

Welcome to the third of four chapters in a digital workbook on designing high-quality threedimensional science assessment tasks for classroom use. This workbook is intended to help educators design and evaluate high-quality classroom science assessment tasks that provide meaningful information about what students know and can do in science.

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Chapter 3 of this workbook includes a series of six modules. Together these six modules provide an in-depth exploration of the second phase of principled assessment design: development of the task specifications tool. In this chapter, we focus on translating the unpacking of the three dimensions of a specific performance expectation, or indicator, into assessment tasks using a task specifications tool. We provide opportunities for you to engage in interactive activities and explore and use our design template to complete your own task specifications tool for a threedimensional standard.

In this module, Module 3.6, we provide opportunities for you to engage in an interactive activity to explore and use our design template to identify the key components needed to develop purposeful assessment tasks.



In Module 3.6, we invite you to participate in a guided activity to evaluate an existing task specifications tool. You will have an opportunity to critically analyze statements of the knowledge, skills, and abilities, or KSAs, student demonstrations of learning, work products, task features, aspects that can be varied, and the assessment boundaries to determine whether they are appropriate and well-aligned to the selected PE. By engaging in this activity, our intent is to show the importance and benefits of continually evaluating and refining the task specifications tool.



Now that you are well acquainted with the purpose and elements of the task specifications tool, and the available reference materials in the Web Links and Resources pods, let's begin a guided activity. In this activity, you will first analyze statements and determine their correctness in relationship to a high school PE and then consider additional statements to refine and further develop a task specifications tool.



As discussed in previous modules, the task specifications tool is a design tool that helps educators obtain evidence of what students know and can do and how they are integrating these multiple dimensions across the core ideas, the practices, and the crosscutting concepts.

In this activity, we provide you with an opportunity to use the *Framework* and the NGSS resources to apply your skill at evaluating and refining a task specifications tool for the high school PE, *HS-ESS2-5: Plan and conduct an investigation of the properties of water and their effects on Earth materials and surface processes.* 

Alright. Here are the steps to complete this guided activity. First, access the materials in the Web Links and Resources pods to support your review of the provided task specifications tool for HS-ESS2-5.

Once you've accessed the resources, view the first slide, and pause the presentation to consider the correctness and accuracy of the provided statements. After you evaluate the statements, resume the presentation for guidance about which statements are incorrect. Consider the explanations provided for why the statements are incorrect.

Next, view the second slide, which is populated with the correct statements for the same element, and pause the presentation to consider and determine what additional statements could be added to the element. After you determine what additional statements could be added, resume the presentation for suggested additional statements and explanations for these additions.

Repeat these steps for each element of the task specifications tool. For each element, we provide two slides with statements from the task specifications tool for you to consider.

Please note that you can obtain directions for completing this guided activity in the Resources pod titled, "Guided Activity—Review of an Existing Task Specifications Tool."

Let's get started.

## Knowledge, Skills, and Abilities (KSAs)

Element	Description		
<ul> <li>Performance Expectation</li> <li>Indicate the PE from the instructional sequence to be assessed.</li> </ul>	<ul> <li>HS-ESS2-5. Plan and conduct an investigation of the properties of water and their effects on Earth materials and surface processes.</li> </ul>		
<ul> <li>Knowledge, Skills, &amp; Abilities (KSAs)</li> <li>Develop statements which specify what is expected of students to demonstrate (i.e., knowledge, skills, and abilities) to provide evidence that they have learned one or more aspects of a PE.</li> </ul>	<ul> <li>KSA1: Plan an investigation of the properties of water and their effects on Earth materials.</li> <li>KSA2: Plan an investigation of the properties of water and their effects on surface processes.</li> <li>KSA3: Plan and/or conduct an investigation of the properties of water and their effects on Earth materials.</li> <li>KSA4: Plan and/or conduct an investigation of the properties of water and their effects on surface processes.</li> <li>KSA4: Plan and/or conduct an investigation of the properties of water and their effects on surface processes.</li> <li>KSA5: Plan and/or conduct an investigation of the properties of water to measure the predicted effect of water on Earth's materials or surface processes.</li> </ul>		
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On this first slide associated with the PE, *HS-ESS2-5: Plan and conduct an investigation of the properties of water and their effects on Earth materials and surface processes,* consider if each KSA statement is correct or incorrect. Pause the presentation to read and consider each statement. Then, resume the presentation to see which statements, if any, are incorrect. Incorrect statements will be indicated in red and struck through. As appropriate, an explanation is provided as to why each statement is incorrect.

