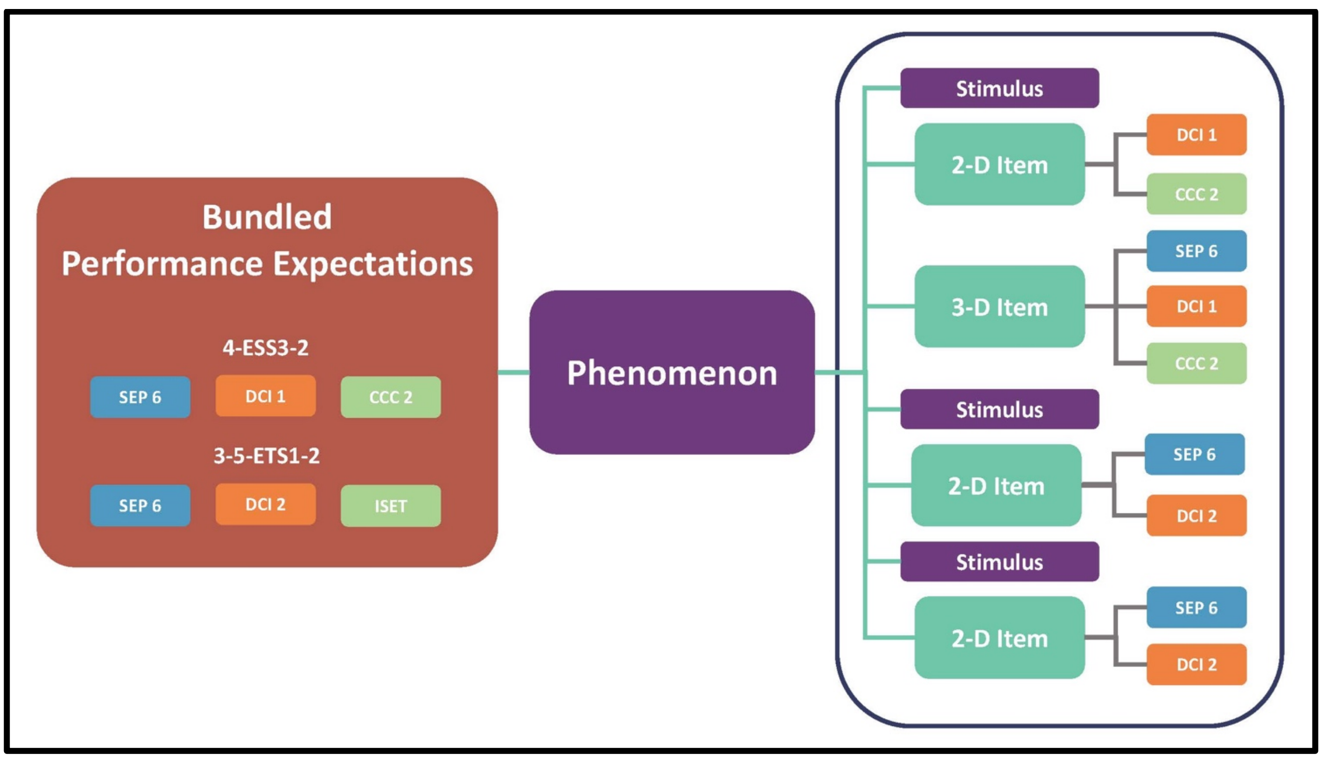
Item Clusters

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 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 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 grade 8 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	35%	25–35%	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

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 8 WCAS use language targeted to a reading level of sixth 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.

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 **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

Performance Expectation	**MS-PS2-5** 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	**Science & Engineering Practice**	**Disciplinary Core Idea**	**Crosscutting Concept**
	Planning and Carrying Out Investigations 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. • 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.	**PS2.B: Types of Interactions** • 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).	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems.
These item specifications were developed using the following reference materials:			
K–12 Framework	pp. 59–61	pp. 116–118	pp. 87–89
NGSS Appendices	Appendix F pp. 7–8	Appendix E p. 7	Appendix G pp. 5–6
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.		
Expected DCI Vocabulary	electric charge, electric field, electric force, magnetic field, magnetic force		

Items may ask students to:

Code	Alignment	Item Specification
MS-PS2-5.1	SEP-DCI-CCC	**Conduct** and/or **evaluate** an **investigation** to provide **evidence** of the **cause and effect** relationships between **forces** that can act at a distance and the **fields** that exist between objects.
MS-PS2-5.2	SEP-DCI	**Conduct** and/or **evaluate** an **investigation** to provide evidence that **forces** can act at a distance due to **fields** that exist between objects.
MS-PS2-5.3	DCI-CCC	Connect the crosscutting concept of **cause and effect** to **forces** that act at a distance due to **fields** between objects.
MS-PS2-5.4	SEP-CCC	**Conduct** and/or **evaluate** an **investigation** of **cause and effect** relationships.

