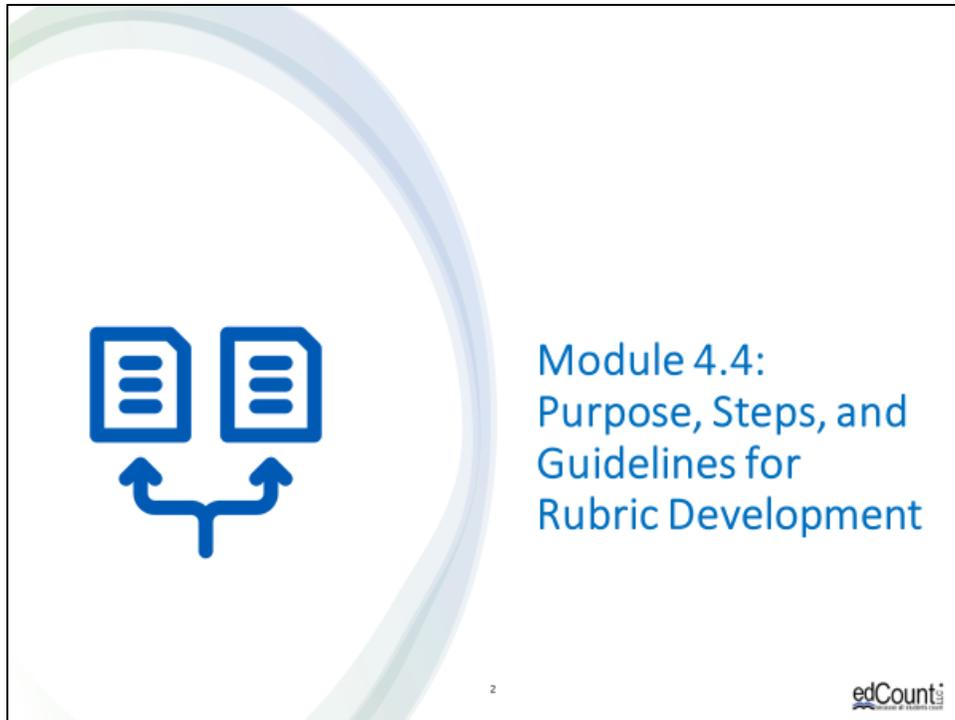


Welcome to the last of four chapters in a digital workbook on designing high-quality three-dimensional science assessment tasks for classroom use. This workbook is intended to help educators design and evaluate tasks that provide meaningful information about what students know and can do in science.

This digital workbook was developed by edCount, LLC, under the US Department of Education's Enhanced Assessment Grants Program, CFDA 84.368A.



Chapter 4 of this workbook includes a series of six modules. Together these six modules provide an in-depth exploration of the third phase of principled assessment design: development of tasks, rubrics, and exemplars. In this chapter, we focus on translating the unpacking of the three dimensions of a specific performance expectation or indicator and the design elements in the task specifications tool into an assessment task and rubric. We provide opportunities for you to engage in interactive activities and explore and use our design template to complete your own task and rubric, and learn how to apply scoring guidelines for a three-dimensional standard.

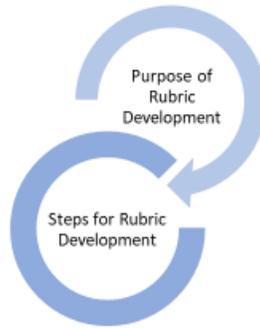
In this module, we provide an orientation to the development of rubrics to evaluate three-dimensional science tasks and outline steps you can use to create your task rubric. We provide task rubrics at the elementary, middle, and high school grade bands to illustrate the outcomes of the process as well as resources, key strategies, and guiding questions for completing a rubric.

Module 4.4 Outcomes



Steps for Rubric Development

To articulate the criteria and best practices for rubric development for classroom science assessment tasks



Purpose of Rubric Development

To review the purpose, components, and development of a classroom-based task rubric to evaluate student performance from a three-dimensional science assessment task

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In the previous Chapter 4 modules, we explored the purpose and use of classroom science assessment tasks, and you engaged in an interactive activity to gain a deeper understanding of the elements of a high-quality classroom science assessment task.

In this module, Module 4.4, we begin by considering the purpose and use of classroom-based task rubrics and articulate the criteria and best practices for rubric development. We provide a guided walk-through of the steps for developing a rubric for a classroom assessment task aligned to a NGSS PE.



Recall that phase 3 includes the design of the task and rubric. In Module 4.3, we modeled the use of phase 1, the unpacking tool, and phase 2, the task specifications tool to create high-quality multi-dimensional tasks to make students' thinking visible and promote accessibility for all learners through questions that are fair and equitable. In this module, we further explore the implementation of phase 3 by reviewing the purpose, components, and development of a task rubric using a step-by-step process that results in accurate and consistent evaluations of student performance on each question or prompt of a three-dimensional science task.

It is important to note that just as consideration of task development is a key focus during the completion of the first and second phases of principled assessment design, so is the consideration of rubric development. It is not an afterthought. An important step in this process is considering how you are going to score the task; therefore, the rubric is developed at the same time as the task. The rubric helps to highlight what you are intending to measure with the task and helps to evaluate whether the task allows students to provide evidence that they have attained the KSAs selected for the task. And we expect that as the KSAs that are being measured become more sophisticated and complex, so do the rubrics.

Let's talk more about the purpose and components of a rubric for a classroom-based assessment task.



Defining Terms: Task Rubrics



Rubrics define criteria to accurately and consistently interpret and evaluate student evidence of learning to make accurate inferences about what students understand which allows educators to determine how to shape instructional decisions based on students' performance to improve student learning.

Rubrics include descriptors for each question or prompt in an assessment task and describe the full range of evidence of student understanding from low to high levels of competency to determine specific areas where students might be performing well or might be struggling and need additional instruction.



