Unit 1–Trash

DEVELOPER: Carolina

GRADE: 2 **| DATE OF REVIEW:** November 2021

Unit 1–Trash

EQuIP RUBRIC FOR SCIENCE EVALUATION

OVERALL RATING: E

TOTAL SCORE: 8

CATEGORY I: NGSS 3D Design Score	CATEGORY II: NGSS Instructional Supports Score	CATEGORY III: Monitoring NGSS Student Progress Score
2	3	3

Click here to see the scoring guidelines.

This review was conducted by NextGenScience using the EQuIP Rubric for Science.

CATEGORY I CRITERIA RATINGS			CATEGORY II CRITERIA RATINGS			CATEGORY III CRITERIA RATINGS		
A.	Explaining Phenomena/ Designing Solutions	Extensive	**A.**	Relevance and Authenticity	Extensive	**A.**	Monitoring 3D Student Performances	Extensive
B.	Three Dimensions	Adequate	**B.**	Student Ideas	Extensive	**B.**	Formative	Extensive
	Integrating the Three Dimensions	Extensive	**C.**	Building Progressions	Adequate	**C.**	Scoring Guidance	Adequate
D.	Unit Coherence	Extensive	**D.**	Scientific Accuracy	Adequate	**D.**	Unbiased Tasks/Items	Extensive
E.	Multiple Science Domains	Adequate	**E.**	Differentiated Instruction	Extensive	**E.**	Coherence Assessment System	Extensive
F.	Math and ELA	Extensive	**F.**	Teacher Support for Unit Coherence	Extensive	**F.**	Opportunity to Learn	Extensive
			G.	Scaffolded Differentiation Over Time	Adequate			

Unit 1–Trash

EQuIP RUBRIC FOR SCIENCE EVALUATION

Summary Comments

Thank you for your commitment to students and their science education. NextGenScience is glad to partner with you in this continuous improvement process. The unit is strong in several areas, including supporting student use of three-dimensional performances focused on solving problems, extensive connections to students' personal lives, and centering student ideas in the classroom.

During revisions or use in the classroom, the reviewers recommend paying close attention to the following focus areas to strengthen materials:

- **Support for developing Science and Engineering Practices (SEPs).** The unit provides extensive support for developing the targeted Disciplinary Core Ideas (DCIs) and some Crosscutting Concept (CCC) elements. However, although SEPs are claimed as being developed, they are currently only applied, with learning supports provided only "if students struggle."
- **Scientific Accuracy.** The concepts of function and purpose are conflated many times in the unit, leading to possible student misconceptions.
- **Editing for consistency.** The current materials seem to include artifacts from previous versions, such as numerous references to prior Grade 2 units (although this is Unit 1 of Grade 2), and many places where section headings don't match text (e.g., support for students during assessment under the heading "Remediation After Assessment").

Note that in the feedback below, black text is used for either neutral comments or evidence the criterion was met, and purple text is used as evidence that doesn't support a claim that the criterion was met. The purple text in these review reports is written directly related to criteria and is meant to point out details that could be possible areas where there is room for improvement. Not all purple text lowers a score; much of it is too minor to affect the score. For example, even criteria rated as Extensive could have purple text that is meant to be helpful for continuous improvement processes. In these cases, the criterion WAS met. The purple text is simply not part of the evidence for that Extensive rating.

Unless otherwise specified, page numbers in the document refer to the page numbers listed on the "Lessons" pdf.

CATEGORY I

NGSS 3D DESIGN

- I.A. EXPLAINING PHENOMENA/DESIGNING SOLUTIONS
- I.B. THREE DIMENSIONS
- I.C. INTEGRATING THE THREE DIMENSIONS
- I.D. UNIT COHERENCE
- I.E. MULTIPLE SCIENCE DOMAINS
- I.F. MATH AND ELA

Unit 1–Trash

EQuIP RUBRIC FOR SCIENCE EVALUATION

I.A. EXPLAINING PHENOMENA/DESIGNING SOLUTIONS	
Making sense of phenomena and/or designing solutions to a problem drive student learning. i. Student questions and prior experiences related to the phenomenon or problem motivate sense-making and/or problem solving. ii. The focus of the lesson is to support students in making sense of phenomena and/or designing solutions to problems. iii. When engineering is a learning focus, it is integrated with developing disciplinary core ideas from physical, life, and/or earth and space sciences.	
Rating for Criterion I.A. Explaining Phenomena/Designing Solutions	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that learning is driven by students making sense of phenomena or designing solutions to a problem because the learning is based on students figuring out an anchor problem, investigative phenomena, and then designing solutions to the anchor problem. The targeted learning, along with the applied prior learning, match the scope of the anchor problem, such that almost all learning is in service of students making sense of the anchor problem and designing solutions for it. Much of the instruction is closely connected to student ideas and, in most cases, the materials provide facilitation to help students feel as if they are driving instruction.

The learning in the unit focuses on figuring out a solution to the anchor problem. Related evidence includes:

- Lesson 1: The unit opens with students exploring a bag of trash from their classroom and responding to the prompt "What do you think happens to the trash from all the classrooms in our school?" (page 12).
- Lesson 1: "The anchoring problem for this unit: Humans make a lot of trash, and it is polluting the Earth" (page 18).
- Lesson 1: Students complete the "Design Solutions" section of their artifact sheet to share possible solutions to the pollution problems they identified (page 25). Students' ideas are recorded on the "Our initial Ideas for Solutions" class chart.
- Lesson 1: "Ask students to consider how the five pounds of trash they create, as well as the trash their family, class, and community creates, relates to the problems they identified on the Trash Problems Class Chart. Help students come to consensus on an anchoring problem like, 'Humans throw away a lot of trash, and it is polluting the Earth.' Record the agreed-upon anchoring problem on a piece of paper and hang it above the Trash Problems Class Chart" (page 32). Note that students have not yet made a connection to planet-wide effects, so it may not be natural for students to include the planet in the problem statement.

- Lesson 2: Students watch a video that represents an investigative phenomenon. The teacher supports say, "Press for students to explain what they think is happening in this video and why…Have students consider how what they saw relates to the anchoring problem or any of the problems they identified in Lesson 1. Record these ideas on the Initial Ideas Class Chart as well" (page 53).
- Lesson 2: "Facilitate a class discussion to further sensemaking by reviewing the infographic as a class and discussing how it relates to both the classification investigation and what students saw in the Trash Robot video…. The purpose of this discussion is for the students to apply the science ideas they learned to make sense of the lesson's investigative phenomenon" (page 77).
- Lesson 2: "Encourage students to connect what they learned in this lesson back to the anchoring problem. Say, 'In Lesson 1, we identified that the problem we want to solve is that humans throw away a lot of trash, and it is polluting the Earth. How does what we learned about matter and its observable properties helps us better understand this problem or help us design a solution?'" (page 79).
- Lesson 3: Part of the learning is not directly connected to the problem or phenomenon: "Say, 'Last time, we explored how different observable properties can cause an object to be well-suited for its intended purpose. Today, we are going to take a look at one property in particular: shape'" (page 111).
- Lesson 3: "Remind the class of the lesson question they are trying to figure out: 'Why do some things get thrown away?' Have students reflect on what they have figured out and make their thinking visible by recording their answer to lesson question individually in their science notebooks" (page 129).
- Lesson 3: "Encourage students to connect what they learned in this lesson to the anchoring problem. Say something like, 'In Lesson 1, we identified the problem that we wanted to solve: Humans throw away a lot of trash, and it is polluting the Earth. How does what we learned about why people throw things away help us better understand this problem? How might what we learned help us when we design a solution to our problem?'" (page 133).
- Lesson 4: Students have an opportunity to observe a new investigative phenomenon. The materials prompt the teacher to ask, "How do these images connect to the problem we are trying solve?" making a connection between the investigative phenomenon and the anchor problem (page 173). The prompts direct the teacher to, "Ask students to recall the anchoring problem: Humans make a lot of trash, and it is polluting the Earth. Invite the class to explain how the science ideas they have figured out so far relate to this problem and how those ideas may help when designing a solution to this problem." (page 173)
- Lesson 6: "Connect to the Anchoring Problem: Have students imagine that no one chose to do these things. Ask students to explain what would happen to the classroom trash and facilitate a discussion about the potential impacts on the environment (land, air, water, and other living things) if humans don't reuse any of their trash items" (page 232).
- Lesson 6: "Use the Classroom Trash Model to quickly revisit the problem students are trying to solve: Humans make a lot of trash, and it is polluting the Earth" (page 245).
- Lesson 7: The lesson begins by revisiting the anchor problem (page 288).

- Lesson 7: "Work as a class to finalize students' answer to the unit-driving question (e.g., How can we help solve the trash problem?) and how the solutions they have developed can help solve the anchoring problem. As needed, use talk moves and chart paper to help students organize their final thoughts" (page 306).

Student questions and ideas motivate the learning throughout most of the unit. Related evidence includes:

- Lesson 1: After students share initial ideas about where trash goes but before they explore their own class's bag of trash, the materials instruct the teacher to say, "Today, we will explore a bag of our trash and use it to create a model that we will use throughout this unit" (page 12). This reference to a model comes before students engage in the activities enough to realize that a model might be helpful, and therefore is driven by the teacher rather than by student curiosity. The model comes up again later in the lesson, and again without a clear reason (from the students' perspective) for making a model: "Direct students' attention to the trash bag that you drew. Say, 'Let's brainstorm ways that we could use this drawing to make a model of our ideas about our classroom trash'" (page 15).
- Lesson 1: The class creates a "Questions We Have" chart (page 14). The teacher prompts say to share that, "This class chart should be accessible to students throughout the unit and will be revisited and modified during each lesson."
- Lesson 1: To begin thinking about trash as a problem, the teacher is told, "Highlight student concerns about trash harming the environment. If students do not express concerns on their own, use talk moves [sic] draw them out" (page 20). Example talk moves are given, such as "Probe: What did you see happening to the trash? Follow-Up: Can you say more? Press: What could happen if a bird ate trash? Revoice: What I hear you saying is that trash can be harmful. Is that true?" The teacher then is told, "Say, 'It sounds like you are concerned that trash could be harmful to living things and our environment. Raise your hand if you think that the trash humans make might be a problem for the environment.'"
- Lesson 1: The teacher is told, "Say, 'We have many fantastic questions listed on our chart. What we really need is one big question about how we are going to figure out a solution to our problem. This will be our unit-driving question. Does anyone have a suggestion for what our unit-driving question should be?' After students have shared their ideas, say, 'Those are some great ideas. It seems like many of us think that our unit-driving question should be about designing solutions to the trash problem. I think that is a great idea. Maybe a question like, How can we help solve the trash problem? Does that describe most of your ideas?'" (page 34). The teacher is also given facilitation prompts for this discussion to use if needed.
- Lesson 1: "We have recorded quite a few questions related to the trash problem. What makes the most sense for us to investigate first about the anchoring problem? Provide time for students to think about and share their ideas. End the discussion by saying, 'It looks like we have a lot to figure out, but many of you are suggesting that we need to learn more about the trash we throw away. Does it make sense to investigate our trash first?' Wait for student responses, and then say, 'OK, let's begin by trying to answer all our questions that are related to the things we throw away'" (page 36).

- Lesson 2: "Remind students that they said they wanted to learn more about the things we throw away to help them better understand the trash problem. Have students come up with a question they could investigate to help them learn more about the types of things we throw away…Work together to come to consensus on one question to investigate" (page 54). "Say, 'These are all wonderful ideas that we could investigate. I think we can learn a lot about the things we throw away. Let me see what types of materials I can gather so we can test them next time'" (page 55).
- Lesson 2: "Have students identify which questions on the Questions We Have Class Chart they can now answer. After the class explains the answer to a question, write a large check mark near the question to show that it has been answered" (page 80).
- Lesson 2: "Ask students what they should investigate next about trash or the anchoring problem. As students share ideas, prompt them to articulate any new questions they have about trash or the anchoring problem" (page 80). Facilitation prompts are given, and a teacher note says, "Prioritize any questions related to why people throw things away. Now that students understand what we throw away, they should want to move toward understanding why things get thrown away. Questions related to why trash is thrown away will drive students toward Lesson 3" (page 80).
- Lesson 3: "Have students brainstorm ways they could use what they learned about observable properties to help them explore the question they came up with at the end of Lesson 2…. As students share their investigation ideas with the class, record them on the Initial Ideas Class Chart. Say, 'These are some great ideas about how we could investigate our lesson question. Let me see what I can gather to help us investigate why things are thrown away during the next class'" (page 100). However, the next activity does not seem to connect to student investigation ideas. The teacher is told to say: "Scientists often use familiar things to help them explore new phenomena. What if we explore objects in our classroom to figure out how they help us or are useful? Then we can use this understanding to help us figure out why things get thrown away. Does that sound good to everyone?" (page 101). A teacher note says "As needed, refer to the Initial Ideas Class Chart to have students review the question they decided to investigate during the last class and the ideas they came up with about how to investigate that question" but there is no connection between student investigation ideas and what the teacher is proposing. The lesson continues by telling students exactly what investigation steps they will take without making connections back to students' investigation ideas (page 101).
- Lesson 3: The teacher is told, "Explain that they will investigate how changes to an object's structure can affect its function more during the next session" (page 115) without connecting to any student ideas about what should be investigated.
- Lesson 3: The investigation is teacher-driven, but there is an attempt to connect student ideas to it: "Say, 'Today, we are going to use our understanding of structure and function to help us figure out why some things get thrown away and other things don't. We already have some ideas on the Initial Ideas Class Chart, but we may have new ideas.' Have students discuss their investigation ideas with a partner and then share them with the class. Next, revoice the ideas the class shared. Say something like, 'So it sounds like we should investigate trash items, like the

ones we collected during lunch, to help us gather evidence for why we want to throw things away. Does this plan work for everyone? Great!'" (page 116).