Details and Clarifications

- **Conduct** and/or **evaluate** an **investigation** is expanded to include:
    - conducting an investigation to produce evidence
    - identifying independent and dependent variables and/or controlled variables
    - making predictions about what would happen if a variable changes
    - evaluating appropriate methods and/or tools for collecting and/or recording data
- **Fields** and **forces** may include:
    - electric fields and electric forces
    - magnetic fields and magnetic forces
- **Evidence** of **cause and effect** relationships may include, but is NOT limited to:
    - observation of change in motion due to attraction or repulsion between magnets
    - observation of change in motion due to attraction or repulsion between electric charges
    - descriptions of how the force exerted by one magnetic object causes another magnetic object to move or change motion
    - descriptions of how the force exerted by one charged object causes another charged object to move or change motion

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Performance Expectation	**MS-PS4-2** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.		
Dimensions	**Science & Engineering Practices**	**Disciplinary Core Ideas**	**Crosscutting Concepts**
	Developing and Using Models 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. • Develop and use a model to describe phenomena.	**PS4.A: Wave Properties** • A sound wave needs a medium through which it is transmitted. **PS4.B: Electromagnetic Radiation** • 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. • 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. • A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. • However, because light can travel through space, it cannot be a matter wave, like sound or water waves.	**Structure and Function** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
These item specifications were developed using the following reference materials:			
K–12 Framework	pp. 56–59	pp. 131–136	pp. 96–98
NGSS Appendices	Appendix F p. 6	Appendix E p. 8	Appendix G pp. 9–10
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.		
Expected DCI Vocabulary	absorb, amplitude, frequency, light wave, mechanical wave, medium, reflect, refract, sound wave, transmit, transparent, wavelength		

Items may ask students to:

Code	Alignment	Item Specification
MS-PS4-2.1	SEP-DCI-CCC	**Develop** and/or **use** a **model** to describe that **wave interactions** with materials can support the use of materials for certain **functions**.
MS-PS4-2.2	SEP-DCI	**Develop** and/or **use** a **model** to describe how **waves** and different materials **interact**.
MS-PS4-2.3	DCI-CCC	Connect the crosscutting concept of **structure and function** to **waves interacting** with different materials.
MS-PS4-2.4	SEP-CCC	**Develop** and/or **use** a **model** 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 predict or describe phenomena
  - revising a given complete or partial model
  - describing the limitations of a complete or partial model
  - using a model to represent a current understanding of a system
  - using a model to aid in the development of questions and explanations
  - using a model to communicate ideas
- A **model** of the properties of **wave interactions** with materials may include, but is not limited to, a diagram, drawing, simulation, or written description that includes qualitative representations 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

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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	**MS-LS2-4** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.		
Dimensions	**Science & Engineering Practices**	**Disciplinary Core Idea**	**Crosscutting Concept**
	Engaging in Argument from Evidence 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). • 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. **Connections to Nature of Science** **Scientific Knowledge is Based on Empirical Evidence** • Science disciplines share common rules of obtaining and evaluating empirical evidence.	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** • 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.	**Stability and Change** • Small changes in one part of a system might cause large changes in another part.
These item specifications were developed using the following reference materials:			
K–12 Framework	pp. 71–74	pp. 154–156	pp. 98–101
NGSS Appendices	Appendix F pp. 13–14 Appendix H pp. 4–5	Appendix E p. 5	Appendix G pp. 10–11
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.		
Expected DCI Vocabulary	biodiversity, ecosystem, population, stability		

Items may ask students to:

Code	Alignment	Item Specification
MS-LS2-4.1	SEP-DCI-CCC	**Construct** an **argument** supported by evidence that small physical or biological **disruptions** might cause large **changes** in **populations**.
MS-LS2-4.2	SEP-DCI	**Construct** an **argument** supported by evidence that physical or biological **disruptions** might shift **populations**.
MS-LS2-4.3	DCI-CCC	Connect the crosscutting concept of **stability and change** to small physical or biological **disruptions** that might shift **populations**.
MS-LS2-4.4	SEP-CCC	**Construct** an **argument** supported by evidence that a small change in one factor might cause a large **change** in a second factor.