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The online Merriam-Webster dictionary lists the first meaning of rubric as “an authoritative rule” and the fourth meaning as “a guide listing specific criteria for grading or scoring academic papers, projects, or tests. “Although educators may use rubrics to assign grades or score papers, our definition of a rubric is tied to a larger purpose, and that is to accurately and consistently evaluate evidence of student understanding to ultimately inform and guide educators’ instructional decisions.

A classroom science assessment rubric serves as a tool by which educators can accurately and consistently evaluate evidence of student science learning generated by questions or prompts within a task to determine how instruction may need to be adjusted along an instructional sequence. Classroom task rubrics are a tool to help educators get their finger on the pulse of what kids know and can do along an implemented instructional pathway. They define the criteria to interpret and evaluate student evidence of learning to properly evaluate what students understand and where they still need support. This allows educators to question and determine how to shape instructional decisions based on students’ performance to improve student learning.

Rubrics include descriptors for each question or prompt in the assessment task that describe the full range of evidence of student understanding from low to high levels of competency to determine specific areas where students might be performing well or might be struggling. A high-level response is scientifically accurate, complete and coherent, and consistent with the type of evidence gathered, and a low-level response may include misconceptions, is incomplete, or is not accurate.

Rubrics must address and detail all ways in which student evidence of learning is collected in the task, which will likely vary from question to question based on the assessed KSA(s). This supports educators in their ability to consistently evaluate and interpret student-produced evidence related to each question or prompt, make accurate inferences about student learning, and determine “next steps” for instruction to address the learning needs of all students.

Purpose of Task Rubrics



- Classroom-based task rubrics:
 - Are used to assess student performance
 - Connect to expectations, goals, or intended learning outcomes of instruction
 - Address the potential range of student responses
 - Describe criteria across score points for each aspect of the collected evidence contained within the student work products
 - Allow for the evaluation of students' ability to integrate the three-dimensions to explain a phenomenon or create a design solution
 - Provide diagnostic information to the educator to inform future instructional decisions
 - Provide feedback to students to see what aspects of their learning and demonstration of that learning may need attention

Now that we have a working definition of task rubrics, let's discuss their role and purpose in principled assessment design.

Rubrics must clearly define the criteria that educators use to accurately and consistently interpret and evaluate student evidence of learning. Given that evaluation of student performance is in the service of learning, rubrics should connect to and reflect the expectations, goals, or intended learning outcomes of instruction. When evaluating student work products containing evidence of the accuracy and depth of students' science learning, we expect to see a range of student ability reflected in that evidence, and therefore, the rubric must describe criteria to address this range. Criteria or descriptions for each score point must include all aspects of the measured KSAs that will allow for an accurate evaluation of students' ability to integrate the three-dimensions to explain a phenomenon or create a design solution. Rubrics must allow for the differentiation of a high-quality from a low-quality performance as well as provide specific diagnostic information to inform future instructional decisions. Rubrics can also be a valuable tool for educators to provide feedback to individual students and for students to recognize strengths and weaknesses in their science learning and their ability to demonstrate that learning through a range of work products and responses.

Components of a Task Rubric: Grade 5 Example



Question or Prompt	0	1	2	3
1	No response or a response not related to the prompt (e.g., off topic; student writes, "I don't know.>").	Model does not show two representations each with two different bulk matter and matter too small to see (particles) or representations in the correct position and scale relative to each other. The key is incorrect.	Model shows a flawed connection between bulk matter and particles too small to be seen or a flawed connection between the representations' correct position and scale relative to each other. The key is partially correct.	Model shows two representations each with two different bulk matter and matter too small to be seen (particles) and shows representations in correct position and scale relative to each other. The key is correct.
2	No response or a response not related to the prompt (i.e., off topic; student writes, "I don't know.>").	The description is incorrect.	The description is partially correct.	The description is correct.

Annotations in the image:

- Content:** Points to the 'Question or Prompt' column.
- Rating scale:** Points to the score columns (0, 1, 2, 3).
- Response criteria for each score point:** Points to the descriptive text within each cell of the rubric grid.
- Response criteria for student's explanation of the model:** Points to the '2' row, column '1' cell.
- Response criteria for student's model:** Points to the '1' row, column '3' cell.

A rubric can be used to evaluate and score a range of student work products, including, but not limited to, a written response, completion of an investigation, a model, a diagram, or a graph. Components of a classroom-based task rubric based on a grade 5 task are highlighted here.

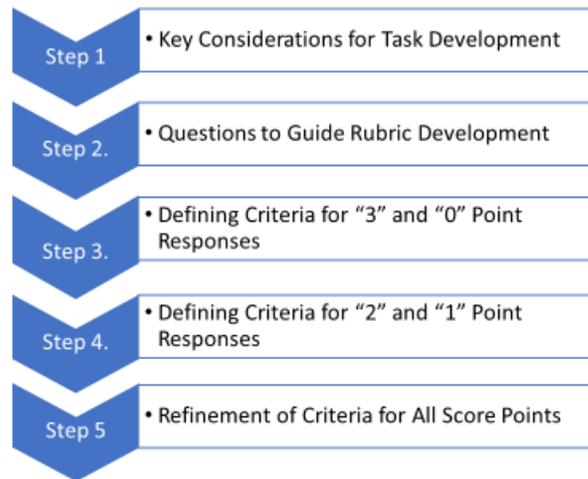
Think of a rubric as a grid with columns and rows that defines the criteria and the level or degree of the quality of student performance. The first column, labeled “question or prompt” in this example, identifies the organizational unit of the content in which the student evidence will be evaluated. It could be at the question or prompt level, or the content could be organized by dimension—SEP, DCI, or CCC. A score scale using numbers, in this example a score point range of “0” to “3”, provides a way to assign a point and quantify the performance based on how well the evidence meets the specific criteria associated with each question or prompt. Note that other labels or descriptive tags could be used to describe or qualify the range of performance, such as beginning, developing, satisfactory, and accomplished. A rating scale provides a way for educators to organize the results to identify more generally the overall performance of the class or strengths and weaknesses of groups of students or individual students. For example, if the results indicate that all students scored a “3” on prompt one, adjustments to instruction may not be warranted, whereas if most students scored a “1”, an educator might further evaluate the curriculum and instructional strategies and materials and adjust the sequence of instruction.