- Lesson 3: In the "Navigate to the Next Lesson" section, the teacher is given suggestions "if time permits," including "After questions have been asked, prompt students to consider what they should investigate next about trash to better understand the anchoring problem…. Have students consider what else they need to learn about trash before they can start designing a solution to the anchoring problem" (page 134). Discussion prompts are given to guide students toward the investigations for the next lesson. However, it is unclear whether students will feel like they are a part of the navigation to the next lesson if time is short, as these suggestions will not be used.
- Lesson 4: "Have students think of ways they could investigate the questions they recorded in their notebooks and under the heading, 'What Happens to Our Trash?' Ask for volunteers to share their ideas" (page 158). Although some students might suggest reading, this is not facilitated, so the next activity in which students gather information from reading (page 158) may feel teacher driven.
- Lesson 4: "Have students review the Questions We Have Class Chart to determine which questions they can now answer. Have students use evidence from the lesson to support their answers to these questions. Place a check mark next to these questions to symbolize that they have been answered. Ask students if they have any new questions after completing this lesson…Ask students if they think they have collected enough information about the who, what, when, where, why, and how of the trash problem to begin thinking about solutions for the anchoring problem. Facilitate a discussion that helps students realize that they are ready to begin designing solutions that will answer the question, 'How can I help solve the trash problem?'" The teacher is told, "Always allow time for the student to agree or disagree with your revoicing and say more as needed" (pages 174–175).
- Lesson 5: "Students should write or draw to explain which of their classmates' design solutions they think could be developed in the next lesson…Help students reach agreement that they should look more deeply in the next lesson at solutions that reuse items. Listen for students to suggest that research should be done in Lesson 6 to better answer the question, 'How could we test our ideas about reuse?'" (page 209). However, students do not revisit these ideas in the next lesson.
- Lesson 6: "Have partners consider both of the ideas they designed and choose one they would like to build and test together" (page 243).
- Lesson 6: "Say, 'It sounds like you think testing designs is an important part of engineering. You have a lot of experience planning and carrying out investigations, so I think you will have some good ideas about this.' Distribute Student Artifact 6.2: How Could We Test Our Ideas About Reuse? and have students individually complete the Brainstorm section by documenting ways they could test their group's solutions" (page 247).
- Lesson 6: "Remind students that they obtained new information by testing their solutions. Ask them for ideas about what they could do with this information" (page 254).
- Lesson 6: "Help students anticipate the next lesson in the storyline. Say, 'Wow, it sounds like you have some really good ideas for things we can do to make less trash. Do we have more

questions we must answer, or are we ready to answer the unit-driving question on our Questions We Have Class Chart (e.g., How can we help solve the trash problem?)?.....If students ask an important question they feel must be figured out before moving on to Lesson 7, help them work on answering it before the class proceeds to answering the unit-driving question'" (page 259).

- Lesson 7: "Use guiding questions to draw out the idea that a community-based solution would also help solve the trash problem…Suggested Guiding Questions: Probe: Do you think anyone else is affected by the trash problem?" (page 292). "Say, 'It sounds like you think you can engineer a solution to help our community throw away less trash and reduce pollution. This seems like a good idea. Let's talk about important features of a community-based solution'" (page 293).
- Lesson 7: "Post the Unanswered Questions Class Chart near the Questions We Have Class Chart or in another highly visible location. Invite the class to review each question and collaboratively determine whether they have developed the ideas they need to answer it. If students cannot answer a question, move that sticky note to the Unanswered Questions Class Chart or write that question on the new chart" (page 307).

Students share prior experiences and connect to the anchor problem and investigative phenomenon to aid in sense-making and problem solving. Related evidence includes:

- Lesson 1: The teacher is told, "Prompt students to describe prior experiences they've had working on a problem in science" (page 21). The materials also include discussion prompts.
- Lesson 1: "Encourage students to use their prior knowledge and experiences to consider what could be done or changed to help the pollution problems they identified. Provide time for students to discuss possible solutions to the problems they illustrated on their artifact sheet with a partner" (page 24).
- Lesson 1: The teacher facilitates a class discussion, saying, "What prior experiences have we had solving problems? What are some things we did to help figure out solutions?" (page 34). Note that this discussion somewhat repeats the one from earlier in the lesson (see bullet above) so students may not feel like their earlier ideas were heard or valued.
- Lesson 3: "Expand the discussion to tie in students' prior knowledge and experiences with human impact. Say, 'In kindergarten you learned about deforestation and how the choices humans made impacted the local environment when they cut down all the trees to make a new neighborhood. People needed somewhere to live, but this choice still impacted the local environment. How is our trash problem similar to that situation?'" (page 131).
- Lesson 7: "Remind students that they have designed individual and classroom solutions in previous lessons but decided that their community could also help solve their trash problem…Ask students if they have experience with community solutions. As needed, provide examples like food drives, toy donation programs, community service projects, or government improvements (e.g., adding stop signs or crosswalks)" (page 298).

Unit 1–Trash

EQuIP RUBRIC FOR SCIENCE EVALUATION

Engineering and Science are connected throughout the unit.

- The focus of the entire unit is on solving a problem. Students consistently learn science ideas as they work toward figuring out solutions.
- No science DCI is claimed as a learning goal in Lessons 1 and 7, but science ideas are built toward as students identify a problem and describe possible solutions in Lesson 1, and science ideas are applied in the unit wrap up in Lesson 7.

Suggestions for Improvement

- In Lessons 3, 4, and 5, consider ensuring that students consistently connect their ideas to the class activities.
- Consider if there are ways to add more student-driven opportunities in places where the teacher is guiding the direction for next steps.

I.B. THREE DIMENSIONS

Builds understanding of multiple grade-appropriate elements of the science and engineering practices (SEPs), disciplinary core ideas (DCIs), and crosscutting concepts (CCCs) that are deliberately selected to aid student sense-making of phenomena and/or designing of solutions.

i. Provides opportunities to *develop and use* specific elements of the SEP(s).

ii. Provides opportunities to *develop and use* specific elements of the DCI(s).

iii. Provides opportunities to *develop and use* specific elements of the CCC(s).

Rating for Criterion I.B. Three Dimensions	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found Adequate evidence that the materials give students opportunities to build understanding of grade-appropriate elements of the three dimensions. The lesson materials distinguish between elements that students develop during the unit and elements that they apply from prior learning. There is a match between most claimed elements of the three dimensions and evidence that the students will use those elements. However, there is limited evidence that students develop new understanding of SEP elements and a moderate mismatch between claims and evidence of student use of claimed CCC elements, particularly for the **Cause and Effect** category.

Science and Engineering Practices (SEPs) | Rating: Adequate

The reviewers found adequate evidence that students have the opportunity to use SEPs in this unit. In most cases, claims of student use of the SEP elements are accurate, though there are a small number of mismatches between claims and evidence. In addition, students have extensive opportunities to practice SEP performances, but there is little support for building new understanding of SEP elements.

Asking Questions and Defining Problems:

- *Ask questions based on observations to find out more information about the natural and/or designed worlds.*
    - This element is claimed as being used in Lesson 1.
    - Lesson 1: Sentence starters offer options "to aid students in their partner discussion" when they share their observations. For example, "I thought __ was interesting." "I wonder if ___", "Why did ________ get thrown away?" (page 13).
    - Lesson 1: Sentence starters are provided to be used "as needed" after students watch the initial video. For example: "Who has seen_______? What do you think about _________? Where ________? When _______? Why ________?" (page 19).

Planning and Carrying Out Investigations:

- *Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.*
    - This element is claimed as being developed in Lesson 2 and used in Lesson 6.
    - Lesson 2: "Provide time for each student to individually think about ways they could investigate trash items. After some time, prompt them to share and discuss their ideas with a partner" (page 54).
    - Lesson 6: Students work with groups to plan an investigation then test the design solutions and collect data (e.g., Student Artifact 6.2).
    - Students are not supported with clear steps in how to develop their competence in this element.

Analyzing and Interpreting Data:

- *Record information (observations, thoughts, and ideas).*
    - Lesson 1: This element is not claimed but is used in the lesson. "Allow time for students to share their initial observations, ideas, and questions about their trash in a class discussion. Give students sticky notes on which they can record their observations and questions" (page 14).
    - Lesson 3: This element is not claimed but is used in the lesson. "Prompt students to work with a partner to complete Table 1 under the Collect Data section of their artifact sheet. Explain that they need to use their knowledge of structure and function and observable properties to describe each object before the food or drink was consumed" (page 118).
- *Analyze data from tests of an object or tool to determine if it works as intended.*
    - This element is claimed as being developed in Lesson 3 and used in Lesson 6.
    - Lesson 3: Students make observations of objects to comment on their usefulness (e.g., page 102), but they do not make determinations about whether the objects work as intended. The scoring guidance for this element doesn't fully explain the element. Full understanding says, "Student accurately analyzes data from tests for three everyday objects to help them determine which observable property most aids in each object's purpose" (page 107).

- Lesson 6: "Every student in the group should make observations or measurements to record data according to their plan in the Test section of Student Artifact 6.2. When testing is complete, groups should discuss if each solution worked as intended" (page 249).
- Lesson 6: "Students should work in pairs to describe the strengths and weaknesses of both physical models [design solutions] built by their group. As students work, ask guiding questions to help them identify relationships and interpret their data" (page 255). Students also are given the question prompt: "How does analyzing data from testing the designs help you figure out if the solutions worked as you expected?" (page 277).

- *Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.*
    - This element is claimed as being developed in Lessons 3 and 5.
    - Lesson 3: Students make observations of objects' properties and "use prior knowledge to determine an object's purpose and analyze the data as evidence to determine which property makes the object well-suited for this purpose" (page 103).
    - Lesson 5: Students make observations of peers' design solutions to provide feedback related to solving a problem. Students are encouraged to look for patterns in peers' design solutions (page 206).

Constructing Explanations and Designing Solutions

- *Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.*
    - This element is not claimed in the unit, but it is built toward in Lesson 3.
    - Lesson 3: "Together, create a class claim, supported by evidence from their investigation, about why humans throw some things away" (page 124).
- (Grades 3–5 element) *Apply scientific ideas to solve design problems.*
    - This element is not claimed in the unit but is built toward in Lesson 5.
    - Lesson 5: "The goal of this discussion is to revisit ideas developed in prior lessons that will help students design solutions to the anchoring problem. By this point in the unit, students have explored and should be able to articulate the following science ideas for the class list: Trash can be solid or liquid. Trash items represent many types of materials that can be described by their observable properties…" (page 193). "Using their observations and the information they have obtained during previous lessons, have students talk with a partner about possible solutions to the anchoring problem. Next, allow time for each pair to discuss their solution ideas with another pair" (page 195). In this practice, the K–2 elements focus on students using prior experience and evidence to design solutions while the 3–5 elements progress to using scientific ideas to solve problems and designing multiple solutions to design problems.

Obtaining, Evaluating, and Communicating Information:

- *Read grade-appropriate text and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about ~~the natural~~ and designed world(s).*
    - This element is claimed as being developed in Lessons 4 and 5.
    - Lesson 4: Students use a reading to get information. The teacher is told, "Before beginning to read aloud, establish a purpose for reading. Remind students that scientists and engineers use many different types of resources to gather information to help answer questions and solve problems" (page 158).
    - Lesson 5: Students do not use this claimed element in the lesson. Another unclaimed element from the same SEP category is used, however.
- *Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim.*
    - This element is not claimed in the unit but is developed in Lesson 2.
    - Lesson 2: "Distribute Literacy Resource 2.1: What Is Recycling? to each student. Have students read and discuss the information on this infographic with a partner and then answer the following questions in their science notebooks: What is this infographic communicating? How does this infographic help you better understand what the robot in the video was doing? How do these new ideas compare to the science ideas you communicated earlier in the lesson?" (page 76).
- *Communicate information ~~or design ideas~~ and~~/or~~ solutions with others in oral and/or written forms using ~~models,~~ drawings, writing ~~or numbers~~ that provide detail about scientific ideas, ~~practices, and/or design ideas.~~*
    - This element is claimed as being developed in Lessons 1, 2, and 6, and as being used in Lesson 7.
    - Lesson 1: The Scoring Guidance says, "Students individually draw or write to complete a graphic organizer to communicate two problems related to trash (cause) from the video and their effects on the environment" (page 26).
    - Lesson 2: "Have students consider how they could use the evidence they collected about observable properties to communicate reasons why the robot in the video from Part A was picking up only certain trash items" (page 69).
    - Lesson 2: "When describing how the science ideas they figured out relate to the Classroom Trash Model, encourage students to include appropriate facts and communicate relevant descriptive details while speaking audibly and in coherent sentences. (SL.2.4)" (page 75).
    - Lesson 5: This element is not claimed but is used in the lesson in students' design posters. "Explain that students will create a poster of their improved final design to share with the class in a gallery walk. Explain that a gallery walk is a way to actively engage in discussions about their ideas and the ideas of others" (page 202). Later, students present their ideas orally: "Allow time for each student to present their poster to the class. While their classmates are presenting, encourage students to listen carefully to their peers' ideas" (page 206).

- Lesson 6: Students communicate their design solutions in the Student Artifact pages (e.g., Student Artifact 6.2).
- Lesson 7: Students communicate information and design ideas, including drawing and writing related to what they have learned (e.g., Student Artifact 7.1).

Disciplinary Core Ideas (DCIs) | **Rating: Extensive**

The reviewers found extensive evidence that students have the opportunity to use and develop the DCIs in this unit. There is a close match between claims and evidence of student use and development of the DCI elements.

PS1.A: Structure and Properties of Matter

- *Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.*
  - This element is claimed as being developed in Lessons 2, 3, and 4.
  - Lesson 2: Students sort matter into different groups. The teacher is told, "These many different patterns will provide evidence that will build toward developing an understanding of the observable properties of different materials and types of matter" (page 66). The teacher is also told to make this learning explicit to students: "Explain that observable properties include how the item looks (e.g., color and shape), how it feels (e.g., rough, smooth, soft, hard), and how it behaves (e.g., bendy, not bendy). Explain that all the sorting students did is something that scientists and engineers do quite often. This skill of sorting or organizing things by similarities is known as 'classifying.' Have students explain how they used observable properties to classify trash items into different groups" (page 68).
  - Lesson 3: Students observe different types of objects to describe observable properties (e.g., Student Artifact 3.1).
  - Lesson 4: Students learn that trash is sorted by the observable properties of each object (e.g., page 159).
  - The unit has some inconsistencies regarding the first part of the element. In several places the unit states that students learned about matter as solids and liquids in a prior grade 2 unit (e.g., page 47, page 56). The Unit Overview labels this unit as Unit 1 while the Lessons file labels it as Unit 2. In the Lessons file, portions of the DCI are included with strikethrough text, but the amount of text is not consistent (e.g., page 47, page 62 page 91, page 107).
- *Different properties are suited to different purposes.*
  - This element is claimed as being developed in Lessons 3, 5, and 6.
  - Lesson 3: "Facilitate a class discussion for students to share their objects and explain which observable properties cause the object to be useful, or well-suited for their intended purpose" (page 105).
  - Lesson 3: "Students use their observations of each object to document the shape(s) and other observable properties, such as the type of material and flexibility. For example, a

yogurt container is plastic and round so it can hold the yogurt in place. It has a flexible lid that can be pulled off when it is time to eat it" (page 118).