Details and Clarifications

- **Construct** an **argument** is expanded to include:
    - making a claim based on observations, data, and/or models
    - using evidence and/or scientific reasoning to support an explanation or a model
    - identifying flaws in explanations, procedures, or models, and/or modifying arguments
- **Disruptions** may include:
    - changes in physical conditions in an ecosystem (e.g., rainfall, fire, pollution)
    - changes in biological conditions in an ecosystem (e.g., predator removal, species introduction)
- **Changes** in **populations** may include, but are not limited to:
    - the migration of species into or out of an area
    - the extinction of species
    - the formation of a new species
    - differences in the types and/or total numbers of organisms in one or more populations

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Performance Expectation	**MS-LS4-4** 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	**Science & Engineering Practice**	**Disciplinary Core Idea**	**Crosscutting Concept**
	Constructing Explanations and Designing Solutions 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. • Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena.	**LS4.B: Natural Selection** • Natural selection leads to the predominance of certain traits in a population, and the suppression of others.	**Cause and Effect** • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
These item specifications were developed using the following reference materials:			
K–12 Framework	pp. 67–71	pp. 163–164	pp. 87–89
NGSS Appendices	Appendix F pp. 11–12	Appendix E p. 6	Appendix G pp. 5–6
Clarification Statement	Emphasis is on using simple probability statements and proportional reasoning to construct explanations.		
Assessment Boundary	There is no assessment boundary provided for this PE.		
Expected DCI Vocabulary	environment, genetic variation, natural selection, population, probability, reproduce, survival, trait		

Items may ask students to:

Code	Alignment	Item Specification
MS-LS4-4.1	SEP-DCI-CCC	**Construct** an **explanation** that includes **cause and effect** relationships among **natural selection**, the variation of **traits** in a population, and the probability of survival and/or reproduction in a specific environment.
MS-LS4-4.2	SEP-DCI	**Construct** an **explanation** of how **natural selection** leads to the variation of **traits** in a population and the probability of survival and/or reproduction in a specific environment.
MS-LS4-4.3	DCI-CCC	Connect the crosscutting concept of **cause and effect** to **natural selection**, the variation of **traits** in a population, and the probability of survival and/or reproduction in a specific environment.
MS-LS4-4.4	SEP-CCC	**Construct** an **explanation** of **cause and effect** relationships using probability.

Details and Clarifications

- **Construct** an **explanation** is expanded to include:
    - using valid data, models, and/or scientific knowledge to construct, revise, and/or support an explanation of phenomena
    - predicting and/or describing phenomena using qualitative and/or quantitative relationships
    - using models and/or evidence to support explanations
- Examples of **traits** may include, but are not limited to:
    - morphological traits (e.g., body shape, wing pattern, bone structure)
    - physiological traits (e.g., disease resistance, heart rate, photosynthesis)
    - behavioral traits (e.g., feeding, mating, defense)
- Evidence of **cause and effect** relationships due to **natural selection** may include, but is not limited to:
    - specific traits that increase or decrease over time in a species after a change in the environment
    - specific traits that confer advantages to organisms in a particular environment and increase the probability of survival and/or reproduction
    - the increase in the proportion of organisms with advantageous traits from generation to generation
    - the decrease in the proportion of organisms with disadvantageous traits from generation to generation

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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	**MS-ESS1-3** Analyze and interpret data to determine scale properties of objects in the solar system.		
Dimensions	**Science & Engineering Practice**	**Disciplinary Core Idea**	**Crosscutting Concept**
	Analyzing and Interpreting Data 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.	**ESS1.B: Earth and the Solar System** • 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.	**Scale, Proportion, and Quantity** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. **Connections to Engineering, Technology, and Applications of Science** **Interdependence of Science, Engineering, and Technology** • 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	pp. 61–63	pp. 175–176	pp. 89–91
NGSS Appendices	Appendix F p. 9	Appendix E p. 2	Appendix G pp. 6–7 Appendix J pp. 1–3
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.		
Expected DCI Vocabulary	asteroid, crust, gravity, orbital radius, solar system		

Items may ask students to:

Code	Alignment	Item Specification
MS-ESS1-3.1	SEP-DCI-CCC	**Analyze** and/or **interpret data** that describe the **features** of **objects** in the solar system at various **scales**.
MS-ESS1-3.2	SEP-DCI	**Analyze** and/or **interpret data** that describe the **features** of **objects** in the solar system.
MS-ESS1-3.3	DCI-CCC	Connect the crosscutting concept of **scale** to the **features** of **objects** in the solar system.
MS-ESS1-3.4	SEP-CCC	**Analyze** and/or **interpret data** observed at various **scales**.