Careful evaluation of the statements associated with the PE, *HS-ESS2-5: Plan and conduct an investigation of the properties of water and their effects on Earth materials and surface processes* indicates that ALL of the statements are correct, and none are struck through or removed. These statements, as indicated, align to the high school resources used to confirm these statements.

## Knowledge, Skills, and Abilities (KSAs)



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<ul> <li>Performance Expectation</li> <li>Indicate the PE from the instructional sequence to be assessed.</li> </ul>	<ul> <li>HS-ESS2-5. Plan and conduct an investigation of the properties of water and their effects on Earth materials and surface processes.</li> </ul>		
<ul> <li>Knowledge, Skills, &amp; Abilities (KSAs)</li> <li>Develop statements which specify what is expected of students to demonstrate (i.e., knowledge, skills, and abilities) to provide evidence that they have learned one or more aspects of a PE.</li> </ul>	<ul> <li>KSA1: Plan an investigation of the properties of water and their effects on Earth materials.</li> <li>KSA2: Plan an investigation of the properties of water and their effects on surface processes.</li> <li>KSA3: Plan and/or conduct an investigation of the properties of water and their effects on Earth materials.</li> <li>KSA4: Plan and/or conduct an investigation of the properties of water and their effects on surface processes.</li> <li>KSA4: Plan and/or conduct an investigation of the properties of water and their effects on surface processes.</li> <li>KSA5: Plan and/or conduct an investigation of the properties of water to measure the predicted effect of water on Earth's materials or surface processes.</li> <li>KSA6: Refine the plan to produce more accurate and precise data related to the connection between the properties of water and their effects on Earth materials and surface processeş.</li> </ul>		

On this second slide associated with the PE, HS-ESS2-5, consider how well the KSA statements address the multiple aspects of the PE to determine what additional statements could be added. Pause the presentation to consider and determine additional KSA statements. Then, resume the presentation for suggested additional statements and explanations for these additions.

With regard to the KSAs, the task specifications tool is populated with one additional KSA statement. The added statement, *Refine the plan to produce more accurate and precise data related to the connection between the properties of water and their effects on Earth materials and surface processes*, is an appropriate addition as it explicitly specifies a skill, "refining the design," which is aligned to the SEP. The addition of this KSA allows for tasks in which students may evaluate the accuracy and precision of the collected data and whether the data can be used to infer the effect of water on processes in the natural world.

Student Demonstrations of Learning 왕			
Element	Description		
<ul> <li>Performance Expectation</li> <li>Indicate the PE from the instructional sequence to be assessed.</li> </ul>	<ul> <li>HS-ESS2-5. Plan and conduct an investigation of the properties of water and their effects on Earth materials and surface processes.</li> </ul>		
<ul> <li>Student Demonstration of Learning</li> <li>List what students should be able to do to demonstrate that they have met the KSA(s).</li> <li>Define qualities of student performance that constitute student evidence.</li> </ul>	<ul> <li>Accurately and completely plans and conducts an investigation that provides evidence of the connection between the properties of water and its effects on Earth materials and/or surface processes</li> <li>Develops a logical investigation plan and accurately describes the data that will be collected and the evidence to be derived from the data (i.e., properties of water, effect of the properties of water (e.g., energy transfer, mechanical effects, chemical effects))</li> <li>Constructs accurate and complete explanations of phenomena using knowledge of accepted scientific theory and linking it to models and evidence.</li> <li>Correctly describes how the data collected in an investigation will be relevant to determining the effect of water on Earth materials and/or surface processes</li> <li>Correctly evaluates the accuracy and precision of the collected data</li> </ul>		