- Lesson 3: This DCI seems to be interpreted in the lesson as "purpose" = "function" and therefore the DCI application is expanded to all functions of both natural and designed objects rather than being tightly focused on engineered objects that are designed for an explicit purpose. For example, the extra supports to help students understand the DCI say, "Have students identify which observable property makes the bowl suitable for its intended purpose of holding soup. (Shape)" (page 127). This is discussed without any indication that the bowl designer intended for it to be used for soup (rather than cereal, oatmeal, a water bath for washing hands, etc.). In contrast, the spoon discussion allows students to connect to their own purpose: "Ask students which utensil they would choose to eat the soup with and why. Listen for students to describe the structure and shape of each utensil and how the spoon's shape makes it the most suitable utensil to serve the purpose of scooping soup" (page 127).
- Lesson 5: Students review this element (and the other **PS1.A** element) as they discuss ideas they have learned that can help in the creation of a solution to the anchor problem (page 194).
- Lesson 6: "As students work, ask them to explain how they will reuse the objects from the classroom trash. Press students to explain how shape and other observable properties relate to how each chosen material will function in their design solution" (page 238).

ETS1.A: Defining and Delimiting Engineering Problems

- *Asking questions, making observations, and gathering information are helpful in thinking about problems.*
    - This element is claimed as being developed in Lessons 1 and 4.
    - Lesson 1: The teacher is prompted to say, "What can we do that will help us think about this problem so that we can design solutions for it?" (page 24). Students complete the "Think Like an Engineer" section of their artifact sheet.
    - Lesson 1: The teacher shows an engineering process diagram and talk moves are suggested: "Probe: Why do you think research appears before design in this diagram? Follow-Up: Can you tell me more about that? Press: Can you give me an example? Focus: Tell me what you think 'research' mean. Revoice: What I hear you saying is that we need to learn more about the trash problem before we can design solutions. We can do this by asking questions and then doing investigations to answer those questions. Is that right?" (page 35).
    - Lesson 4, Part A: Students gather information about where trash goes and how it travels to help them understand the problem.
    - Lesson 4: "Ask students to explain what helped them think about and understand this problem better. Use guiding questions to help students consider why this is important…Students are expected to understand that asking questions, making observations, and gathering information are helpful in thinking about problems. The

goal of this discussion is to develop the idea that before beginning to design a solution, it is important to understand the problem. If students struggle, ask the following guiding questions" (page 174).

- *Before beginning to design a solution, it is important to clearly understand the problem.*
  - This element is claimed as being developed in Lesson 5.
  - Lesson 5: The class discusses an "Engineering Design Process" graphic and reviews that they have already done part of the steps, including understanding the problem (page 194).

ETS1.B: Developing Possible Solutions

- *Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.*
  - This element is claimed as being developed in Lessons 5 and 6.
  - Lesson 5: "Tell students they are going to make a draft of their design solution using drawings, sketches, or words (oral or written). Ask, Why do you think making a draft is an important step in engineering? What makes a draft different from a final solution or product?.... The goal of the draft is for students to understand that using sketches and drawings helps them brainstorm and communicate their ideas. Tell students that before engineers build or test anything, they write or draw out their ideas. This step helps them see what may or may not work in their design" (page 197). The teacher is also told that the students "may need to be reminded that making a representation of an idea is a way to help others see what you're thinking and that it is useful in communicating ideas to others. If students have trouble explaining why sketching their ideas is an important step, ask the following questions: Do the words on your sticky note fully explain everything about your idea? Are your classmates able to read your mind or the minds of others?" (page 198).
  - Lesson 6: "Students are expected to understand that drawings are useful in communicating ideas for a problem's solution to other people…Giving and responding to feedback helps students improve their writing and uncover the most effective ways to communicate design ideas to others" (page 243).

ETS1.C: Optimizing the Design Solution

- *Because there is always more than one possible solution to a problem, it is useful to compare and test designs.*
  - This element is claimed as being developed in Lessons 5 and 6.
  - Lesson 5: Students discuss different ideas for design solutions. The teacher is told, "A common misconception is that there is only one way to solve a problem. If students mention this, address the misconception by sharing examples of a different but relevant problem that has more than one solution" (page 196).
  - Lesson 5: The class discusses the idea of testing designs, and the teacher is told, "This discussion is an opportunity for students to understand that engineers test their ideas and that, after testing, they might make changes to their ideas. Engineers don't always

get it right on the first try. Sometimes it takes a lot of testing of a lot of ideas before one is successful" (page 200).
    - Lesson 6: "Use guiding questions to develop the idea that that[sic] because there is more than one possible solution that can reuse trash (or more than one solution to any engineering problem), it is useful to compare and test designs. Possible Guiding Questions for Class Discussion: Why do we have so many ideas? How do we know which one will work the best?" (page 242).

Crosscutting Concepts (CCCs) | **Rating: Adequate**

The reviewers found adequate evidence that students have opportunities to use or develop the CCCs in this unit. Most of the claims for CCC use and evidence of student use are accurate (although there are many mismatches), and students have extensive opportunities to develop the claimed **Structure and Function** CCC element.

An explicit discussion of CCCs in general is in Lesson 6: "Refer students to the How Are You Working Like a Scientist or Engineer Today? poster. Focus their attention on the Crosscutting Concepts, which are shown in green. Ask, 'Which of these do you think you are using when you consider reusing something?'" (page 237).

Evidence related to claimed CCC elements includes:

Patterns

- *Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.*
    - This element is claimed as being used in Lessons 1 and 2.
    - Lesson 1: Students are asked to use the first part of this element when the teacher says, "Deepen the conversation by asking students to describe any similarities or differences they observed among the trash items**.** Say, 'What sort of patterns do you notice among the things we throw away? Do you notice any similarities? Differences?'" (page 15).
    - Lesson 2: Support is provided related to this element for students who struggle: "Gather together any students who struggled to use the lens of Patterns to classify the trash items…. Provide images or objects that represent an assortment of shapes and colors. Have students make observations of these objects and remind them that their observations can be used as evidence to identify patterns…Ask students if they can identify a pattern among any of the objects or images (e.g., some of them are blue). Have students sort the objects with that pattern into a group and explain the evidence they used to sort these objects by this pattern" (page 64).
    - Lesson 2: "Have students consider if there are any additional ways to use patterns as evidence to sort the trash items. After providing a minute to think, invite students to share their ideas and record them on the chart as well" (page 67). "Continue the discussion to explain that what students recorded as the results of their tests is considered evidence and that they are now communicating that evidence to the class….

Help students understand that scientists look for patterns and order when making observations about the natural and designed worlds" (page 68).

- Lesson 3: This element is not claimed but is used when students are expected to recognize patterns and use them to make a claim. "Push students to share some of the patterns they identified as they analyzed their data. Together as a class, determine if these same patterns exist on the After Eating Class Chart" (page 121).
- Lesson 4: This element is not claimed in this Lesson, but it is built toward. "Prompt students to think about patterns in a different way—as repeating events—not just as repeating shapes, as they have observed before. A repeating event is something that happens over and over again in the same way. These patterns can occur each day, each week, each month, etc." (page 162). Note that this guidance is placed under the header of **Cause and Effect**, even though causes are not discussed.
- Lesson 5: This element is not claimed in this Lesson, but it is built toward. "Remind students that a variety of patterns exist. Some questions to help students find patterns in design solutions include: What do the different design solutions have in common? What is the same? What is different? Who will the solutions help? Suggest that students make a list of patterns in their science notebooks as they listen to the presentations" (page 207).

Cause and Effect

- *Events have causes that generate observable patterns.*
    - This element is claimed as being developed in Lessons 1, 4, and 5, and used in Lessons 6 and 7.
    - Lesson 1: The teacher is given the following discussion prompts to use: "Look at all the problems and effects we have identified. Does anyone notice a pattern? What pattern(s) do we observe from these trash events?" (page 23).
    - Lesson 1: The teacher leads a discussion to get students to think about the causes of pollution. A sample prompt includes: "What caused the pollution in the environments we observed?" (page 29).
    - Lesson 4: The teacher is told to discuss part of the investigative phenomenon video, asking students "What is taking place? What causes the trash to be picked up and moved?" (page 157). The teacher is then told that students "will begin to understand that humans make a lot of trash every day (cause) and that trash is moved by trucks (event) from their home or school to another location on a regular basis (pattern)." However, humans generating trash is not the cause of trash being picked up and moved, so the teacher is prompted to expect inaccurate ideas from students. An inaccurate prompt is even given: "Humans throwing away trash causes it to ___" [expected answer: be picked up by the truck.] A similar issue comes up later in the lesson: "Assist students in recognizing that trash moving from one place to another is an event and that this event has a cause (trash can't stay in the house or at the curb) that generates patterns (trash is sorted by its observable properties) in where trash goes (whether trash is burned, buried, or recycled [effect])" (page 163). In this case, the stated cause is more

closely connected to the stated event, but the reason trash can't stay at the curb is not well-defined for students. The same inaccurate prompt is also given: "Humans throwing away trash causes it to ___."

- Lesson 5: This element is claimed but it is not clear that it is used, rather than a related **Patterns** element. Teacher notes say, "Cause and Effect: Guide students to use the lens of Cause and Effect to identify patterns in how the design solutions work. Patterns might include: Items being reused, Items being moved to new places, Items being burned, Items being buried, Items being recycled" (page 208). The idea of events having causes is not used clearly.
- Lesson 6: The teacher is told that students use this element when they describe how their design solutions reduce human impacts on pollution, but there isn't evidence that students will explicitly understand and use this concept.
- Lesson 7: The teacher is told that students use this element when they describe how their design solutions make less trash and therefore reduces pollution, but there isn't evidence that students will explicitly understand and use this concept (e.g., connecting causes to patterns).

- *Simple tests can be designed to gather evidence to support or refute student ideas about causes.*
    - This element is claimed as being developed in Lesson 3 and used/applied in Lesson 6.
    - Lesson 3: "Students are using their prior knowledge and the data they collected during their simple tests as evidence to support or refute their partner's ideas about which observable properties cause the object to be well-suited for its intended purpose" (page 104). The CCC element is not explicit in the activity, though, so students may build toward the element if they notice that they're using evidence from tests to support or refute peer ideas, but there isn't evidence that students have or use this CCC understanding.
    - Lesson 6: Student Artifact 6.2 scoring guidance for the CCC doesn't fully describe the targeted CCC element. The "Full Understanding" description says, "Student collaboratively designs a simple test and gathers evidence to support ideas about item properties suited for reuse" (page 250). However, the CCC requires understanding the concept — not just performing the test. In the "Remediation after assessment" section there is guidance marked for this CCC element to "provide extra support for students who struggle to design a simple test…". The teacher is told, "After they have tested the objects, ask students to describe how data from their test provided evidence of the suitability of different materials for cleaning up a spill" (page 252). In this case, students are building an understanding of this element.

Structure and Function

- *The shape ~~and stability~~ of structures of natural and designed objects are related to their function(s).*
    - This element is claimed as being developed in Lesson 3 and used/applied in Lesson 6.
    - Lesson 3: Students make observations of objects to compare properties to functions: "Students should apply their understanding of purpose and observable properties to

identify which property causes the object to be the best suited for its purpose" (page 102).

- Lesson 3: "Continue the discussion to explain that the shape and the pieces that make up an object are parts of the object's structure. 'Function' is another word for 'purpose.' Invite students to share their prior experiences and knowledge with the words 'structure' and 'function'… Ask students to identify a structure or part of the object, like the wheel of a bike. Invite students to describe the shape of this structure (round) contributes to the part's function (rolls so the bike can move forward). Have students continue to make sense of the words 'structure' and 'function' by looking at other structures on the bike, like the seat and handlebars, and identifying each part's shape and how the shape helps these structures be useful" (page 112). Note that "function" and "purpose" do not have the same meaning.
- Lesson 3: "Students use their observations of each object to document the shape(s) and other observable properties, such as the type of material and flexibility. For example, a yogurt container is plastic and round so it can hold the yogurt in place. It has a flexible lid that can be pulled off when it is time to eat it" (page 118).
- Lesson 6: "For example, a flexible object can change shape and is not stable. On the other hand, a non-flexible object does not change shape and is stable. Draw out specific properties that make each trash item suited to different purposes. Students should be able to explain how they want any item to function in their design solution" (page 237).

Suggestions for Improvement

Science and Engineering Practices

Consider providing students opportunities to develop new proficiencies in the SEP elements. For example, consider opportunities to help students develop their competence in the following element by linking the patterns and relationships to developing a solution to a problem: *Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.* Specific guidance for the teacher or steps that students follow could strengthen the understanding of how observations connect to solutions.

Disciplinary Core Ideas

N/A

Crosscutting Concepts

- Consider adjusting claims related to **Cause and Effect** elements to match what students do in the lessons.
- Consider adding steps for the teacher or students to ensure that the students develop a clear understanding of how to use the CCC elements in solving problems.

I.C. INTEGRATING THE THREE DIMENSIONS

Student sense-making of phenomena and/or designing of solutions requires student performances that integrate elements of the SEPs, CCCs, and DCIs.

Rating for Criterion I.C. Integrating the Three Dimensions	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that student performances integrate elements of the three dimensions in service of figuring out phenomena and designing solutions to problems. Almost all learning in the unit is at least two-dimensional and there are numerous events where students integrate all three dimensions to make sense of phenomena and design solutions to the unit problem.

Lesson-level, three-dimensional Performance Expectations (PEs) are provided for each lesson (pages xxiv–xxix). For example, the expectation for Lesson 2 is *"*Collaboratively plan and conduct an investigation to collect data that can be used to describe and classify matter by patterns in its observable properties."

Lesson 3 offers an opportunity for students to use all three dimensions together to determine how changes to an object affect its ability to serve its intended purpose. To do this, students use the following elements:

- **Analyzing and Interpreting Data.** *Analyze data from tests of an object or tool to determine if it works as intended.*
- **PS1.A: Structure and Properties of Matter.** *Different properties are suited to different purposes*.
- **Structure and Function.** *The shape ~~and stability~~ of structures of natural and designed objects is related to their function*.

Almost all the 10 Student Artifacts provide opportunities for students to use grade-appropriate elements from all three dimensions together to make sense of phenomena and solve problems. For example, Student Artifact 6.1 asks students to communicate design ideas and provide details about how the shape and properties of items help them function as needed for a new purpose. This performance uses the following elements:

- **Obtaining, Evaluating, and Communicating Information.** *Communicate information or design ideas and/or solutions with others in oral and written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas*.
- **PS1.A: Structure and Properties of Matter.** *Different properties are suited to different purposes*.
- **Structure and Function.** *The shape and stability of structures of natural and designed objects is related to their function*.

Suggestions for Improvement

N/A

I.D. UNIT COHERENCE

Lessons fit together to target a set of performance expectations.

i. Each lesson builds on prior lessons by addressing questions raised in those lessons, cultivating new questions that build on what students figured out, or cultivating new questions from related phenomena, problems, and prior student experiences.

ii. The lessons help students develop toward proficiency in a targeted set of performance expectations.