Response criteria are provided for each question or prompt for each score point. The response criteria serve as evaluative criteria to justify the assignment of a score point. The response criteria provide a clear description of what a response should look like or include to be accurate and complete for each aspect of the assessed KSAs. It is expected given the nature of the assessed KSAs, the response criteria will be stated in such a way that educators can determine

the accuracy and the degree to which students sense-make by integrating the three dimensions. The criteria should be easily differentiated across the score scale or descriptive tags, be written in a uniform or parallel manner, and be clear and concise. As the task becomes more complex, and the criteria increase, these considerations become even more critical. Think about additional ways in which the criteria could be structured, for example, using bullets or numbers. This enables the educator to evaluate student evidence of learning against each criterion—scored separately—and thus provide more information about students’ ability and sophistication of understanding related to different aspects of the assessed KSAs. The end goal is that the rubric supports consistent evaluation of student performance based on the criteria stated in the rubric and yields accurate inferences about student understanding and competency of the assessed KSAs.

Indeed, there is a lot to consider when developing rubrics. Let’s now look at a multi-step process that will guide the development of high-quality rubrics.

Task Rubric Development Process



A five-step process to support rubric development is shown here. Each step includes a series of questions that will guide the development of the response criteria to be included for each question or prompt for each score point. After briefly discussing each of these steps, we will guide you through the application of each step to create a classroom-based task rubric for a grade 5 task.

In step 1, we consider what students are expected to know and do for the selected KSAs that are to be evidenced in their responses to each component of a question or prompt. A clear understanding of what is to be measured is imperative to phase 3 of principled design, just as it is imperative in phases 1 and 2.

In step 2, we consider key questions to guide the development of the rubric, such as:

- Are the criteria equally weighted? If not, what is the priority?
- What are the ways students can get this wrong? Where and how are these incorrect responses represented across the score points?
- What are the challenges in scoring?

Then in step 3, we define the criteria or descriptions of a “3” point response and a “0” point response working from the outside in. A clear understanding of what a high-quality response looks like and contains creates a benchmark and helps define expectations for lower-quality performances from which other response criteria can be articulated. Similarly, defining what a score point of “0” looks like and does or does not contain helps define the lowest boundary for student performance.

Next, in step 4, the “2” and “1” score point responses are defined based on the response criteria defined for a “3” and “0” point response. We determine the criteria (i.e., cutoffs) for score points “2” and “1” and check these criteria based on the expected range of student responses. Remember, a well-written rubric provides criteria that enable the educator to differentiate a high-quality from a low-quality performance, given that we expect to see a range of performance across students.

And finally, in step 5, we refine and revise the response criteria for all score points to ensure that the expected range of student responses is addressed for each question or prompt at each score point (or descriptive tag).

In the following series of slides, this multi-step approach is applied to the development of a rubric for a grade 5 task aligned to PE, 5-ESS1-2. Please access the “Rubric Development Guide: Sample Task and Rubric” from the Resources pod for reference as we walk through each step.



Sample Task and Rubric for NGSS PE 5-ESS1-2

- **NGSS PE 5-ESS1-2** Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
 - **KSA1:** Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows.
 - **KSA6:** Use organized data to identify and describe relationships among data sets to reveal patterns of the orbit of Earth around the sun, the orbit of the moon around Earth, or the rotation of Earth about an axis between its North and South poles.

A sample task aligned to a grade 5 NGSS PE, 5-ESS1-2: *Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky*, is the basis for modeling the application of the rubric development process. Two KSAs were selected for this task from the 5-ESS1-2 task specification tool: *KSA1: Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows*, and *KSA6: Use organized data to identify and describe relationships among data sets to reveal patterns of the orbit of Earth around the sun, the orbit of the moon around Earth, or the rotation of Earth about an axis between its North and South poles*. Please obtain the 5-ESS1-2 unpacking tool, the 5-ESS1-2 task specifications tool, and the 5-ESS1-2 classroom-based science task from the Resources pod for reference.

Let's take a look at the task.

Sample Task for NGSS PE 5-ESS1-2

- As part of a fifth-grade science project, students recorded the position of the sun in the sky and the position of the shadow of a tree at different times of the day.

The students stood in the same location for each observation. The students were not able to observe the sky at 3 p.m. The drawings the students produced are shown in Figure 1. Student Drawing.

If the students had completed their drawing at 3 p.m., what would it have looked like? In the space provided, include a drawing of what the students would have observed.

- The next day, the students stood in the same location and recorded the length of the shadows cast by the tree at 10:00 a.m., 1:00 p.m., 3:00 p.m., and 5:00 p.m. The students are told to make a line graph to show the relationship between the time of day and the length of the tree's shadow.
 - Describe the pattern that would be shown by the students' line graph.
 - Use the relationship between the length of the shadow, the apparent motion of the sun as recorded at different times of day, and information from Figure 1 to support your answer.

Figure 1. Student Drawing

10:00 a.m.	
1:00 p.m.	
3:00 p.m.	
5:00 p.m.	
3:00 p.m.	

The sample task for NGSS PE 5-ESS1-2, *Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky*, is comprised of two questions or prompts. Please pause the presentation and familiarize yourself with the task and consider the ways in which students would be expected to demonstrate their science learning of the assessed PE and selected KSAs. Notice that the task includes a relatable scenario, clear and necessary graphics, and two different item types, work products, and modes of student response.



Prompt 1: KSA1

1. As part of a fifth-grade science project, students recorded the position of the sun in the sky and the position of the shadow of a tree at different times of the day.