On this first slide associated with the Student Demonstration of Learning for the PE, HS-ESS2-5, consider if each SDL statement indicated for the multiple KSAs is correct or incorrect. Pause the presentation to read and consider each statement. Then, resume the presentation to see the incorrect statements, which will be indicated in red and struck through. An explanation is provided as to why each statement is incorrect.

The statement, *Constructs accurate and complete explanations of phenomena using knowledge of accepted scientific theory and linking it to models and evidence*, is incorrect. While this statement does use "accurate" and "complete" as qualifiers to describe the way in which students should demonstrate their science learning, the statement exceeds the expectation of the SEP, *Planning and Carrying out Investigations*. While high school students are expected to construct accurate and complete explanations, this expectation is associated with a different SEP, *Constructing Explanations and Designing Solutions*, and exceeds the boundaries of what students are expected to know and be able to do for the selected PE, HS-ESS2-5. The statement does not provide explicit evidence for the KSAs defined for this PE, which focus on students' understanding of the connection between the properties of water and their effects on Earth materials and surface processes.

Student Demonstrations of Learning			
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<ul> <li>Student Demonstration of Learning</li> <li>List what students should be able to do to demonstrate that they have met the KSA(s).</li> <li>Define qualities of student performance that constitute student evidence.</li> </ul>	<ul> <li>Accurately and completely plans and conducts an investigation that provides evidence of the connection between the properties of water and its effects on Earth materials and/or surface processes</li> <li>Develops a logical investigation plan and accurately describes the data that will be collected and the evidence to be derived from the data (i.e., properties of water, effect of the properties of water (e.g., energy transfer, mechanical effects, chemical effects))</li> <li>Correctly describes how the data collected in an investigation will be relevant to determining the effect of water on Earth materials and/or surface processes</li> <li>Correctly evaluates the accuracy and precision of the collected data</li> <li>Correctly evaluates whether the data collected in an investigation can be used to infer the effect of water on processes in the natural world</li> </ul>		

On this second slide associated with the Student Demonstrations of Learning for the PE, HS-ESS2-5, consider how well the SDL statements address the multiple KSAs to determine what additional statements could be added. Pause the presentation to consider and determine additional SDL statements. Then, resume the presentation for suggested additional statements and explanations for these additions.

The added statement, *Correctly evaluates whether the data collected in an investigation can be used to infer the effect of water on processes in the natural world,* is an appropriate addition as KSA6 references students' ability to refine a plan to produce more accurate and precise data. The addition of this SDL statement allows for the development of tasks, which may ask the student to identify the design that will provide the best evidence to address the purpose of the investigation by evaluating alternative designs.

## Work Products



Element	Description	
<ul> <li>Performance Expectation</li> <li>Indicate the PE from the instructional sequence to be assessed.</li> </ul>	<ul> <li>HS-ESS2-5. Plan and conduct an investigation of the properties of water and their effects on Earth materials and surface processes.</li> </ul>	
<ul> <li>Work Product</li> <li>Determine the "vehicles" (i.e., work products) that are intended to contain observable evidence (e.g., a model, an argument, a description, a graph, a chart).</li> </ul>	<ul> <li>Description of steps for a planned investigation</li> <li>Record of observations</li> <li>Constructed-response</li> <li>Short response</li> <li>Plan and conduct an investigation of the properties of water</li> <li>Laboratory demonstration</li> </ul>	

On this first slide associated with the Work Products for the PE, HS-ESS2-5, consider if each statement indicated for the work products is correct or incorrect. Pause the presentation to read and consider each statement. Then, resume the presentation to see the incorrect statements, which will be indicated in red and struck through. An explanation is provided as to why each statement is incorrect.