Rating for Criterion I.D. Unit Coherence	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that lessons fit together coherently to target a set of PEs because all content in the unit is sequenced coherently and explicitly, students have opportunities to build toward almost all of the targeted learning in the three dimensions, and students have regular opportunities to ask questions based on what was learned and revisit their questions later.

Students have opportunities to build on their understanding by adding to and revising representations as they learn more information.

- Lesson 1: The teacher creates a model of trash and is told, "Revisit this model throughout the unit to aid sensemaking and help students make connections between the ideas they are developing and the problem driving the unit" (page 15).

Connections are made between lessons and class sessions to help students follow the chain of instruction. For example:

- Lesson 1: "Invite students to revisit the concerns they identified during the last class session about trash in the environment. As students review their concerns, encourage them to use the earned word 'environment.' Remind them that at the end of the last class session they identified these concerns as problems." (page 21).
- Lessons 1 and 2: At the end of Lesson 1, students are facilitated to decide what they want to investigate first (learning more about their trash) (page 36). At the beginning of Lesson 2, students are reminded of what they decided: "After choosing our anchoring problem, we realized that we needed to learn more about trash before coming up with a good solution to the problem. What were some questions we asked about the trash we throw away?" (page 51).

Later in Lesson 2: "Remind students that they said they wanted to learn more about the things we throw away to help them better understand the trash problem. Have students come up with a question they could investigate to help them learn more about the types of things we throw away" (page 54).

- Lesson 2: Class sessions are connected to prior class sessions: "Say, 'Last time, we discussed different ways we could investigate the things we throw away to help us dig deeper into our trash problem. I gathered some things that people often throw away. Who can remind us what question we decided to investigate?'" (page 55).
- Lesson 2: Later in the lesson (after a class investigation), the teacher is told, "Remind students of the question they decided to investigate in this lesson, which is recorded near the top of the Investigation Ideas Class Chart from Part A: 'What types of trash are thrown away?'" (page 74).
- Lesson 2: The lesson ends with the teacher facilitating a class discussion about what should be investigated next. The teacher is then told, "End the discussion by saying, 'So, I heard several of you mention wanting to learn more about why things get thrown away. Since we just learned more about what we throw away, does it make sense for us to learn more about why things get thrown away next?'" (page 80). Lesson 3 begins with "Have students review what they have figured out about trash so far and what they decided should be investigated next" (page 97).
- Lesson 3: "Have students brainstorm ways they could use what they learned about observable properties to help them explore the question they came up with at the end of Lesson 2, which is something similar to, 'Why do some things get thrown away?'" (page 100).
- Lesson 3: The lesson ends with an optional discussion about what to figure out next. "End the discussion by saying, 'I heard several of you mention wanting to learn more about where things go when they are thrown away. Since we have figured out the who, what, when, why, and how related to throwing away trash, does it make sense for us to learn more about where our trash goes once it is thrown away?'" (page 135). However, Lesson 4 begins by repeating the same discussion without connecting back to the previous discussion: "Review the Questions We Have Class Chart and highlight the questions that students want to explore next. Help students realize that so far in this unit, they have discussed the who, what, when, why, and how related to the trash problem. Access their prior knowledge of the 5W questions and how (who, what, when, where, why, and how) to help them prioritize questions related to where trash goes" (page 154).
- Lesson 4: The lesson ends with "Ask students if they think they have collected enough information about the who, what, when, where, why, and how of the trash problem to begin thinking about solutions for the anchoring problem. Facilitate a discussion that helps students realize that they are ready to begin designing solutions that will answer the question, 'How can I help solve the trash problem?'" (page 175). Lesson 5 begins with "Draw students' attention to the Questions We Have Class Chart, which they have been developing since Lesson 1. Ask students to connect back to the anchoring problem by reviewing the questions they want to answer that still remain on the chart" (page 193). There seems to be a disconnect between designing solutions to answer one question (Lesson 4 ending) and finding other questions students want to answer (Lesson 5 beginning).

- Lesson 5: Before going into a class break, the teacher tells the students, "Choose one idea that you would like to revisit and develop further tomorrow. Write that idea on your sticky note" (page 196). The next class session starts with, "Revisit: Have students take out their sticky notes from the last session" (page 197).
- Lesson 5: The lesson ends with "Students should write or draw to explain which of their classmates' design solutions they think could be developed in the next lesson…Help students reach agreement that they should look more deeply in the next lesson at solutions that reuse items. Listen for students to suggest that research should be done in Lesson 6 to better answer the question, 'How could we test our ideas about reuse?'" (page 209). Lesson 6 opens with a review of questions students have been working on, what they still want to figure out, and reviewing the posters created in Lesson 5. Students then go on to participate in activities about reuse unrelated to the ideas agreed upon at the end of Lesson 5 (pages 227–228).

The unit states that students build toward the PEs below during instruction. The unit indeed provides almost all the learning necessary to perform these expectations. See related evidence in Criterion I.B:

- 2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
- K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
- K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Suggestions for Improvement

- Consider specifying when students will be expected and prepared to perform the full target PEs, e.g., in which future unit.
- Consider removing repeats in instruction (e.g., the beginning of Lesson 4) and ensuring that each activity is connected to the previous.

I.E. MULTIPLE SCIENCE DOMAINS

When appropriate, links are made across the science domains of life science, physical science and Earth and space science.

i. Disciplinary core ideas from different disciplines are used together to explain phenomena.

ii. The usefulness of crosscutting concepts to make sense of phenomena or design solutions to problems across science domains is highlighted.

Rating for Criterion I.E. Multiple Science Domains	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that links are made across the science domains when appropriate. The unit focuses primarily on the physical sciences domain but makes explicit links to students' prior knowledge related to Earth sciences. However, CCC elements are not used to make explicit links across science domains.

For example, in Lesson 1, students discuss their prior knowledge about how humans affect Earth and how they can make choices to reduce their effects on the land, water, air, and other living things (page 20). Using their prior knowledge of **ESS3.C** from a kindergarten unit helps make connections between the trash that humans produce and the effects disposing of it can have on the world around them.

Suggestions for Improvement

- Consider supporting students to understand explicitly how one or more of the targeted CCC elements is helpful in sense-making or problem solving in multiple scientific domains.
- In Lesson 1, consider making explicit links to **LS2.A**: **Interdependent Relationships in Ecosystems** or **LS4.D**: **Biodiversity and Humans** to help students understand the broader impacts of the effects that they share.

I.F. MATH AND ELA

Provides grade-appropriate connection(s) to the Common Core State Standards in Mathematics and/or English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects.

Rating for Criterion I.F. Math and ELA	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials provide grade-appropriate connections to the Common Core State Standards (CCSS) in mathematics and English language arts (ELA) because CCSS ELA connections are provided for each lesson, and in Lesson 1 CCSS mathematics connections are also listed (pages xxiv–xxix). These connections are further elaborated on pages xxxviii–xxxix. In addition, students are guided to see how their ELA-Literacy learning supports their sense-making and problem solving.

Mathematics connections are made in Lesson 1:

- Lesson 1: "For each category, help students use counting and numbers to describe how many items fit under that label. Support understanding of base ten by writing each quantity on the Classroom Trash Model (2.NBT.A.2, 2.NBT.A.3)" (page 15).
- Lesson 1: "Students use their drawings as concrete models and apply strategies based on place value, or skip counting by fives. If students have not learned the skill of skip counting by fives yet, encourage students to add by fives instead. (2.NBT.B.5, 2.NBT.A.2)" (page 30).

Explicit ELA connections are made throughout the unit. For example:

- Lesson 1: "During the discussion, students are expected to share the observations they made during the video to communicate key ideas and other information about trash and potential problems it causes. (SL.2.2)" (page 18).
- Lesson 1: "ELA Connection: Students are expected to recount and describe key details presented through media through productive discourse. (SL2.2)" (page 52).
- Lesson 2: "Using science notebooks is an opportunity for students to develop their writing skills. Student responses should demonstrate the ability to recall information obtained during their investigation and use the ideas they developed to answer the lesson question. (W.2.8)" (page 74).
- Lesson 2: "When describing how the science ideas they figured out relate to the Classroom Trash Model, encourage students to include appropriate facts and communicate relevant descriptive details while speaking audibly and in coherent sentences. (SL.2.4)" (page 75).
- Lesson 3: "ELA Connection: This part of the discussion is an opportunity for students to tell a story or recount a personal experience using appropriate facts and relevant descriptive details while speaking audibly and in coherent sentences. (SL2.4)" (page 98).

- Lesson 3: "While formatively assessing each student's artifact, also formatively assess their ability to write informative sentences using facts and definitions to develop their ideas about structure and function and to use their ideas to draw a conclusion about how structure and function relate to why so many things get thrown away. (W.2.2)" (page 124).
- Lesson 4: Students' reading work is explicitly connected to their sense-making work as the reading not only supports students in getting more information about observable properties but also in carrying out their work to describe how trash is sorted. "Before beginning to read aloud, establish a purpose for reading. Remind students that scientists and engineers use many different types of resources to gather information to help answer questions and solve problems" (page 158).
- Lesson 5: "Giving and receiving peer feedback presents opportunities for students to practice speaking and listening skills. Support students by encouraging them to follow the agreed-upon rules for sharing feedback about individual work. (SL.2.1)" (page 201).
- Lesson 6: "ELA Connection: This is an opportunity for students to practice the production and distribution of writing. Students may excel when drawing what they would like to make, but instructions on Student Artifact 6.1 also require that they use words to label trash items and describe how shape and observable properties help items function in the design. As needed, provide guidance and support to strengthen writing that appears on the student artifact. (W.2.5)" (page 243).

Suggestions for Improvement

N/A

OVERALL CATEGORY I SCORE: **2** (0, 1, 2, 3)	
Unit Scoring Guide – Category I	
Criteria A-F	
3	At least adequate evidence for all of the unit criteria in the category; extensive evidence for criteria A–C
2	At least some evidence for all unit criteria in Category I (A–F); adequate evidence for criteria A–C
1	Adequate evidence for some criteria in Category I, but inadequate/no evidence for at least one criterion A–C
0	Inadequate (or no) evidence to meet any criteria in Category I (A–F)

CATEGORY II

NGSS INSTRUCTIONAL SUPPORTS

II.A. RELEVANCE AND AUTHENTICITY

II.B. STUDENT IDEAS

II.C. BUILDING PROGRESSIONS

II.D. SCIENTIFIC ACCURACY

II.E. DIFFERENTIATED INSTRUCTION

II.F. TEACHER SUPPORT FOR UNIT COHERENCE

II.G. SCAFFOLDED DIFFERENTIATION OVER TIME

II.A. RELEVANCE AND AUTHENTICITY

Engages students in authentic and meaningful scenarios that reflect the practice of science and engineering as experienced in the real world.

i. Students experience phenomena or design problems as directly as possible (firsthand or through media representations).

ii. Includes suggestions for how to connect instruction to the students' home, neighborhood, community and/or culture as appropriate.

iii. Provides opportunities for students to connect their explanation of a phenomenon and/or their design solution to a problem to questions from their own experience.

Rating for Criterion II.A. Relevance and Authenticity	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials engage students in authentic and meaningful scenarios that reflect the real world because students have opportunities to link their home lives to instruction and explore learning from the point of view of themselves, their families, the classroom, and the community. They develop solutions based on these different viewpoints.

Students are supported to make connections to the problems, phenomena, and activities. Related evidence includes:

- Lesson 1: The teacher is encouraged to save actual trash from the classroom and use that trash to frame the unit opening discussion, which would be very authentic and relevant to students (page 9).
- Lesson 1: "Encourage students to pay attention to the things they throw away that night. Let them know that they will have the chance to share their experiences with the class during the next session. Some things for them to observe include what kinds of things they are they throwing away and where they are when they are doing this" (page 16). An optional teacher note says, "If desired, document these locations digitally or on chart paper or sticky notes so that you can draw on students' experiences as a resource for authentic and meaningful problem solving in later lessons" (page 16).
- Lesson 1: "The anchoring problem for this unit: Humans make a lot of trash, and it is polluting the Earth" (page 18). This is a good problem but uses a much broader scale (the planet Earth) than may not be relevant to most students. This is made more concrete for students with talk moves such as "what could happen if a bird ate trash" (page 20).
- Lesson 1: "Invite students to make a personal connection to the new word by sharing an example of pollution they have experienced**.** Students should be able to explain how their example caused harm to a part of the environment" (page 23).

- Lesson 1: Connections are made to students' personal lives: "Invite students to share their observations and any questions they have related to these images … Have students draw a stick figure in their science notebook to represent themselves. Beside it, ask them to draw a bag to represent their daily trash. They should write the number five in the bag to describe the five pounds of trash they throw away. Next, have students calculate how much trash their household produces each day. They should draw a stick figure and bag for each person in their home. In each bag they should write the number five. Students should skip count to total the amount of trash their household makes each day" (page 30).
- Lesson 1: Data from students' own community are used in the lesson: "On the board, write the total number of people living in your community. Below that, write how much trash your community throws away in a single day" (page 31).
- Lesson 2: "Encourage students to share with a partner any prior knowledge or personal experiences they have with what they saw in the video. Ask, What does what you saw in the video remind you of? Have you ever seen or experienced something like this before? If so where?" (page 53). Examples are given, such as "Observing different types or colors of trash bins for certain items in public places."
- Lesson 2: "Invite students to share a personal experience related to sorting. Ask students to think of times when they sorted things by a pattern or similarity or a time when they observed things that were already grouped by a pattern. Record these ideas on the board or digitally so they can be revisited later in Part C" (page 57). Examples are given, such as "Sorting laundry by color, material, or type of clothing."
- Lesson 2: "Invite students to describe additional ways they have classified or seen something classified in their everyday lives" (page 68).
- Lesson 2: "Invite students to share any personal experiences they have with recycling" (page 77).
- Lesson 3: "To complete this session, students will need three things that they would normally throw away after lunch. This will bring relevancy to the investigation by having students analyze the trash they actually produce as a result of eating lunch" (page 96).
- Lesson 3: After students see an image, the teacher is told, "Ask students if they have ever seen or experienced something like what is shown in this image. Invite students to describe their experiences by explaining where they were and what they observed" (page 98). Examples of analogous phenomena are given.
- Lesson 3: Students are asked to "consider something from a previous lunch that they did not throw away. Provide time for students to think of an item, its purpose before and after eating, and why they did not throw it away" (page 122).
- Lesson 4: "Say, 'Yesterday after school I noticed the custodian collecting trash from around the building. As I was leaving school, I noticed a large garbage bin. Those things reminded me of this video. Invite students to share their ideas about how your experience relates to the video they watched… Have students turn to a partner and ask questions about how the things they observed in the video relate to their own experiences'" (pages 155–156).
- Lesson 6: "Use talk moves and guiding questions to help students share experience reusing objects for a new purpose. The goal of this discussion is to draw out relevant student

experiences. Facilitate the discussion by using guiding questions to help students describe objects they reuse, their original purposes, and their new purposes" (page 230).