The students stood in the same location for each observation. The students were not able to observe the sky at 3 p.m. The drawings the students produced are shown in Figure 1. Student Drawing.

If the students had completed their drawing at 3 p.m., what would it have looked like? In the space provided, include a drawing of what the students would have observed.

3:00 p.m.	W	E
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Figure 1. Student Drawing

10:00 a.m.	
1:00 p.m.	
3:00 p.m.	
5:00 p.m.	

First, let's apply the rubric development process to prompt 1, *KSA1: Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows*. To support the application of step 1, begin to consider what the students are asked to do and what evidence of student learning might look like in their response to the prompt: *"If the students had completed their drawing at 3 p.m., what would it have looked like? In the space below, include a drawing of what the students would have observed."*

Rubric Development Step 1: Prompt 1



Step 1. Key Considerations for Rubric Development

First, consider what students are expected to know and do (KSAs) that are to be evidenced in the student's response to each component of a prompt. It is expected that a task will include multiple prompts.

Step 1. Sample Response for Prompt 1

For prompt 1, consider: What do we want students to notice, reflect, and show in their pictures?

- The sun moves to the left (W) and down.
- The shadow moves to the right (E) (or aligns with the sun).
- The shadow becomes longer as the sun gets closer to the horizon.

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Before we consider step 1, let's review the format of the information presented on this slide and each subsequent slide to explain the steps in the process. First, beneath the gray heading, which denotes the name of the step, we define the key considerations or activities that you will engage in to complete the step. Then, beneath the black heading, we provide a sample response for the prompt. The sample response reflects the specific evidence or criteria one might consider for the selected KSAs being measured by the prompt for the grade 5 PE, 5-ESS1-2.

Let's begin. In step 1, we consider what students are expected to know and do for the selected KSAs that are to be evidenced in their responses to each component of the prompt.

For prompt 1, consider, what do we want students to notice, reflect, and show in their pictures? Should the response reflect that they understand that

- the sun moves to the left (west) and down?;
- the shadow moves to the right (east) (or aligns with the sun)?; or
- that the shadow becomes longer as the sun gets closer to the horizon?

Having a clear understanding of what prior knowledge and science learning you expect students to use to respond to the prompt will support completion of the subsequent steps in the rubric development process.

Rubric Development Step 2: Prompt 1



Step 2. Questions to Guide Rubric Development

The second step is to consider key questions to guide the development of the rubric which include:

1. What are the ways students can get this wrong? Where and how are these incorrect responses represented across the score points?
2. What are the challenges in scoring?

Step 2. Questions to Guide Rubric Development

Step 2. Sample Response to Address Each Key Question for Prompt 1

1. Are the criteria equally weighted? If **not**, what is the priority?
 - a. Is it more important that the shadow is in alignment with the sun? Or that the sun is in the correct place?
2. What are the ways students can get this wrong? Where and how are these incorrect responses represented across the score points?
 - a. What happens if they get the sun wrong?
 - b. What happens if they get the shadow wrong?
3. What are the challenges in scoring?
 - a. It may be hard to determine or interpret how stretched out the shadow is in the drawing.
 - b. The tree may not be in the middle of the square.

In step 2, we consider key questions to guide the development of the rubric. At this point, we are not actually populating the rubric with response criteria for each score point. Rather, we are formulating answers to questions to support drafting response criteria in the next step. Consider:

1. What are the ways students can get this wrong? Where and how are these incorrect responses represented across the score points?
2. What are the challenges in scoring?

To answer each of these key questions for this prompt, some sample responses could include:

1. Are the criteria equally weighted? If **not**, what is the priority?
 - a. Is it more important that the shadow is in alignment with the sun? Or that the sun is in the correct place?
2. What are the ways students can get this wrong? Where and how are these incorrect responses represented across the score points?
 - a. What happens if they get the sun wrong?
 - b. What happens if they get the shadow wrong?
3. What are the challenges in scoring?
 - a. It may be hard to determine or interpret how stretched out the shadow is in the drawing.
 - b. The tree may not be in the middle of the square.

Rubric Development Step 3: Prompt 1



Step 3. Defining Criteria for “0” and “3” Point Responses

To complete the rubric for each prompt within a task, in the third step, determine the criteria or descriptions for the “0” and “3” score points. A score of “0” reflects “no response” (i.e., blank) or an unrelated/off topic response to the prompt. A score of three reflects a high-quality response that provides evidence that students have demonstrated the knowledge, skills, and abilities (KSAs) assessed by the prompt.

Step 3. Defining
Criteria for “3” and
“0” Point Responses

Step 3. Sample Response for Criteria for “0” and “3” Point Responses

Prompt	0	1	2	3
1	No response or a response not related to the prompt (e.g., off topic; student writes, “I don’t know.”)			The drawing shows: <ul style="list-style-type: none"> • sun moves to the left (W) and down • shadow moves to the right (or aligns with the sun) • shadow becomes longer as the sun gets closer to the horizon

On to step 3! In step 3, we define the criteria or descriptions of a “3” point response and a “0” point response. A score of “0” reflects “no response” (i.e., blank) or an unrelated or off-topic response to the prompt. A score of “3” reflects a high-quality response that provides evidence that students have demonstrated the knowledge, skills, and abilities (KSAs) assessed by the prompt.

Take a moment to examine the criteria for a “3” point response and a “0” point response. The score point “3” criteria are detailed, clear, and concise. It specifies three criteria that must be evidenced in the students’ drawing to show that the sun moves to the left (W) and down, the shadow moves to the right (or aligns with the sun), AND the shadow becomes longer as the sun gets closer to the horizon. The score point “0” identifies that no response or evidence was provided or reflects an unrelated or off-topic response to the prompt.