The statement, *Plan and conduct an investigation of the properties of water*, is incorrect. This statement is written as a KSA statement rather than as a work product. Remember, a work product allows students to demonstrate the KSA. For example, students might describe in a *constructed response* how to indicate or measure the predicted effect of water on Earth's materials or surface processes.

## Work Products



Element	Description		
<ul> <li>Performance Expectation</li> <li>Indicate the PE from the instructional sequence to be assessed.</li> </ul>	<ul> <li>HS-ESS2-5. Plan and conduct an investigation of the properties of water and their effects on Earth materials and surface processes.</li> </ul>		
<ul> <li>Work Product</li> <li>Determine the "vehicles" (i.e., work products) that are intended to contain observable evidence (e.g., a model, an argument, a description, a graph, a chart).</li> </ul>	<ul> <li>Description of steps for a planned investigation</li> <li>Record of observations</li> <li>Oral presentation</li> <li>Constructed-response</li> <li>Short response</li> <li>Laboratory demonstration</li> </ul>		

On this second slide associated with the Work Products for the PE, HS-ESS2-5, consider how well the work products address the multiple SDLs to determine what additional statements could be added. Pause the presentation to consider and determine additional WP statements. Then, resume the presentation for suggested additional statements and explanations for these additions.

The added statement, *Oral presentation*, is an appropriate addition. According to the *Framework*, high school students should be able to make oral presentations of their results and conclusions as well as to engage in appropriate discourse with other students by asking questions and discussing issues raised in such presentations (the *Framework*, NRC, 2012, p. 92). This relates to the aspect of the SEP, which states that students must "*plan and conduct an investigation individually and collaboratively*."

Task Features			
<ul> <li>Performance Expectation</li> <li>Indicate the PE from the instructional sequence to be assessed.</li> </ul>	<ul> <li>HS-ESS2-5. Plan and conduct an investigation of the properties of water and their effects on Earth materials and surface processes.</li> </ul>		
<ul> <li>Task Features</li> <li>List the task features that are required in the design of an assessment task.</li> <li>Reference the "Clarification Statement" in the NGSS for the PE as appropriate.</li> </ul>	<ul> <li>Prompt students to describe relationships between observed phenomenon or evidence and reasoning underlying the observation/evidence</li> <li>Provide evidence that can be used to make accurate inferences about student learning</li> <li>Require scientific reasoning and process skills</li> <li>Elicit core ideas as defined in the PE</li> <li>A high-quality scenario that focuses on phenomena or a design problem</li> <li>Accurate science content</li> <li>Provide information about Earth's formation and early history</li> <li>Engaging and relevant</li> </ul>		

On this first slide associated with the Task Features for the PE, HS-ESS2-5, consider if each statement indicated for the task features is correct or incorrect. Pause the presentation to read and consider each statement. Then, resume the presentation to see the incorrect statements, which will be indicated in red and struck through. An explanation is provided as to why each statement is incorrect.

The statement, *Provide information about Earth's formation and early history*, is incorrect. This information is aligned with the DCI, *ESS1.C: The History of Planet Earth*, and not the DCI, *ESS2.C: The Roles of Water in Earth's Surface Processes*. While concepts of Earth's formation and early history *may* be incorporated into a task, they would NOT be a feature of the task *necessary* to appropriately measure one or more of the KSAs.