- Lesson 7: An optional enrichment activity includes connections to the community: "4. Help students identify appropriate community members and invite them to the school (or to a virtual meeting) to hear about the problem students have been working on and the community solution they have developed. 5. If community members are interested, help students work with them to design, build, and test students' solution" (page 303).
- Lesson 7: "Prompt students to think of other problems they could solve, phenomena they could explain, or new questions they can answer using ideas and concepts from this unit" (page 305).

The teacher is guided to expect student questions that come from their experiences or culture. For example:

- Lesson 1: After students make their initial observations and ask questions, the teacher is told, "Student questions should be related to their own interests in and personal experiences with the anchoring problem" (page 14). Two of the student discussion prompts relate to this goal: "I thought __ was interesting", "This reminded me of __" (page 13). However, no question prompts relate to this goal.

Suggestions for Improvement

- Consider adding question prompts throughout the unit to elicit student questions that connect to their experiences and cultures.
- Consider adding teacher notes to look for possible sensitivity issues that might arise due to the lesson content. For example, in Lesson 1 (page 30), when students are making their personal connections drawing, a note could alert the teacher to sensitivities when students discuss personal contents of trash or listing family members. A possible alternative could be offered to students, such as drawing a friend's family.

II.B. STUDENT IDEAS

Provides opportunities for students to express, clarify, justify, interpret, and represent their ideas and respond to peer and teacher feedback orally and/or in written form as appropriate.

Rating for Criterion II.B. Student Ideas	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials provide students with opportunities to both share their ideas and thinking and respond to feedback on their ideas. Students have opportunities to negotiate their understanding by sharing their own thinking related to the ideas developed in the unit. They also communicate with their peers and offer feedback to each other to help improve their understandings.

Student thinking is elicited in the unit. For example:

- Lesson 1: "What do you think happens to the trash from all the classrooms in our school? Allow time for students to think and then to share some ideas…" (page 12).
- Lesson 1: "Discourse is an opportunity for students to participate in collaborative conversations. Support students in following the agreed-upon rules for class discussions and ask them to clarify and explain their ideas as needed" (page 17).
- Lesson 1: "As needed, help students recognize when they share something that is similar to their classmates' responses or to information that is already on the chart. This will support students' ability to build on others' talk in conversations by linking their comments to the remarks of others" (page 18).
- Lesson 1: Discussion prompts are provided to help students clarify their ideas, such as, "Can you tell me more? What do you mean when you say ___?" (page 18).
- Lesson 1: To help follow the progression of student ideas over time, supports for recording students' initial ideas are provided: "Additionally, students with limited written language skills may benefit from the opportunity to share their ideas using oral language skills. Ask an adult or peer to record the explanation so that the student can revisit their initial ideas in later lessons" (page 22).
- Lesson 2: "When sharing additional patterns, ensure that every student participates and shares their ideas either verbally or nonverbally. When a new pattern is described, use a strategy such as thumbs up/thumbs down to invite every student to communicate whether they also thought of this idea" (page 67).
- Lesson 3: "What would happen if that object had the opposite property? Would its purpose be affected? Why or why not?" (page 105).
- Lesson 3: "Invite students to share their interpretation of their data to explain why they think so many things get thrown away. Record their ideas on the board or a piece of chart paper" (page 124).
- Lesson 3: "What part of the environment is impacted by our trash? How do you know this?... Does anyone disagree with the idea presented or want to add to this idea?" (page 131).
- Lesson 5: "What evidence do you have to support how you think you could keep trash out of a landfill? What new questions do you have now that you have thought of and heard about possible solutions to the trash problem? Do you think any trash items could be reused? Why do you think so?" (page 196).
- Lesson 6: "Say, 'I wonder if there are things in the classroom that could help us test some of the ideas we have about reuse. What do you think?' Have students think about this individually, and then provide time for them to discuss their thoughts with a partner. Circulate around the room and listen as students talk with their partners" (page 229).
- Lesson 6: "Which items do you think you can reuse in your solution? What makes you think that?" (page 235).
- Lesson 7: Suggested talk moves are given to the teacher: "What do you think will happen if people make different choices about things they throw away? Follow-Up: What makes you think that? Cross-talk: Does anyone what to respond to that idea? Revoicing: What I hear you saying is _____. Is that right?" (page 306).

Students reflect on their learning. Related evidence includes:

- Lesson 2: "Prompt students to revisit their ideas about the robot's actions from Step 4. As needed, allow students the opportunity to make changes or add details to reflect any new understanding" (page 73).
- Lesson 2: "Provide time for students to review the class'[sic] initial ideas and individually reflect on how what they learned about matter and its observable properties relates to the video of the robot sorting trash. After some time to think, allow time for students to share their thoughts with a partner" (page 76).
- Lesson 3: "The Initial Ideas Class Chart will help students recall these early ideas at the end of this lesson and reflect on how their thinking has changed" (page 100).
- Lesson 6: "Ask guiding questions to help students share how their understanding of the trash problem has changed since beginning the unit" (page 258).
- Lesson 7: "Next, ask them to think about how their understanding has changed and how what they figured out helped improve their designs" (page 304).

Opportunities for peer and teacher feedback are described on page xxxii and throughout the unit:

- Lesson 1: Talk moves are given to help students build on each other's thinking, such as, "Does anyone agree or disagree with _____? Why?" (page 20).
- Lesson 2: "Use the checklist on Lesson Resource 2.1: Investigation Checklist to assess the Investigate section to determine whether each group was able to collaboratively plan and conduct an investigation …. As needed, provide feedback to help groups strengthen their ideas and investigation plan" (page 60).
- Lesson 2: "Provide time for students to reflect and record their ideas in their science notebooks. When the class is ready, have each student communicate their ideas to a partner. Each member of the pair should give and receive peer feedback by describing what they agree or disagree with or suggesting a way their partner could strengthen their ideas. Prompts like the following may be useful to students when giving feedback: I agree because ___. I disagree because__" (page 69).
- Lesson 3: "Distribute Lesson Resource 3.1: Peer Feedback to each student. Explain that they will provide peer feedback to their partner by agreeing with or disagreeing with their ideas. Students can also suggest ways that their partner could strengthen their ideas about the purpose of the object and which property best supports that purpose. Provide time for students to listen to their partner, provide feedback, and consider the feedback they receive. Encourage students to make changes to their artifact sheet after receiving peer feedback from their partner if they would like to do so" (page 104).
- Lesson 3: "Teacher Feedback: If students appear to describe the correct shape for each of their objects, say something like, 'The shape you described makes sense. How does the shape help the object's purpose?' If students struggle to tie the object's purpose to its shape, the following prompts may help generate the feedback they need to get back on track: How would you describe the shape of this object? How might that shape relate to the object's purpose?" (page 111).

- Lesson 5: "Have students explain their design solution to a partner. When it is their turn to listen, students should listen for ways their partner's design solution might not work based on how it is described and modeled. The listening partner should ask questions and provide feedback based on the information shared by the speaker. Pass out a sticky note to each student and have them write their feedback on it. Each student should attach the feedback sticky note they receive in the box in the Peer Feedback section of their artifact sheet" (Page 201). Students then apply the feedback to update their designs (page 202).
- Lesson 6: The teacher is told, "have students communicate their solution to a partner in their group. Encourage students to use the Gotta Have Checklist to make suggestions for improvement in the second step of the Improve Your Design section of their partner's artifact sheet. If students wish to make changes to their own solution on the artifact sheet, they should do so in a different color. After obtaining peer feedback, students will also ask you to provide teacher feedback. While reviewing student work, ensure that all students have had an opportunity to record or receive written feedback" (page 243).
- Lesson 6: "When groups have completed their investigation plans, they will share their plan with you. Use Lesson Resource 6.2: Solution Testing Checklist to evaluate the group's plan and provide students with the sheet as feedback. Have students make changes to their plan and resubmit as needed until all items on the checklist are met" (page 247).
- Lesson 7: "Next, have students share their community solution with their group. Encourage students to use the Gotta Have Checklist to offer feedback to their peers" … "After obtaining peer feedback, students will also ask you to provide teacher feedback. Ask students to explain their design solution with you and note if they use their artifact sheet (sketch, drawing or model) to communicate their idea. Record this observation in Step 3 of the artifact sheet. If students wish to make changes, they should do so in a different color" (page 300).

Suggestions for Improvement

N/A

II.C. BUILDING PROGRESSIONS

Identifies and builds on students' prior learning in all three dimensions, including providing the following support to teachers:

i. Explicitly identifying prior student learning expected for all three dimensions
ii. Clearly explaining how the prior learning will be built upon.

Rating for Criterion II.C. Building Progressions	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials identify and build on students' prior learning in all three dimensions because although extensive space is given in the unit to describing progressions information, most described information does not include how new understanding is built. In addition, the unit refers (and relies on) many times to understanding built in prior Grade 2 units even though this is the first unit.

Prior learning for all three dimensions is described (Unit Overview page v). The progression defines examples of prior learning, learning in this unit, and student learning in the next grade band for individual elements of the SEPs, DCIs, and CCCs. For example, prior learning for **Asking Questions** is listed as "In prior grades, students collaboratively and individually asked questions about the natural and designed worlds using multiple modalities and scaffolds such as sentence stems."

The unit includes pages labeled "Full Unit Learning Progression," but in about half the rows, these tables only show in which lessons students **use** each category of the three dimensions (rather than how skills and knowledge are learned). For example:

- The row for **Planning and Carrying Out Investigations** shows evidence of learning progression across the unit.
    - Lesson 2: "Small groups collaboratively plan and carry out an investigation with scaffolding from the teacher to collect data that is used as evidence to answer the question 'What types of things do we throw away'" (page viii).
    - Lesson 6: "Students progress in this element by collaboratively planning and carrying out an investigation without scaffolding from the teacher…." (page ix).
- The **Analyzing and Interpreting Data** rows do not show evidence of learning**.** In the examples below, only application of the SEP is described (rather than learning).
    - Lesson 3: "Students work in pairs to collaboratively collect and analyze data to determine how a change in an object's shape can affect its ability to serve its intended purpose. Partners identify patterns in their data and use this as evidence to answer scientific questions."
    - Lesson 5: "Students collaboratively make observations in pairs to provide peer feedback on design solutions that may help them solve the anchoring problem" (page ix).

Guidance about possible student prior conceptions is provided in the Unit Overview document (Unit Overview page iv) and at the beginning of each lesson. For example:

- Unit Overview Document: A "Possible Prior Conception" listed is "Trash disappears when we throw it away." An accompanying "Accurate Conception" is listed as "Matter is conserved when it changes, even in transitions in which it seems to vanish." (Note that this is a Grade 5 DCI in the NGSS.) The unit overview document page also lists "Lessons that can help unpack Conceptions," and for this example, "Lesson 4: Students figure out that trash does not disappear but instead travels to new places."
- Lesson 2: "As you facilitate this class discussion regarding observable properties, listen for students to express the misconception that color is not a property. If you hear this during the discussion, ask students to consider if color is something that they can observe (yes). Explain

that scientists consider color an observable property because we can physically see it without having to do anything to the object" (page 69). Note that this teacher explanation might lead to misconceptions that all observable properties are physical properties.

Progression of learning information is listed for each lesson. Related evidence includes:

- Notes are included to the teacher about students' prior related learning and how it is built upon in the current lesson. For example, for Lesson 1: "In prior grades, students built upon practices and ideas related to asking questions and making observations. Students used these skills to help them identify phenomena and problems in both the natural and designed worlds. Students continue to use these skills in this unit's opening lesson as they identify and engage with the anchoring problem: Humans make a lot of trash, and it is polluting the Earth" (page 3).
- A table clearly describing learning progressions for each learning goal is included (e.g., pages 4, 46, 90, 150, 188, 218, 282). However, in almost all these cases, student use (not development) of elements in each lesson is described. For example, in the Lesson 5 progression chart for **ETS1.A**, for an element claimed as being developed in the lesson and that is used for the first time in the unit, the description only says, "Students both collaboratively and individually apply their knowledge of clearly understanding a problem before designing a solution" (page 189). No description of actual development (growth, new understanding) is included in most cases.

There are some consistency errors in the progressions information provided in the unit. This is Unit 1 in Grade 2, but the materials tell the teacher to refer to prior Grade 2 units: For example:

- Lesson 1: "Refer to the term 'solution,' which was added to the Word Wall during the earlier grade 2 unit about erosion" (page 24).
- Lesson 2: "In a prior grade 2 unit about migration, small groups collaboratively planned and carried out an investigation" (page 46).
- Lesson 2: "Tie back to the science ideas related to matter that students figured out during an earlier grade 2 unit on water" (page 56). In this case, a lot of expected student understanding seems to be based on this prior unit, which doesn't seem to precede the current unit: "In a prior grade 2 unit about water, students developed the idea that matter is anything that takes up space. Everything they can see and touch is made of matter. Students also figured out that matter exists in solid and liquid forms. (Gas is a concept that is above grade level.) The words 'matter,' 'solid,' and 'liquid' should already be on the Word Wall. Formatively assess the retention of these science ideas during the discussion" (page 56). A similar issue comes up in Lesson 3: "Students should have learned about two types of matter, solids and liquids, during a prior grade 2 unit on water" (page 116).
- Lesson 6: "In a prior grade 2 unit about plant and animal structures, students communicated solutions to a human problem. From this experience, students should know that designs can be conveyed to others through sketches, drawings, or physical models" (page 238).
- Lesson 6: "Previously in grade 2, students compared multiple solutions designed to slow or prevent wind or water from changing the shape of the land. Students will build on those prior experiences comparing solutions in this lesson" (page 242).