Rubric Development Step 4: Prompt 1



Step 4. Defining the “2” and “1” Point Responses

Based on the criteria defined for “0” and “3” point response, first determine the criteria (i.e., cutoffs) for score points “2” and “1”. Then, check this criteria based on the expected range of student responses.

Step 4. Defining Criteria for “2” and “1” Point Responses

Step 4. Sample Response for Criteria for “2” and “1” Point Responses for Prompt 1

Given the range of expected student responses, consider and make decisions about how criteria will be defined for “2” and “1” score points. For this prompt, the following possible student responses are addressed and a score point is assigned.

- If the shadow looks good (moved to the right and stretched), but the sun isn’t in alignment or isn’t in the correct place – score this as “2”
- If the sun is in the correct place, but the shadow either doesn’t look stretched out (be generous) or isn’t in the correct place, score this as “2”
- If the student only draws the sun, or if they only have the position of the shadow, or if they only have the length of the shadow – score this as “1” [Could argue that the length of the shadow is most important; so if they get that, regardless of anything else, a score of “2” is assigned.]

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Next, in step 4, the “2” and “1” score point responses are defined based on the response criteria defined for a “0” and “3” point response. We determine the criteria (i.e., cutoffs) for score points “2” and “1” and check these criteria based on the expected range of student responses. Please note that the rubric criteria for prompt 1 can be referenced in the “Rubric Development Guide: Sample Task and Rubric” document in the Resources pod and is also included on the next slide.

Given the range of expected student responses, consider and make decisions about how criteria will be defined for the “2” and “1” score points. For this prompt, the following possible student responses can be addressed, and a score point can be assigned.

- If the shadow looks good (moved to the right and stretched), but the sun isn’t in alignment or isn’t in the correct place – score this as “2.”
- If the sun is in the correct place, but the shadow either doesn’t look stretched out (be generous) or isn’t in the correct place, score this as “2.”
- If the student only draws the sun, or if they only have the position of the shadow, or if they only have the length of the shadow – score this as “1” [It could be argued that the length of the shadow is most important; so if they get that, regardless of anything else, a score of “2” is assigned.].

Rubric Development Step 4: Prompt 1, Cont.



Step 4. Defining Criteria for "2" and "1" Point Responses

Prompt	0	1	2	3
1	No response or a response not related to the prompt (e.g., off topic; student writes, "I don't know.")	<p>Student draws a sun and a shadow of a tree, but only meets one of the criteria (or none)</p> <p>Criteria:</p> <ul style="list-style-type: none"> • sun moves to the left (W) and down • shadow moves to the right (or aligns with the sun) • shadow becomes longer as the sun gets closer to the horizon 	<p>The student gets 2 out of the 3 criteria:</p> <ul style="list-style-type: none"> • sun moves to the left (W) and down • shadow moves to the right (or aligns with the sun) • shadow becomes longer as the sun gets closer to the horizon 	<p>The drawing shows:</p> <ul style="list-style-type: none"> • sun moves to the left (W) and down • shadow moves to the right (or aligns with the sun) • shadow becomes longer as the sun gets closer to the horizon

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Take a moment to examine the criteria for a "2" point response and a "1" point response.

A score of "2" reflects a response in which the student demonstrates two out of the three criteria. A score of "1" is assigned if a student only addresses one criterion in his or her response. Let's suppose, for example, the student only draws the correct position of the sun, or only shows the correct position of the shadow, or only shows the correct length of the shadow; this type of response would be scored as a "1."

Notice that the criteria for score point "2" and "1" shown in bold in the rubric indicates that a student has a partial or some understanding of the KSA by stating that the student's response includes, respectively, two out of three or one out of three criteria indicated in score point "3." Based on the nature of the assessed KSA, this approach to differentiating performance, reducing the amount of evidence required to earn a score point, is useful and easily interpreted by the educator.

Rubric Development Step 5: Prompt 1



Step 5. Refinement of Criteria for All Points

Step 5. Refinement of Criteria for All Points

After defining criteria for “2” and “1”, check and further clarify or refine the criteria to address the expected range of student responses across all of the score points. Then revise criteria as appropriate.

Step 5. Sample Response for Refinement of Criteria for All Score Points for Prompt 1

For this prompt, consider the following questions and then refine the criteria.

- What happens if the student only draws a sun? Is it a “0” or a “1”?
- What happens if the sun is to the left, but not down? Or down but not to the left of the 1:00 p.m. drawing?

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In step 5, we refine and revise the response criteria for all score points to ensure that the expected range of student responses is addressed for each prompt or question at each score point (or descriptive tag). Please note that the rubric can be referenced in the “Rubric Development Guide: Sample Task and Rubric” document in the Resources pod and is also included on the next slide.

For this prompt, consider the following questions and what refinement to the rubric would be warranted.

- What happens if the student only draws a sun? Is it a “0” or a “1”?
- What happens if the sun is to the left, but not down? Or down but not to the left of the 1:00 p.m. drawing?

Rubric Development Step 5: Prompt 1 cont'



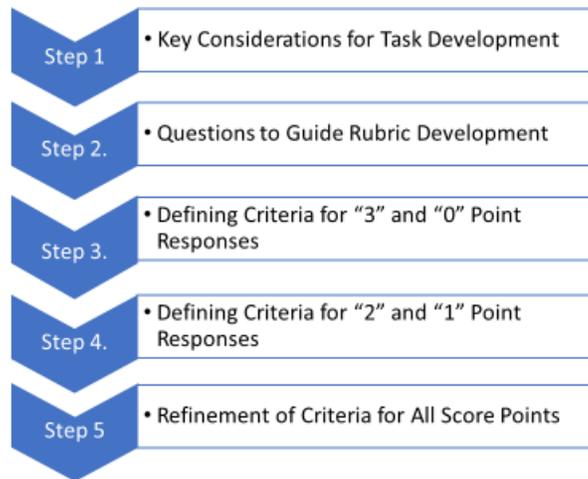
Step 5. Refinement
of Criteria for All
Points