Task Features	
Element	Description
<ul> <li>Performance Expectation</li> <li>Indicate the PE from the instructional sequence to be assessed.</li> </ul>	<ul> <li>HS-ESS2-5. Plan and conduct an investigation of the properties of water and their effects on Earth materials and surface processes.</li> </ul>
<ul> <li>List the task features that are required in the design of an assessment task.</li> <li>Reference the "Clarification Statement" in the NGSS for the PE as appropriate.</li> </ul>	<ul> <li>Prompt students to describe relationships between observed phenomenon or evidence and reasoning underlying the observation/evidence</li> <li>Provide evidence that can be used to make accurate inferences about student learning</li> <li>Require scientific reasoning and process skills</li> <li>Elicit core ideas as defined in the PE</li> <li>Opportunity for students to respond with sufficient evidence to produce a full-credit response</li> <li>A high-quality scenario that focuses on phenomena or a design problem</li> <li>Accessible for students with a variety of learning styles and needs</li> <li>Accurate science content</li> <li>Engaging and relevant</li> </ul>

On this second slide associated with the Task Features for the PE, HS-ESS2-5, consider how well the statements address the multiple aspects of the KSAs to determine what additional task features would cover the range of those KSAs in your task specification. Then, resume the presentation for suggested additional statements and explanations for these additions.

For the task features, there are two added statements. The first added statement, *Opportunity for students to respond with sufficient evidence to produce a full-credit response,* is an appropriate addition as the task will require to be scored. Consider how you are going to score the task; a scoring rubric must be developed that reflects students' ability to provide evidence that they have attained the KSAs. The second added statement, *Accessible for students with a variety of learning styles and needs,* is critical. You want to create tasks that are accessible to all students because, as part of their educational experience, they need opportunities to transfer what they know and demonstrate what they can do in new or related scenarios.

	Aspects of a Task that Can be Varied		
	Element		Description
Pe	rformance Expectation	•	HS-ESS2-5. Plan and conduct an
•	Indicate the PE from the		investigation of the properties of water
	instructional sequence to be		and their effects on Earth materials and
	assessed.		surface processes.
As	pects of an assessment task that <u>can</u>	٠	Number and complexity of scientific
be	varied to shift complexity or focus		concept(s) to be investigated
•	Allows for a range of tasks to be	•	Connections between hydrological and
	developed of varying complexity.		rock cycles
•	Allows for development of tasks that	•	Use the expansion of water as it freezes
	focus on various skills related to the		to show the ability of water to break rocks
	PE.		into smaller pieces
•	Allows the task developer to match	•	Amount of data and complexity of data
	features of the task with the	•	Various chemical effects of water on
	characteristics of students such as		Earth's materials
	their interests, familiarity, and	•	Number and type of properties of water
	provided instruction.	•	Number and type of effects of water on
		1	Earth's materials or surface processes
			•

On this first slide associated with Aspects of a Task that Can be Varied for the PE, HS-ESS2-5, consider if each statement indicated is correct or incorrect. Pause the presentation to read and consider if each statement allows for the development of a range of tasks varying in complexity and focusing on various skills related to the KSAs. Then, resume the presentation to see the incorrect statements, which will be indicated in red and struck through. An explanation is provided as to why each statement is incorrect.

The statement, *Use the expansion of water as it freezes to show the ability of water to break rocks into smaller pieces*, is incorrect because it does not describe an aspect of the task which may be varied. As written, it implies that the task designer must include this aspect. It is written as an imperative statement rather than providing an option for how tasks might be varied, for example, with respect to properties of water or chemical and physical effects on Earth materials.

	Aspects of a Task that Can be Varied		
	Element	Description	
Pe	rformance Expectation	<ul> <li>HS-ESS2-5. Plan and conduct an</li> </ul>	
•	Indicate the PE from the instructional	investigation of the properties of water and	
	sequence to be assessed.	their effects on Earth materials and surface	
		processes.	
As	pects of an assessment task that <u>can</u>	<ul> <li>Number and complexity of scientific</li> </ul>	
be	varied to shift complexity or focus	concept(s) to be investigated	
•	Allows for a range of tasks to be	Connections between hydrological and rock	
	developed of varying complexity.	cycles	
•	Allows for development of tasks that	<ul> <li>Amount of data and complexity of data</li> </ul>	
	focus on various skills related to the PE.	<ul> <li>Various chemical effects of water on Earth's materials</li> </ul>	
•	Allows the task developer to match	<ul> <li>Data may include graphical displays of:</li> </ul>	
	features of the task with the	observations, measurements, tables,	
	characteristics of students such as	graphs, and diagrams	
	their interests, familiarity, and	<ul> <li>Number and type of properties of water</li> </ul>	
	provided instruction.	<ul> <li>Number and type of effects of water on</li> </ul>	
		Earth's materials or surface processes	
		• Types of landforms impacted by water on	
		Earth's surface	