Throughout the unit, support is provided to help build on students' prior learning. For example:

- Lesson 1: Support is given to build on students' prior understanding of problems. "To draw out prior experiences with problems, refer to the erosion unit students completed prior to this unit. Have students recall the problem they identified in that unit and the process they went through to solve it. If students have not completed the erosion unit, they should be able to draw on prior knowledge from the units about collisions or designing an accessible device" (page 21).
- Lesson 1: "Students should have prior experience describing cause-and-effect relationships from the grade 2 unit on erosion and from prior grades…. If students have not completed the erosion unit, they should be able to draw on prior experiences from kindergarten describing cause-and-effect relationships in kindergarten, or from grade 1 using simple tests to support or refute ideas about causes" (page 22).
- Lesson 3: "Students gained experience with the terms 'structure' and 'function' during the prior grade 2 unit on migration as they learned about the plant and animal structures involved in the functions of pollination and seed dispersal. If students have not experienced this unit, they should be able to apply prior knowledge from grade 1 when they investigated plant and animal structures and how they help organisms live and grow. If students do not have any prior experiences with this crosscutting concept, thoroughly explore these terms using more examples than the one provided" (page 112).
- Lesson 3: "Students should have prior experiences with this practice from kindergarten units about beavers and weather and from a grade 1 unit about objects in the sky. If students do not have any prior experience with this practice, spend some time exploring how to look over (analyze) data and use it as evidence to explain ideas" (page 117).
- Lesson 7: "In the next grade 2 unit, students will explore phenomena related to glassblowing. Broken pieces of glass are recycled to make a new object. Look for unanswered questions related to how objects can change into other objects, and plan to ask students if they should be added to the list of questions they want to answer when they begin the next unit" (page 307).

Suggestions for Improvement

When supports are provided for helping teachers understand progressions for specific SEPs or CCCs, consider specifying parts of the intended element. For example, in Lesson 3, page 117, the supports focus on generating evidence, which isn't a focus of any of the K–2 elements.

II.D. SCIENTIFIC ACCURACY

Uses scientifically accurate and grade-appropriate scientific information, phenomena, and representations to support students' three-dimensional learning.

Rating for Criterion II.D. Scientific Accuracy	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials use scientifically accurate and grade-appropriate scientific information because the science ideas and representations are generally accurate. In some cases, some wording choices could lead to additional misconceptions that are not addressed in the teacher supports or in the subsequent learning.

Related evidence includes:

- Lesson 2: "Explain that scientists consider color an observable property because we can physically see it without having to do anything to the object" (page 69). This teacher explanation might lead to misconceptions that all observable properties are physical properties.
- Lesson 3: Several places in the lesson refer explicitly to function and purpose as being interchangeable words (e.g., pages 112, 115, 117, 119, 120), and is even in the lesson-level PE (page 125), one of the headers of Student Artifacts 3.1 and 3.2, and the teacher answer key to Student Artifact 3.2 (page146). This could lead to student misconceptions. For example, students could begin to assume that apples have a purpose, or that manmade objects that can function in multiple ways must have been designed on purpose to function in all those ways.
- Lesson 3: A teacher note explicitly links natural objects and the idea of "purpose." "Students may describe the apple's original purpose with a statement similar to the following: 'An apple provides food/energy when it is eaten'" (page 118). This could lead students to think this is *why* apples exist, rather than as a randomly occurring trait that provided reproductive advantages to the plant and therefore was passed on, and that later, humans found a function for the apples. This same issue is repeated:
    - Lesson 3: Teacher guidance supporting CCC use of Structure and Function says: "Have students describe the function (purpose) of each part [of a banana]. (The stem holds the banana to the plant, the peel protects the soft banana flesh inside, and the inside banana is food.)" (page 127).
    - Lesson 3: Teacher guidance supporting enrichment after assessment says: "Have students draw a picture of their animal, label these structures on the picture, and describe how the purpose (function) of each structure helps the animal live (e.g., fur to keep warm, eyes to see food and danger, horn for protection, etc.)" (page 128).

Suggestions for Improvement

Consider revising materials where the activities, representation, or supports may lead to additional misconceptions. In these cases, consider adding in strategies, activities, or ways to elicit student ideas to ensure that students are developing an accurate understanding of the concepts in all three dimensions.

II.E. DIFFERENTIATED INSTRUCTION

Provides guidance for teachers to support differentiated instruction by including:

i. Supportive ways to access instruction, including appropriate linguistic, visual, and kinesthetic engagement opportunities that are essential for effective science and engineering learning and particularly beneficial for multilingual learners and students with disabilities.

ii. Extra support (e.g., phenomena, representations, tasks) for students who are struggling to meet the targeted expectations.

iii. Extensions for students with high interest or who have already met the performance expectations to develop deeper understanding of the practices, disciplinary core ideas, and crosscutting concepts.

Rating for Criterion II.E. Differentiated Instruction	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials provide guidance for teachers to support differentiated instruction because the materials provide multiple and varied learning strategies to support students throughout the unit. There is support for different student groups and the support is specific to the guidance at that point in the lessons. In addition, there is support for multiple modalities for both the ways students work and for the artifacts they produce.

Supports are provided for students to access instruction, including for students with disabilities. Related evidence includes:

- In the beginning of each lesson, “earned words” are described, including guidance for when to add the new vocabulary to the word wall based on students’ increasing understanding. These words are added after students describe the concept in their own words (e.g., “environment” on page 19).
- Lesson 1: Sentence starters are provided to help students ask questions (page 19).
- Lesson 2: “When conversing with each group, use the terms students use to describe their investigation, such as ‘bendy’ or ‘smooth’ rather than ‘flexibility’ or ‘texture’” (page 60).
- Lesson 2: During class communication, the teacher is told, “Allow students to express their ideas in the modality (or combination of modalities) that best meets their needs: writing, drawing, oral communication, etc.” (page 69).
- Lesson 2: “Accessibility to the poster allows students to use sight and touch to remind them of the many properties they have identified. Creating a tactile class chart ensures that all students, particularly English learners and individuals with visual impairments, can benefit” (page 71).
- In the “Enrichment After Assessment” Section in several lessons, the teacher is told at the top of the page that “the strategies are for students with a full understanding, or a high interest in the content, by extending their understanding of targeted dimensions” (page 110). In the following

paragraph, however, the teacher is also told, "This strategy supports gifted and talented students, economically disadvantaged students, and students with special needs." It is likely that teachers looking for strategies for students with disabilities will skip past this page due to its initial framing.

- Lesson 3: "For students who need more support, allow them to find pictures of their items to glue into their science notebooks" [rather than write about the items] (page 111).
- Lesson 4: Supports are provided for students who have different levels of reading ability. "Depending on your students' reading ability, you could have them read aloud in small groups instead of as a whole class so that you can monitor and assist with annotation and comprehension. You may also use the digital version of the literacy resource, which includes read-aloud and notation features" (page 159).
- Lesson 4: "Allow students to work in small groups or pairs to complete the artifact sheet. Allow students to answer the questions and communicate their ideas using multiple modalities, such as taking and uploading pictures, making a video, or recording oral responses. Consider allowing students who struggle with writing to use technology to voice-record their answers. Alternatively, these students could share their questions orally with a peer, who can then record the student's questions ideas exactly as they stated them" (page 163).
- Lesson 5: "Allow students with fine motor challenges to verbalize or act out their ideas while another student draws or sketches for them. It may also be helpful to set a timer, as some students work better with a visual or verbal cue for time" (page 198).
- Lesson 5: "See It and Say It (Pictures and Patterns). Provide extra support for students who struggle to demonstrate understanding using written language…1. Find and share pictures of trash items in various locations (e.g., a cup in a trash can, a cup in trash truck, a cup at the beach, etc.). 2. Show the picture and say, 'I see a ___.' 3. Repeat the statement and ask students to repeat after you" (page 204).

Supports are provided for students who struggle with each of the three dimensions, including after each assessment (e.g., pages 27–28). Scoring guidance is provided for each assessment to help teachers identify students who struggle.

- Lesson 2: "As needed, differentiate for students who need additional support understanding patterns and sorting by having them experience hands-on or digital resources first. This may include colored and shaped blocks, cards with different pictures, or a simulation that allows students to sort based on patterns they observe" …. "There is not one 'correct' way to sort, but many. If a student or group struggles to identify patterns, work with these students in small groups to look for similarities between the trash items, such as color, and to sort the items by that similarity. Explain that this is a pattern that they can observe and that can be used to sort the trash items. Prompt students to look for another similarity or pattern based on how the item looks, feels, or behaves" (pages 57–58).
- Lesson 2: "Gather together any students who struggled to plan and carry out an investigation with their group…As needed, review the skills and behaviors needed to collaborate, such as listening, waiting one's turn to talk, and providing constructive feedback…Select one pattern to test (e.g., shiny or not shiny). Have students use the collaboration skills you just reviewed to

work together to design a simple test for this pattern…Once they have reached consensus on a plan, prompt students to work together to follow their agreed-upon plan to collect data and sort the objects into groups…As time permits, prompt students to complete the process for another pattern without any scaffolds from you" (page 63). Note that this guidance focuses on supporting collaboration skills. Specific scaffolds are not provided for planning and carrying out investigations.

- Lesson 2: "Gather together any students who struggled to describe and classify items based on observable properties…. Provide new objects from the classroom for students to observe and test (e.g., book, pen, pipe cleaner) … Draw attention to the Patterns We Identified Class Chart. Ask students to choose an object and use words from the chart to describe how the object looks, feels, or behaves…" (page 64).
- Lesson 3: "Students may need help to complete this section of the artifact sheet. Consider projecting the Analyze Data section of the sheet or copying it onto the board. Use the following steps to support the class or individual students in data analysis…" (page 102).
- Lesson 3: "Prepare a filled-in version of the table from the Collect Data section of Student Artifact 3.1 that provide students with information about the observable properties of several objects. Gather a physical example of each object you choose to list 2. Present one of the objects from the table and have students describe the purpose of the object" (page 108).
- Lesson 3: The teacher notes provide guidance that is meant to help students struggling with the element *Simple tests can be designed to gather evidence to support or refute student ideas about causes* (page 109). However, the guidance only relates to the DCI element*, Different properties are suited to different purposes,* and the CCC element*, Events have causes that generate observable patterns* (which is not claimed in the lesson). No guidance is provided related to understanding that simple tests can be designed to gather evidence.
- Lesson 3: "Provide extra support for students who struggle with collecting and analyzing data…. Work together to describe the shape of the item and its intended purpose, or how it is useful to humans… Have students open the food item. Ask students if the package can do its same job, or function, now that it has been changed. (Students should realize that by opening the package, it can no longer hold or protect the food.)" (page 126).
- Lesson 6: "If groups struggle to describe the anchoring problem, provide support by sharing ideas as a class. On the board or on chart paper, draw a larger version of the graphic organizer from Lesson Resource 6.1. Discuss the questions printed in the organizer and work as a class to reach consensus on an answer to each. Record these consensus responses on the chart so that groups can copy them onto their lesson resource sheets" (page 233).
- Lesson 6: "While students are working on their physical models, ask questions to provide another opportunity to describe relationships between the structure and function using a non-written means of communication (oral, or kinesthetic). Possible questions include: What are some items you chose to use in your solution? What is the function of that item? How does it work?" (page 241).
- Lesson 6: "Provide extra support for students who struggle collaboratively to plan an investigation with their group and produce data that can be used to answer questions… 1. Review the Questions We Have Class Chart and use guiding questions to help students identify a

question that can be answered by investigation. 2. Have students write the question down and work as a group to plan an investigation that can produce evidence to answer it. Support students in determining what evidence they need to answer the selected question and how they could go about collecting it...” (page 251).

- Lesson 7: Supports are provided for understanding an ETS DCI: “Look through students’ completed copies of Student Artifacts 6.1 or 7.2 for a solution that requires the drawing to fully and effectively communicate the solution idea. Make copies of that drawing. 2. Make an audio recording of the artifact’s author describing their solution. 3. Play the audio recording for students and have them draw what they believe the design looks like. 4. Distribute the copies of the drawing and have students compare what they drew with the original designs. Discuss the differences between the drawings and highlight important features that were not communicated using only oral language” (page 303).

Extensions are provided for students “with a full understanding, or a high interest in the content, by extending their understanding of targeted dimensions” (page 28). For example:

- Lesson 1: “1. Have students work in small groups to consider other ways that humans harm the environment…. 3. Prompt students to choose two harmful events (effects) that interest them the most and describe the cause of their events in their science notebooks or on a graphic organizer similar to that on Student Artifact 1.1” (page 28).
- Lesson 2: “Provide extra support for students with high interest in this topic to help them develop deeper understanding of the three dimensions… 1. Show students the recycling symbol on an object and explain that this symbol means that the object can be recycled. Explain that some items without this symbol can also be recycled. 2. Have students research what types of things can be recycled. 3. Next, have students dig deeper into recycling by analyzing the sample trash items from the investigation and the items on the Classroom Trash Model to determine which items can be recycled and which need to be thrown away. Remind students to document their findings. 4. Ask students to identify the main pattern by which they can determine if something is recyclable (e.g., the type of material it is made of)” (page 65).
- Lesson 3: “Have students select a sport or type of art (painting, sculpture, drawing) that interests them. 2. Have students identify the basic equipment they need to participate in the activity…. 4. Encourage students to test the items or use prior experiences to describe the observable properties for each piece of equipment…” (page 110).
- Lesson 5: “Have students select a company that has ‘gone to zero waste.’ 2. Have students research what this means and if zero really means zero. They should also find out what steps the company took to get to zero waste and how long it took them to do so….” (page 205). This strategy supports extra practice in the lesson’s claimed SEP element, which isn’t otherwise used in the lesson.
- Lesson 6: “While students are working on their physical models, have them consider items that are not available in the classroom. Ask questions to help students provide details about what items they would want to use, and how the shape and properties of items help them function as needed in the design solution. Possible questions include: …. What properties of ______ seem important? Why?” (page 241). This activity provides extra practice with a target DCI and CCC.

- Lesson 6: "Students may anticipate that testing could help them improve their designs. Although this expectation goes beyond expectations in this grade, it may be appropriate for students who demonstrate full understanding on formative assessments or a have high interest in engineering" (page 242).

Suggestions for Improvement

- There are some repetitive sections of the unit that could be used as support for students who need it rather than for all students, with a much briefer review for all students. For example, in the next class after students complete an assessment describing what happens to trash after it is thrown away, the teacher is told, "Review: Invite students to recall the lesson question, 'Where does our trash go once it is thrown away?' Allow students a few minutes to reflect on this question and then record an answer to it in their science notebooks. Class Discussion: Facilitate a class discussion for students to share their answers to the lesson question with the class. Encourage students to use science ideas developed in this lesson to help explain their thinking" (page 171).
- In the Options for Supporting All Learners, consider adding additional guidance for teachers to ensure that they are clear about which students the strategies support. Although there is some guidance that is specific for multilingual learners or students with disabilities, being explicit about the strategies, who they might support, and why they are effective strategies for those groups of students could help teachers as they are making decisions about differentiation and additional learning.

II.F. TEACHER SUPPORT FOR UNIT COHERENCE

Supports teachers in facilitating coherent student learning experiences over time by:

i. Providing strategies for linking student engagement across lessons (e.g. cultivating new student questions at the end of a lesson in a way that leads to future lessons, helping students connect related problems and phenomena across lessons, etc.).

ii. Providing strategies for ensuring student sense-making and/or problem-solving is linked to learning in all three dimensions.