Prompt	0	1	2	3
1	No response or a response not related to the prompt (e.g., off topic; student writes, "I don't know.") OR student just draws a sun, shadow or a tree.	Student draws a sun and a shadow of a tree, but only meets one of the criteria (or none): <ul style="list-style-type: none"> sun is further down in the drawing than for the 1:00 p.m. drawing; shadow moves to the right (or aligns with the sun); shadow becomes longer as the sun gets closer to the horizon. 	The student gets two out of the three criteria: <ul style="list-style-type: none"> sun is further down in the drawing than for the 1:00 p.m. drawing; shadow moves to the right (or aligns with the sun); shadow becomes longer as the sun gets closer to the horizon. 	The picture shows: <ul style="list-style-type: none"> sun is further down in the drawing than for the 1:00 p.m. drawing; shadow moves to the right (or aligns with the sun); and shadow becomes longer as the sun gets closer to the horizon.

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An example of further refinement of the criteria across all score points is indicated by red font in each of the score points. These refinements support interpretability and consistent application of the rubric to evaluate student responses. Please pause the presentation to review the refinements as compared to the rubric associated with step 4.

Task Rubric Development Process



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We acknowledge that this development process is systematic and detailed and may present some new aspects of rubric development for you to incorporate into your practice. Before we apply the process to the second prompt in this task, please stop the presentation and review the steps.

When you are ready to resume the presentation, we will model the application of the multi-step process to develop the response criteria for each score point for the second prompt in the grade 5 task for PE 5-ESS1-2.

Click on the presentation to stop and resume the slides as needed.



Prompt 2: KSA6

KSA6: Use organized data to identify and describe relationships among data sets to reveal patterns of the orbit of Earth around the sun, the orbit of the moon around Earth, or the rotation of Earth about an axis between its North and South poles.

2. The next day, the students stood in the same location and recorded the length of the shadows cast by the tree at 10:00 a.m., 1:00 p.m., 3:00 p.m. and 5:00 p.m. The students are told to make a line graph to show the relationship between the time of day and the length of the tree's shadow.
 - Describe the pattern that would be shown by the students' line graph.
 - Use the relationship between the length of the shadow, the apparent motion of the sun recorded at different times of day, and information from Figure 1 to support your answer.

Now, let's apply the rubric development process to prompt 2, KSA6: *Use organized data to identify and describe relationships among data sets to reveal patterns of the orbit of Earth around the sun, the orbit of the moon around Earth, or the rotation of Earth about an axis between its North and South poles.*

To support the application of step 1, begin to consider what the students are asked to do and what evidence of student learning might look like in their response to the prompt:

"The next day, the students stood in the same location and recorded the length of the shadows cast by the tree at 10:00 a.m., 1:00 p.m., 3:00 p.m., and 5:00 p.m. The students are told to make a line graph to show the relationship between the time of day and the length of the tree's shadow.

- *Describe the pattern that would be shown by the students' line graph.*
 - *Use the relationship between the length of the shadow, the apparent motion of the sun recorded at different times of day, and information from Figure 1 to support your answer."*

Rubric Development Step 1: Prompt 2



Step 1. Key Considerations for Rubric Development

Consider: What do we want students to notice, reflect, and show in their response?

- A description of the differences in the length of shadows observed at different times of day.
- The apparent motion of the sun from east to west results in patterns of changes in length and direction of shadows throughout a day as Earth rotates on its axis.

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In step 1, consider what students are expected to know and do for the selected KSAs. Given that a task includes multiple prompts, what is that you want students to notice, reflect, and show in their responses? What is the evidence you expect to see of their science learning? Pause the presentation and consider what you want students to notice, reflect, and show in their responses to a task related to KSA6: Use organized data to identify and describe relationships among datasets to reveal patterns of the orbit of Earth around the sun, the orbit of the moon around Earth, or the rotation of Earth about an axis between its North and South poles.

Then resume the presentation for some possible key considerations for rubric development specific to KSA6.

Rubric Development Step 2: Prompt 2



Step 2. Questions to Guide Rubric Development

Consider key questions to guide the development of the rubric, which include:

1. Are the criteria equally weighted? If not, what is the priority?
 - a. If students just describe the line graph by saying, "I would use time of day on one axis and length of shadow on another axis," is that enough?
2. What are the ways students can get this wrong? Where do they fall under the score points?
 - a. Students might describe the sun as it orbits around a stationary Earth.
 - b. Students might not describe the relationships and might just state the variables that would be represented on the line graph (e.g., time of day vs. length of shadow).
3. What are the challenges in scoring?
 - a. Students incorrectly describe the line graph, yet correctly describe the relationship (i.e., The shadow's length gets longer as the day progresses.)
 - b. Pattern description might not be clear.
 - c. Student only references Figure 1 in their response.

Step 2. Questions to Guide Rubric Development

In step 2, consider and determine key questions to guide the development of the rubric. Pause the presentation and consider key questions that you might need to address to guide the development of response criteria for KSA6: *Use organized data to identify and describe relationships among data sets to reveal patterns of the orbit of Earth around the sun, the orbit of the moon around Earth, or the rotation of Earth about an axis between its North and South poles.*

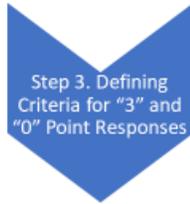
Then resume the presentation for some possible key questions you might ask.

Rubric Development Step 3: Prompt 2



Step 3. Defining Criteria for “0” and “3” Point Response

Determine the criteria or descriptions for the “0” and “3” score points.



Prompt	0	1	2	3
2	No response or a response not related to the prompt (e.g., off topic; student writes, “I don’t know.”).			The student response includes: <ul style="list-style-type: none">the line shows the time of day on one axis and the length of the shadows on the other axisthe line graph shows a relationship between the length of shadow and time of day.