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 is NOT limited to:
  - tables
  - graphs
  - diagrams
  - models
  - statistical information (e.g., mean, median, mode, variability)
- **Features** of objects in the solar system may include, but are NOT limited to:
  - location relative to other objects
  - orbital shape and/or size
  - the relative or absolute measurements of overall size
  - the presence, absence, arrangement, abundance, or sizes of surface features
  - physical composition and/or makeup
- **Objects** in the solar system may include, but are NOT limited to:
  - the sun
  - planets
  - moons
  - asteroids, meteors, comets
- **Scale** may include, but is NOT limited to:
  - mathematical relationships among features of objects
  - absolute measurements of features of objects
  - model scales that represent features of objects
  - the proportional relationship between the size of a feature and the distance from which the feature was observed

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Performance Expectation	**MS-ESS2-4** 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	**Science & Engineering Practice**	**Disciplinary Core Idea**	**Crosscutting Concept**
	Developing and Using Models 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 a model to describe unobservable mechanisms.	**ESS2.C: The Roles of Water in Earth’s Surface Processes** • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. • Global movements of water and its changes in form are propelled by sunlight and gravity.	**Energy and Matter** • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.
These item specifications were developed using the following reference materials:			
K–12 Framework	pp. 56–59	pp. 184–186	pp. 94–96
NGSS Appendices	Appendix F p. 6	Appendix E p. 3	Appendix G pp. 8–9
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.		
Expected DCI Vocabulary	condensation, crystallization, evaporation, gravity, precipitation, thermal energy, transpiration		

Items may ask students to:

Code	Alignment	Item Specification
MS-ESS2-4.1	SEP-DCI-CCC	**Develop** and/or **use** a **model** to describe how **transfers of energy** drive the **processes** that result in the cycling of water among **reservoirs**.
MS-ESS2-4.2	SEP-DCI	**Develop** and/or **use** a **model** to describe **processes** that result in the cycling of water among **reservoirs**.
MS-ESS2-4.3	DCI-CCC	Connect the crosscutting concept of energy and matter to the **transfers of energy** that drive the cycling of water among **reservoirs**.
MS-ESS2-4.4	SEP-CCC	**Develop** and/or **use** a **model** to describe the **transfers of energy** that drive the cycling of matter within a system.

Details and Clarifications

- **Develop** and/or **use** a **model** is expanded to include:
  - using a given complete or partial model to predict or describe phenomena
  - revising a given complete or partial model
  - describing the limitations of a complete or partial model
  - using a model to represent a current understanding of a system
  - using a model to aid in the development of questions and/or explanations
  - using a model to communicate ideas
- A **model** may include, but is not limited to:
  - a description of a process that drives a global motion of water and/or a phase change in water
  - a description of energy transfers that drive the hydrologic cycle
- **Processes** that result in the cycling of water may include, but are not limited to:
  - the transformation of water from liquid to vapor by living things
  - surface waters releasing water vapor into the air
  - water vapor forming clouds, fog, or frost
  - liquid surface water forming ice sheets
  - falling rain, snow, or ice
  - the flow of liquid water or glacial ice toward lower elevations
- **Reservoirs** may include, but are not limited to:
  - living things
  - groundwater
  - rivers, streams, lakes, ponds, and/or oceans
  - clouds, fog, or water vapor
  - glacial ice, ice sheets, or snow
- **Transfers of energy** may include, but are not limited to:
  - the gravity-driven downward motion of liquid water or ice over a sloped surface
  - the gravity-driven downward fall of various forms of water from the atmosphere
  - thermal energy transfer from sunlight to water that drives a phase change (e.g., melting)
  - thermal energy from sunlight that was stored in water that drives a phase change (e.g., condensation)

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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