Rating for Criterion II.F. Teacher Support for Unit Coherence	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials support teachers in facilitating coherent student learning experiences over time. The materials have support for teachers to understand the pathway the unit takes to support student understanding, to guide students to make connections between lessons and between the work they do and science ideas, and to help students capture their questions and use those to drive the learning to logical next steps.

Supports are provided to the teacher to understand the storyline of the unit. For example:

- A table in the Unit Overview document lists a "road map" for the teacher, including each lesson's question, problem or phenomenon, and "what students figure out that helps explain the anchoring problem and answer the lesson question" (page xxi).
- A "Unit Coherence" table is provided, describing what students do and figure out in each lesson (page xxii).
- A Lesson Overview Chart is provided, including pacing guides and lesson-level PEs (pages xxiv–xxix).

Supports are provided for linking student understanding and learning explicitly across lessons, including how their learning relates to sense-making and problem solving. Related evidence includes:

- Lesson 2: Suggested sentence starters are provided for students to help link their learning to sense-making. For example: "During the classification tests, I collected evidence on _____. My evidence helped me figure out that our trash ______" (page 74).
- Lesson 2: "Facilitate a class discussion to further sensemaking by reviewing the infographic as a class and discussing how it relates to both the classification investigation and what students saw in the Trash Robot video" (page 77).
- Lesson 4: Students' reading (SEP) work is explicitly connected to their sense-making work: "Before beginning to read aloud, establish a purpose for reading. Remind students that scientists and engineers use many different types of resources to gather information to help answer questions and solve problems" (page 158).
- Lesson 7: "Students should circle the practices that were helpful parts of their research. Students should also use words or drawings to describe how they used the practices and what they learned about the problem" (page 294).
- Lesson 7: "Help students recognize the many science and engineering practices they used during this unit, and the crosscutting concepts they used as lenses for sensemaking and problem solving" (page 304).

Suggestions for Improvement

N/A

II.G. SCAFFOLDED DIFFERENTIATION OVER TIME

Provides supports to help students engage in the practices as needed and gradually adjusts supports over time so that students are increasingly responsible for making sense of phenomena and/or designing solutions to problems.

Rating for Criterion II.G. Scaffolded Differentiation Over Time	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials support teachers in helping students engage in the practices as needed and gradually adjust supports over time because some SEP elements are used more than once in the unit with some change in scaffolding over time, although this only happens for a small percentage of the claimed SEP elements.

Student learning and proficiency progressions are supported for parts of the following SEPs as described below.

Asking Questions:

- In Lesson 1, Part A, Steps 2 and 3: "Invite students to share their observations about the classroom trash and any questions they may have at this time with a partner. As pairs discuss, move around the room and listen to their observations and questions" … "Allow time for students to share their initial observations, ideas, and questions about their trash in a class discussion. Give students sticky notes on which they can record their observations and questions. As students share these in a discussion, place the sticky notes on the What We Noticed Class Chart and their questions on the Questions We Have Class Chart you prepared" (pages 13–14).
- In Lesson 1, Part B, Step 5: "Provide time for students to discuss their questions about the video with a partner and then with the class. Use sticky notes to record new student questions on the Questions We Have Class Chart from Part A" (page 19).
- Lesson 1, Part D, Step 7: "Direct students' attention to the Questions We Have Class Chart. Remind students that they have already asked some questions about what they. Have observed. Provide time for students to generate new questions and add them to the chart" (page 33).
- The class regularly returns to the class chart to summarize the current lesson, move to the next lesson, introduce a new lesson, or identify what they have learned (for example, pages 36, 51, 80).
- While students refer to their questions often throughout the unit, the way they use questions remains similar as they move from lesson to lesson. For example, students continue to have sentence starters for their questions in the unit in Lesson 4 (page 156).

Planning and Carrying Out Investigations:

- Lesson 2, Part A, Step 7: "Leverage students' ideas about how they could learn more about the things they throw away by inviting students to share their them [sic] with the class. Honor each idea by recording it on the Investigation Ideas Class Chart" (page 55). In the teacher guidance with this step, the teacher is told to accept all reasonable answers at this point.
- Lesson 2, Part B, Step 6: "Next, prompt each group to choose on pattern from their Brainstorm section and use it to complete the Investigate section" (page 59). In the teacher guidance with

this step: "Students will progress in the practice of Planning and Carrying Out Investigations during this unit and more robustly in the next unit about glassblowing."

- Lesson 6, Part C, Step 4 student and teacher guidance: "Say, 'It sounds like you think testing designs is an important part of engineering. You have a lot of experience planning and carrying out investigations, so I think you will have some good ideas about this'" (page 247). In the right column for the step, "In this lesson, students progress to planning and carrying out investigations with peers and minimal teacher feedback as they answer questions …" It is not clear how students would develop the skills needed to progress to this level.
- Lesson 7: The teacher is told, "Throughout the unit, students have collaboratively planned and carried out investigations to produce data and gather evidence to answer questions. Students can build on these experiences and progress to obtaining information independently using various texts, text features, or media to answer questions" (page 307). This support describes two different practices (**Planning and Carrying Out Investigations** and **Obtaining, Evaluating, and Communicating Information**). Student experiences in one does not necessarily develop proficiency in the other.

Analyzing and Interpreting Data:

- Lesson 3, Part D, Step 3 teacher guidance: "Although students individually record data for only three items, they actively discuss and analyze data for six items because they will work with a partner. During their analysis, students determine if and how the structure (shape) of each lunch item/package is changed after the food or drink is consumed and how this affects the intended purpose of the item" (page 117).
- Lesson 3, Part D, Step 7: "After students have completed both their data tables for all three of their items, have them complete the Analyze Data and Make a Claim sections of their artifact sheet with their partner" (page 121).
- Lesson 3, Part D, Step 7 teacher guidance: "Analyzing data for six items will help students better identify patterns associated with structure and function. This will also provide additional evidence to help them make a claim about why so many things get thrown away."
- Lesson 6, Part C, Step 7: "Every student in the group should make observations or measurements to record data according to their plan in the Test section of Student Artifact 6.2. When testing is complete, groups should discuss if each solution worked as intended. As groups work, circulate and ask guiding questions to help students begin to interpret the data they collect."
- Lesson 6, part D, Step 3 teacher guidance: "Ask guiding questions to help students use information from all their completed artifacts to think about how each solution compares to other solutions and what it means for the trash problem."
- There is specific guidance for the teacher on how the different steps can contribute to student learning. However, the teacher continues to ask guiding questions to help students carry out the practice throughout the unit.

Obtaining, Evaluating, and Communicating Information:

- Lesson 2, Part C, Step 4 teacher guidance: “Students should begin to use the data they collected to help them communicate information about scientific ideas related to observable properties. … Though the practice of Obtaining, Evaluating, and Communicating Information is not being assessed at this time, it will be assessed later in this unit” (page 69).
- Lesson 2, Part C, Step 9 teacher guidance: “Look for students to communicate ideas related to the robot testing the trash item’s observable properties to help it determine if it should select the trash item or not” (page 73).
- Lesson 4, Part B, Step 3 teacher guidance: “Using the key information they identified in the article, ask students to share which categories trash items can be divided into” (page 160).
- Lesson 7, Part B, Step 6: “Ask students to explain their design solution with you and note if they use their artifact sheet (sketch, drawing or model) to communicate their idea” (page 300).

Supports are provided for scaffolding students’ use of SEPs if they are struggling. For example:

- Lesson 2: “If a group struggles to plan a test, prompt them to select one pattern from their brainstorm (e.g., rough or smooth) and think about ways they could figure out if an item in their bag fits that pattern (e.g., rubbing the item between their fingers to see if it is rough or smooth). Provide feedback on their selected pattern and proposed test such as, ‘I think that is a great test to use when sorting by this pattern’ or, ‘Is there something else you could do to see if an object is rough?’ Once the group has expressed an idea that will work, leave them to do their testing and data collection” (page 59).
- Lesson 2: “Gather together any students who struggled to plan and carry out an investigation with their group…As needed, review the skills and behaviors needed to collaborate, such as listening, waiting one’s turn to talk, and providing constructive feedback…Select one pattern to test (e.g., shiny or not shiny). Have students use the collaboration skills you just reviewed to work together to design a simple test for this pattern…Once they have reached consensus on a plan, prompt students to work together to follow their agreed-upon plan to collect data and sort the objects into groups…As time permits, prompt students to complete the process for another pattern without any scaffolds from you” (page 63). Note that this guidance focuses on supporting collaboration skills. Specific scaffolds are not provided for **Planning and Carrying out Investigations**. In Lesson 6: A teacher note says, “In this lesson, students progress to planning and carrying out investigations with peers and minimal teacher feedback, [although the ‘Plan’ section of the Student Artifact sheet provides guiding questions] as they answer questions like, ‘How can we test our ideas about reuse?’” (page 247).

Suggestions for Improvement

- Consider how to support students in developing their understanding of the practices more explicitly so they are better able to move toward independence.
- Consider providing additional guidance for teachers on how to support other groups of students, such as learners with disabilities or emerging multilingual students, as they develop their proficiency with the practices.

OVERALL CATEGORY II SCORE: 3 (0, 1, 2, 3)	
Unit Scoring Guide – Category II	
Criteria A-G	
3	At least adequate evidence for all criteria in the category; extensive evidence for at least two criteria
2	Some evidence for all criteria in the category and adequate evidence for at least five criteria, including A
1	Adequate evidence for at least three criteria in the category
0	Adequate evidence for no more than two criteria in the category

CATEGORY III

MONITORING NGSS STUDENT PROGRESS

III.A. MONITORING 3D STUDENT PERFORMANCES

Elicits direct, observable evidence of three-dimensional learning; students are using practices with core ideas and crosscutting concepts to make sense of phenomena and/or to design solutions.

Rating for Criterion III.A. Monitoring 3D Student Performances	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials elicit direct, observable evidence of students using practices with DCIs and CCCs to make sense of phenomena and design solutions.

Student artifacts are collected throughout the unit, and extensive guidance is given to the teacher to understand the learning students should show in each one (e.g., pages 26, 62, 107).

Almost all the 10 Student Artifacts provide opportunities for students to use grade-appropriate elements from all three dimensions together to make sense of phenomena and solve problems. For example, Student Artifact 6.1 asks students to Communicate design ideas and provide details about how the shape and properties of items help them function as needed for a new purpose. This performance uses the following elements:

- **Obtaining, Evaluating, and Communicating Information.** *Communicate information or design ideas and/or solutions with others in oral and written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.*
- **PS1.A: Structure and Properties of Matter.** *Different properties are suited to different purposes.*
- **Structure and Function.** *The shape and stability of structures of natural and designed objects is related to their function.*

Student Artifact 6.3 is listed as a summative assessment. In this assessment, students collect and analyze data to help them design solutions that reuse the trash items from their classrooms. This task uses the following elements.

- **Analyzing and Interpreting Data.** *Analyze data from tests of an object or tool to determine if it works as intended.*
- **ESS3.C: Human Impacts on Earth Systems.** *Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.*
- **Cause and Effect.** Note that the task claims the following element but there isn't strong evidence that students use this CCC at the K–2 level: *Events have causes that generate observable patterns.*

Almost all the targeted learning is elicited in the student tasks. See evidence in Criterion I.B.

Suggestions for Improvement

Consider ensuring a close match between claims and evidence related to student use of **Cause and Effect** elements in student tasks.

III.B. FORMATIVE

Embeds formative assessment processes throughout that evaluate student learning to inform instruction.

Rating for Criterion III.B. Formative	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials embed formative assessment processes throughout that evaluate student learning and inform instruction. There are opportunities for formative assessments throughout the materials that are clearly indicated for teachers and supports are provided for how the teacher can provide feedback and modify instruction based on these assessments.

Related evidence includes:

- "Remediation After Assessment" guidance is provided to the teacher related to all three dimensions (e.g., pages 27–28).
- Lesson 2: "Use the checklist on Lesson Resource 2.1 to determine if the group met the assessment requirements for this practice. Scaffold groups that struggle to complete the task. Refer to Step 6 for guidance on supporting these groups" (page 60).
- Lesson 2: Formative assessment related to DCIs is mentioned. "Continue to use the science ideas that students communicate related to the robot and observable properties to identify misconceptions and gaps in understanding and to guide future instruction" (page 73).
- Lesson 3: A formative assessment opportunity related to DCIs is mentioned. "Students are provided the opportunity to individually demonstrate the science ideas they developed in the previous lesson as well as their current understanding of the relationships between objects and their properties. Reviewing observable properties will aid students as they progress in this lesson toward developing an understanding of an object's intended purpose. Have students refer to the tactile Observable Properties Class Chart from Lesson 2 as needed. This formative assessment opportunity enables you to determine if each student has grasped the science ideas related to observable properties. As needed, provide remediation activities to strengthen students' understanding" (page 101).
- Lesson 5: The teacher is directed to assess and guide student understanding individually: "As students are drafting, move around the room and talk with each student. Use guiding questions

to draw out ideas related to properties of the different parts of their design solutions." Suggestions for guiding questions are offered in the right column (page 199).

- Lesson 6: "Circulate among groups and listen for students to use observable properties to determine if an item is suited to their solution. Ask questions that help students identify relationships that can guide their design decisions…. As needed, direct a group's attention to the Observable Properties Class Chart. Encourage students to repeat the simple tests they performed in previous lessons" (page 234).
- Lesson 6: "Circulate as students work. As you do, ask each student questions about their design and support them in adding details to fully demonstrate their understanding of structure and function" (page 238).
- Lesson 6: "After students respond using oral language, help them determine if their design fully communicates their science and design ideas on paper. If it does not, suggest ways they could improve their written communication" (page 238).
- Lesson 6: "Circulate around the room to ask each pair questions and support them in the building the physical model of their solution" (page 244). Suggested guiding questions are given to the teacher.
- Lesson 6: "As groups work, circulate and ask guiding questions to help students begin to interpret the data they collect." Suggested Guiding Questions are listed in the right column to give teachers suggestions for supporting students (page 249).
- Lesson 7: "Circulate as students are working. Use talk moves and the Gotta Have Checklist to help students fully communicate their design idea using both words and drawings… It may be difficult for students to fully demonstrate both of these [targeted DCI] ideas on the student artifact. As you circulate, ask each student questions and watch for them to use their representations to help them communicate their answers to you. Within teacher feedback, record if the student demonstrated full, partial, or limited understanding of the target disciplinary core idea related to communicating design solutions" (page 299).