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In step 3, the student response criteria for the “0” and “3” score points are defined. Pause the presentation and consider how you would populate the rubric with response criteria that would clearly differentiate a high-quality from a low-quality performance based on the collected evidence.

Then resume the presentation for some suggested student response criteria that would result in the assignment of “0” or “3” score points.

Rubric Development: Step 4 Prompt 2



Step 4. Defining the “2” and “1” Point Responses

Step 4. Defining the “2” and “1” Point Responses

Decisions include:

- Students might accurately describe the data that would be shown on the graph, but might not include a description of the pattern. This *could* still get a “3”. Students must include some sort of description of the relationships/pattern that will be shown by the data.
- A “2” then means that they have a good description of the variables, but they don’t describe the pattern.
- A “1” shows that they don’t do either well.

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Now in step 4, you need to define the “2” and “1” score point responses. Consider what decisions you would need to make about what those score points would need to address and reflect regarding student performance and evidence of science learning.

Then resume the presentation for some possible decisions you need to consider.

Rubric Development: Step 4 Prompt 2 Cont.



Step 4. Defining the
"2" and "1" Point
Responses

Prompt	0	1	2	3
2	No response or a response not related to the prompt (e.g., off topic; student writes, "I don't know.").	The student provides a description of the line graph and/or attempts to describe the relationships within the data set, but the description is not clear or is incomplete.	The student makes it clear that the line graph would include time of day on one axis and length of shadow on the other axis but does not correctly describe the relationships within the data set (e.g., only a description/list of the length of shadows over the course of a day).	The student provides an accurate description of the pattern of changes in length of shadows throughout a day as Earth rotates on its axis.

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Given those decisions, pause the presentation and consider how you would populate the rubric with response criteria that would clearly differentiate a "2" score point from a "1" score point performance based on the collected evidence.

Then resume the presentation for some suggestions for student response criteria that would result in the assignment of two score points or one score point.

Note that response criteria have also been added for a score point of three, shown in red on the slide. This is because the decision, "Students might accurately describe the data that would be shown on the graph but might not include a description of the pattern," could still get a "3." In this instance, to distinguish a "2" score point from a "3" score point performance, additional language indicated in red, The student provides an accurate description of the pattern of changes in length of shadows throughout a day as Earth rotates on its axis, is added in step 4. These criteria will be addressed and will be reflected in step five and in the final rubric.

Rubric Development: Step 5 Prompt 2



Step 5. Refinement of Criteria for All Points

Step 5. Refinement of Criteria for All Points

Consider the following:

- What happens if the student just says the line graph will show a line?
- What happens if the student only uses Figure 1 to describe the relationships?

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Now that you have defined criteria for each score point, in this final step, you need to check and further clarify or refine the criteria to address the expected range of student responses across all the score points. Then revise the criteria as appropriate. Some considerations are provided that include:

- What happens if the student just says the line graph will show a line?
- What happens if the student only uses Figure 1 to describe the relationships?

Please go to the next slide to view a rubric that indicates refinements shown in red with respect to these considerations.

Rubric Development: Step 5 Prompt 2 Cont'



Step 5. Refinement
of Criteria for All
Points

Prompt	0	1	2	3
2	No response or a response not related to the prompt (e.g., off topic; student writes, "I don't know.").	Student provides a description of the graph and/or attempts to describe the pattern, but the description is not clear or incomplete <i>OR</i> the student just indicates the line graph would show a line.	The student makes it clear that the line graph would include time of day on one axis and length of shadow on another, but does not correctly describe the relationships within the dataset (e.g., only a description/list of the length and direction of shadows over the course of a day) <i>OR</i> the student only uses Figure 1 to describe the relationships.	The student provides a description of the pattern that makes it clear that the apparent motion of the sun from east to west results in patterns of changes in length of shadows throughout a day as Earth rotates on its axis.

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Note that response criteria have been added for a score point of "1," "2," and "3" shown in red. With respect to the consideration, What happens if the student just says the line graph will show a line?, additional criteria have been added to score point "1" to reflect this possible student response. Regarding the consideration, What happens if the student only uses Figure 1 to describe the relationships?, additional criteria have been added to score point "2." The additional criteria in score point "3" addresses the likelihood that some students will attribute the motion of the sun from east to west as the cause for changes in the length of shadows throughout a day. This additional specificity in the rubric supports educators' interpretations of the qualities of students' responses that meet the criteria for a score point "3."

Please resume the presentation to see the final rubric for 5-ESS1-2.

Task Rubric for 5-ESS1-2



Prompt	0	1	2	3
<p>NGSS PE 5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.</p> <ul style="list-style-type: none"> KSA1: Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows. KSA6: Use organized data to identify and describe relationships among data sets to reveal patterns of the orbit of Earth around the sun, the orbit of the moon around Earth, or the rotation of Earth about an axis between its North and South poles. 	<p>1</p> <p>No response or a response not related to the prompt (e.g., off topic; student writes, "I don't know.") OR student just draws a sun, shadow or a tree.</p>	<p>Student draws a sun and a shadow of a tree, but only meets one of the criteria (or none):</p> <ul style="list-style-type: none"> sun is further down in the drawing than for the 1:00 p.m. drawing; shadow moves to the right (or aligns with the sun); shadow becomes longer as the sun gets closer to the horizon. 	<p>The student gets two out of three criteria:</p> <ul style="list-style-type: none"> sun is further down in the drawing than for the 1:00 p.m. drawing; shadow moves to the right (or aligns with the sun); shadow becomes longer as the sun gets closer to the horizon. 	<p>The picture shows:</p> <ul style="list-style-type: none"> sun is further down in the drawing than for the 1:00 p.m. drawing; shadow moves to the right (or aligns with the sun); and shadow becomes longer as the sun gets closer to the horizon.
	<p>2</p> <p>No response or a response not related to the prompt (e.g., off topic; student writes, "I don't know.").</p>	<p>Student provides a description of the graph and/or attempts to describe the pattern, but the description is not clear or incomplete OR the student just indicates the line graph would show a line.</p>	<p>The student makes it clear that the line graph would include time of day on one axis and length of shadow on another, but does not correctly describe the relationships within the data set (e.g., only a description/list of the length and direction of shadows over the course of a day) OR the student only uses Figure 1 to describe the relationships.</p>	<p>The student provides a description of the pattern that makes it clear that the apparent motion of the sun from east to west results in patterns of changes in length of shadows throughout a day as Earth rotates on its axis.</p>

This slide presents the final rubric for 5-ESS1-2 created by the application of a systematic and detailed multi-step process that results in the definition of response criteria for each prompt at each score point.