On this second slide associated with Aspects of a Task that Can be Varied for the PE, HS-ESS2-5, consider what aspects of a task can be varied. It is appropriate, based on what is being measured, that the task has some variation in its complexity. When you are thinking about **what** it is you are going to measure and **how** you might design a task to measure it, you can consider possible variations in the complexity or focus of the task using this element of the tool.

For aspects of a task that can be varied, there are two added statements. The first added statement, *Data may include graphical displays*, which includes examples such as *observations*, *measurements*, *tables*, *graphs*, and *diagrams*, is an appropriate addition. As the SEP specifically includes references to students producing and analyzing data, the task may incorporate a wide variety of data types, presentation styles, and units. In fact, a question may require students to identify the tools and instrumentation that can help obtain accurate and precise data. The second added statement, *Types of landforms impacted by water on Earth's surface*, can be varied based on local geological features that students may be familiar with to stimulate interest and engagement. For example, students may compare and contrast the processes which led to the creation of landforms due to the difference in the nature of the substrate.



On this first slide associated with the Assessment Boundaries for the PE, HS-ESS2-5, it is not only important to think about what we are measuring; we also want to think about what is not assessed. For this element, we list ideas and skills that should not be measured by an assessment task. Pause the presentation to consider if the statement indicated, *No assessment boundaries listed for this PE*, is correct or incorrect. Then, resume the presentation to see whether the statement will be indicated in red and struck through.

Many NGSS PEs have assessment boundaries. For this PE, the NGSS does **not** indicate any assessment boundaries. However, this does not mean they do not exist. Another strategy that can be used to define this element is to review other PEs indicated in the topical arrangement to identify related aspects that do not align to the selected PE.

When defining this element for the elementary or middle school grades, another strategy is to examine related PEs and the Common Core State Standards Connections at higher grades or grade bands. This will help you identify ideas and skills that exceed expectations for students and fall outside of the boundaries of the selected PE.



On this second slide for the Assessment Boundaries associated with the PE, HS-ESS2-5, consider what additional statements could be added to the assessment boundaries to ensure the task aligns to only the PE it is meant to address. Pause the presentation to consider and determine additional statements. Then, resume the presentation for suggested additional statements and explanations for these additions.

As stated on the previous slide, the NGSS does not indicate any assessment boundaries for the selected PE. However, for this element, educators should be careful not to address concepts related to *modeling biogeochemical cycles* as this is specific to a different PE, *HS-ESS2-6*, within the topical arrangement. Also, adding the statement, *Tasks should not require students to provide materials or tools to conduct the investigation* helps maintain the fairness of the task. We must strive to provide equal opportunities for students to demonstrate their knowledge, skills, and abilities without giving students an unfair advantage over other students. This may be supported by providing all the materials and tools needed for students to demonstrate their knowledge, skills, and abilities in response to each question in the task.

Congratulations, and thank you for completing this guided activity. We hope that you found it useful and that your familiarity with the task specifications tool and use of the resources have been enhanced.



Finally, we offer additional resources that may be helpful to anyone interested in learning more about the concepts presented in this module. A glossary of terms and our reference list follow.

Thank you for your engagement in this third chapter of the SCILLSS digital workbook on designing high-quality three-dimensional science assessment tasks for classroom use.