Remember, a primary purpose in developing interpretable and useful rubrics is to provide a tool whereby educators can gain an understanding of where their students are in their science learning of three-dimensional standards. Rubrics must address and detail all ways in which student evidence of learning is collected in the task, which will likely vary from prompt to prompt based on the assessed KSA(s). This approach to rubric development supports educators in their ability to consistently evaluate and interpret student-produced evidence of their learning for selected KSAs aligned to a PE, make accurate inferences about student learning, and determine "next steps" for instruction to address the learning needs of all students.

Additional exemplar rubrics for the elementary, middle school, and high school grade bands can be found in the Resources pod.

Guiding Questions for Development of the Task Rubric



- What is it that you want to understand about your students?
- What evidence do you need for students to demonstrate what they know and can do?
- Where would you need to adjust your instruction in response to student performance of the criteria in the rubric?
- How might you differentiate your instruction based on how many students fall into each score point indicated on the rubric?

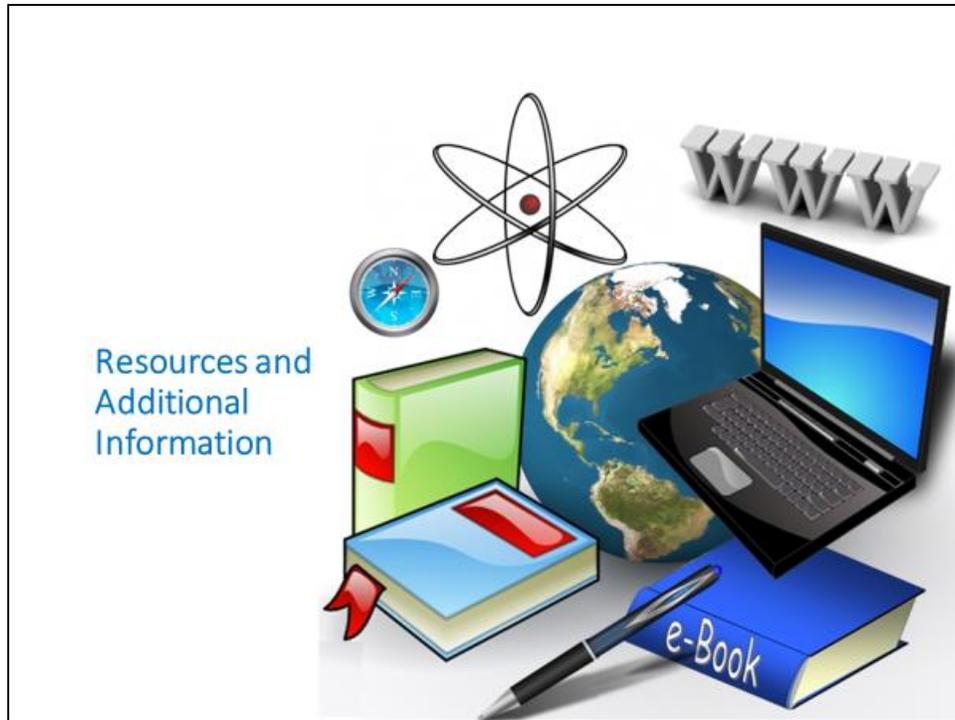
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Now that you are familiar with the purpose and components and the five-step process for developing a classroom-based task rubric, we provide some guiding questions to keep in mind before, during, and after rubric development.

- What is it that you want to understand about your students?
- What evidence do you need for students to demonstrate what they know and can do?
- Where would you need to adjust your instruction in response to student performance of the criteria in the rubric?
- How might you differentiate your instruction based on how many students fall into each score point indicated on the rubric?

Given that evaluation of student performance is in the service of learning, the development of high-quality rubrics is required so that you gain meaningful, accurate, and actionable information about students' science learning generated by high-quality tasks. Rubrics developed using the five-step process foster your ability to get your finger on the pulse about where all of your students are in their science learning and their ability to integrate the three-dimensions to explain a phenomenon or create a design solution.



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 fourth chapter of the SCILLSS digital workbook on designing high-quality three-dimensional science assessment tasks for classroom use.

SCILLSS Glossary



Please refer to the SCILLSS Glossary for operational definitions of terms used.

SCILLSS Glossary Module 4.4
This glossary references NGSS Lead States. (2013). Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press.

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Resources



In the Web Links pod, you can find the following resource:

- A Framework for K-12 Science Education
- NGSS Task Screener

In the Resources pod, you can find the following resources:

- Rubric Development Guide: Sample Task and Rubric
- SCILLSS Model Tasks and Rubrics at grade 5, middle school, and high school
- Unpacking Tool for 5ESS1-2
- Task Specifications Tool for 5ESS1-2
- 5-ESS1-2 Classroom-based Science Task

References



Achieve. (n.d.). EQuIP (Educators Evaluating the Quality of Instructional Products).

Retrieved from <https://www.achieve.org/our-initiatives/equip/equip>

Merriam-Webster. (n.d.). Rubric. In *Merriam-Webster.com dictionary*. Retrieved

December 2020, from <https://www.merriam-webster.com/dictionary/rubric>.