Suggestions for Improvement

Guidance on formative assessment is most useful when it includes the prompts to elicit the artifact, specific descriptions of the artifacts, possible student responses/work examples, and how to respond to student understanding. Consider if there are ways to generate a complete set of guidance for formative assessments.

III.C. SCORING GUIDANCE

Includes aligned rubrics and scoring guidelines that provide guidance for interpreting student performance along the three dimensions to support teachers in (a) planning instruction and (b) providing ongoing feedback to students.

Rating for Criterion III.C. Scoring Guidance	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials include an aligned rubric and scoring guidelines that help the educator interpret student performance. Although rubrics are provided for all student artifacts, including one in every lesson, many of the scoring guidance details are misleading or don't fully represent the assessment targets they claim to represent.

Related evidence includes:

- Scoring guidance is provided with assessment targets specified and different levels of student understanding described for all three dimensions on pages 25, 62, 107, 125, 167, 239, 250, 260, 295, and 301. The levels of understanding are divided by full, partial, and limited understanding and have specific elements that are described at each level.
- Lesson 3: One of the SEP scoring targets is, *Analyze data from tests of an object or tool to determine if it works as intended.* However, the scoring guidance for this element doesn't fully use the element. The "Full understanding" scoring description says, "Student accurately analyzes data from tests for three everyday objects to help them determine which observable property most aids in each object's purpose" (page 107). There is no mention of objects working as intended.
- Lesson 3: One of the CCC scoring targets is, *Simple tests can be designed to gather evidence to support or refute student ideas about causes.* However, the scoring guidance for this element doesn't use the CCC knowledge — only SEP-like performance. The "Full understanding" scoring description says, "Student uses simple tests to gather evidence to support their ideas about how certain properties can cause an object to be better suited for its intended purpose" (page 107).
- Lesson 3: Scoring guidance for the SEP in Student Artifact 3.2 goes beyond the targeted SEP element. The targeted element is from the **Analyzing and Interpreting Data** SEP category, but the "Full Understanding" scoring guidance says, "Student uses firsthand observations to accurately describe the relationship between shape and intended purpose to develop an explanation for why some items are thrown away but others are not" (page 125). The artifact description also says that students will "Make a claim that uses evidence from their investigation to describe how changes in structure and function relate to throwing things away." These performances describe use of the **Constructing Explanations** SEP category.
- Lesson 6: Students are engaged in developing a scoring checklist. "Have the class collaboratively develop a list of everything they think is important about trying to reuse objects that are thrown

away at school. Record their ideas on the Gotta Have Checklist. When the class agrees that the list is complete, ask groups to copy the class list of Gotta Haves into the Desired Features section of Lesson Resource 6.1" (page 233).

- Lesson 6: Student Artifact 6.2 scoring guidance for the CCC doesn't fully describe the targeted CCC element: ***Simple tests can be designed to gather evidence to support or refute students' ideas about causes.*** The "Full Understanding" description says, "Student collaboratively designs a simple test and gathers evidence to support ideas about item properties suited for reuse" (page 250). However, the CCC requires understanding the concept — not just performing the test.
- Lesson 6: The teacher is told, "Look for students who use their sketches, drawings, or physical models to share what they designed. These students demonstrate understanding that these representations are useful in communicating ideas for a problem's solutions to other people" (page 256). This is inaccurate guidance, since just because students use drawings doesn't mean that students understand that drawings are useful for communicating solutions to other people.
- Lesson 7: "Have the class collaboratively develop a checklist on the Gotta Have Class Chart. This list should include everything students think is important about designing a community-based solution to the trash problem" (page 293).
- In each lesson, teachers are reminded to use formative assessment to inform future instruction and to support students in meeting the targeted expectations. Differentiation, remediation, and enrichment strategies that are specific to the assessment opportunity are offered in each lesson. There are also teacher versions of the student artifacts which offer examples of student responses to the questions and tasks. In some instances, there may be other student responses that are common but are not listed.

Suggestions for Improvement

- Consider including example student work, such as for student designs in Lessons 1 and 5.

III.D. UNBIASED TASK/ITEMS

Assesses student proficiency using methods, vocabulary, representations, and examples that are accessible and unbiased for all students.

Rating for Criterion III.D. Unbiased Task/Items	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials assess student proficiency using accessible and unbiased methods, vocabulary, representations, and examples. Vocabulary, representations, and scenarios are unbiased and grade appropriate, students are supported to express their ideas in multiple modalities, and students frequently have choices of the modality they use.

Related evidence includes:

- Tasks involve multiple modalities to present information in meaningful ways. For example, students engage with creating representations (Trash Model), using an infographic (Literacy Resource 2.1), reading information (Literacy Article 4.1), and watching videos (Trash in the Environment and others).
- The Student Artifacts assessment guidance in each lesson provides guidance related to using multiple modalities and gives students choices of which modality to use: "Provide opportunities for students to demonstrate understanding using drawings, gestures, or oral language. If students respond using oral communication, use the Scoring Guidance in the table above to assess their understanding of the three dimensions" (e.g., pages 27 and 63). Note that this language might lead teachers to not use the Scoring Guidance if students respond via writing, drawing, or gestures.
- Lesson 4: In Student Artifact 4.1, one of the student prompts says, "In the space below, write or draw to explain what causes trash to go to a certain place once it is thrown away" (page 177). The expected response is that "Student describes where trash goes (effect) when it is thrown away and why (cause) it would be burned, buried, or recycled" (page 167). However, this described cause in the scoring guidance is not a full listing of causes, so this prompt may be confusing for students who may think of other parts of the causal chain of events.

Suggestions for Improvement

In the Student Artifact 4.1 remediation section, there is guidance for supporting students to communicate in multiple modalities. This guidance is very detailed and could be used in place of the "differentiation during assessment" on the same page (page 168) rather than only after assessment as remediation. Similar support described on pages 204 (Student Artifact 5.1) and 240 (Student Artifact 6.1) could also be moved to be support during assessment.

III.E. COHERENT ASSESSMENT SYSTEM

Includes pre-, formative, summative, and self-assessment measures that assess three-dimensional learning.

Rating for Criterion III.E. Coherent Assessment System	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials include pre-, formative, summative, and self-assessment measures that assess three-dimensional learning, although summative assessments are not present in the materials.

Assessment guidance is provided for teachers, including describing where and how each element of all three dimensions is assessed and what student artifacts will be seen (pages xxxii–xxxvii). Note that many of the descriptions of student artifacts describe student prompts rather than resulting artifacts. For example, "On Student Artifact 3.1, students analyze data from tests for three everyday objects to help them determine which observable property most aids in each object's purpose" (page xxxiii).

Self-Assessment:

- Opportunities for student self-assessment are listed on page xxxii.
- Lesson 2: "Ask students to self-assess their ideas by reflecting on their current feelings about their work. Ask them to draw a smiley face, neutral face, or sad face next to their work in their science notebook" (page 73).
- Lesson 5: Students are asked to do a self-reflection, answering the following questions about their designs: "What is the solution? How does your solution help solve the trash problem? Why do we care about your solution? How does your design solution help others?" (page 206).
- Lesson 6: "Focus students' attention on the Gotta Have Checklist created during Part A. Explain that students can evaluate and compare designs using the important Gotta Have features. Have students self-assess their work by responding individually to the first question in Step 1 of the Improve Your Design section of Student Artifact 6.1" (page 243).
- Lesson 7: "When students are finished, have them use the Gotta Have Checklist to self-assess their work by responding individually to Step 1 of the Improve Your Design section of the artifact sheet" (page 300).

Pre-Assessment:

- Lesson 1: "Pre-assess each student's ability to make observations from media and communicate their ideas" (page 21).
- Lesson: "Students should have prior experience describing cause-and-effect relationships from the grade 2 unit on erosion and from prior grades. This artifact provides an opportunity to pre-

assess students' ability to use the lens of Cause and Effect to describe problems (causes) and possible results (effects)" (page 22).

- Lesson 3: "Recording initial ideas about why we throw things away and possible ways to investigate these ideas provides the opportunity to pre-assess your students' current thinking" (page 100). However, assessment guidance is not provided to help teachers interpret results from a pre-assessment.
- Lesson 3: "The following prompts may help draw out students' prior knowledge and experiences with structure and function and enable you to pre-assess students' current understanding of this concept: 'Structure' and 'function' are words we are already familiar with. Who can remind us when we used these terms this year? What were we learning about? How did we use the words 'structure' and 'function' in that unit?" (page 112). Note that the listed prompts appear to be class discussions, and as such would be less useful as pre-assessments of individual students' understanding.

Formative assessment evidence is described under Criterion III.B.

Suggestions for Improvement

Guidance on formative assessment is most useful when it includes the prompts to elicit the artifact, specific descriptions of the artifacts, possible student responses/work examples, and how to respond to student understanding. Consider if there are ways to generate a complete set of guidance for formative assessments.

III.F. OPPORTUNITY TO LEARN

Provides multiple opportunities for students to demonstrate performance of practices connected with their understanding of disciplinary core ideas and crosscutting concepts and receive feedback.

Rating for Criterion III.F. Opportunity to Learn	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials provide multiple opportunities for students to demonstrate performance of practices connected with their understanding of DCIs and CCCs because students have many iterative opportunities to receive and apply feedback on their performance related to key learning targets, including most of the DCI targets, one of the CCC targets, and two of the SEP targets.

Opportunities for both written and oral peer and teacher feedback are described on page xxxii and are present in many lessons (see Criterion II.B for details), giving students multiple iterative opportunities to receive and apply feedback to improve their performance on the key learning targets. For example,

- In Lesson 2, the teacher is told, "Use the checklist on Lesson Resource 2.1: Investigation Checklist to assess the Investigate section to determine whether each group was able to collaboratively plan and conduct an investigation …. As needed, provide feedback to help groups strengthen their ideas and investigation plan." In the right column, additional guidance is offered to help teachers know what students should include, ways to scaffold the work if students struggle to plan the test, and ways to encourage students to look for patterns as well as sample patterns they might choose to test (page 60). Students have opportunities to apply this feedback and perform again in a later lesson.
- Lesson 2: "Provide time for students to reflect and record their ideas in their science notebooks. When the class is ready, have each student communicate their ideas to a partner. Each member of the pair should give and receive peer feedback by describing what they agree or disagree with or suggesting a way their partner could strengthen their ideas. Prompts like the following may be useful to students when giving feedback: I agree because ___. I disagree because__" (page 69).
- Lesson 3: "Distribute Lesson Resource 3.1: Peer Feedback to each student. Explain that they will provide peer feedback to their partner by agreeing with or disagreeing with their ideas. Students can also suggest ways that their partner could strengthen their ideas about the purpose of the object and which property best supports that purpose. Provide time for students to listen to their partner, provide feedback, and consider the feedback they receive. Encourage students to make changes to their artifact sheet after receiving peer feedback from their partner if they would like to do so" (page 104).
- Lesson 3: "Teacher Feedback: If students appear to describe the correct shape for each of their objects, say something like, 'The shape you described makes sense. How does the shape help the object's purpose?' If students struggle to tie the object's purpose to its shape, the following prompts may help generate the feedback they need to get back on track: How would you describe the shape of this object? How might that shape relate to the object's purpose?" (page 111).
- Lesson 5: "Have students explain their design solution to a partner. When it is their turn to listen, students should listen for ways their partner's design solution might not work based on how it is described and modeled. The listening partner should ask questions and provide feedback based on the information shared by the speaker. Pass out a sticky note to each student and have them write their feedback on it. Each student should attach the feedback sticky note they receive in the box in the Peer Feedback section of their artifact sheet" (Page 201). Students then apply the feedback to update their designs (page 202).
- Lesson 6: The teacher is told, "have students communicate their solution to a partner in their group. Encourage students to use the Gotta Have Checklist to make suggestions for improvement in the second step of the Improve Your Design section of their partner's artifact sheet. If students wish to make changes to their own solution on the artifact sheet, they should do so in a different color. After obtaining peer feedback, students will also ask you to provide

teacher feedback. While reviewing student work, ensure that all students have had an opportunity to record or receive written feedback" (page 243).

- Lesson 6: "When groups have completed their investigation plans, they will share their plan with you. Use Lesson Resource 6.2: Solution Testing Checklist to evaluate the group's plan and provide students with the sheet as feedback. Have students make changes to their plan and resubmit as needed until all items on the checklist are met" (page 247).
- Lesson 7: "Next, have students share their community solution with their group. Encourage students to use the Gotta Have Checklist to offer feedback to their peers" … "After obtaining peer feedback, students will also ask you to provide teacher feedback. Ask students to explain their design solution with you and note if they use their artifact sheet (sketch, drawing or model) to communicate their idea. Record this observation in Step 3 of the artifact sheet. If students wish to make changes, they should do so in a different color" (page 300).

Suggestions for Improvement

N/A

OVERALL CATEGORY III SCORE: 3 (0, 1, 2, 3)	
Unit Scoring Guide – Category III	
Criteria A-F	
3	At least adequate evidence for all criteria in the category; extensive evidence for at least one criterion
2	Some evidence for all criteria in the category and adequate evidence for at least five criteria, including A
1	Adequate evidence for at least three criteria in the category
0	Adequate evidence for no more than two criteria in the category

SCORING GUIDES

SCORING GUIDES FOR EACH CATEGORY

UNIT SCORING GUIDE – CATEGORY I (CRITERIA A-F)

UNIT SCORING GUIDE – CATEGORY II (CRITERIA A-G)

UNIT SCORING GUIDE – CATEGORY III (CRITERIA A-F)

OVERALL SCORING GUIDE

Scoring Guides for Each Category

Unit Scoring Guide – Category I (Criteria A-F)	
3	At least adequate evidence for all of the unit criteria in the category; extensive evidence for criteria A–C
2	At least some evidence for all unit criteria in Category I (A–F); adequate evidence for criteria A–C
1	Adequate evidence for some criteria in Category I, but inadequate/no evidence for at least one criterion A–C
0	Inadequate (or no) evidence to meet any criteria in Category I (A–F)

Unit Scoring Guide – Category II (Criteria A-G)	
3	At least adequate evidence for all criteria in the category; extensive evidence for at least two criteria
2	Some evidence for all criteria in the category and adequate evidence for at least five criteria, including A
1	Adequate evidence for at least three criteria in the category
0	Adequate evidence for no more than two criteria in the category

Unit Scoring Guide – Category III (Criteria A-F)	
3	At least adequate evidence for all criteria in the category; extensive evidence for at least one criterion
2	Some evidence for all criteria in the category and adequate evidence for at least five criteria, including A
1	Adequate evidence for at least three criteria in the category
0	Adequate evidence for no more than two criteria in the category

Unit 1–Trash

EQuIP RUBRIC FOR SCIENCE EVALUATION

OVERALL SCORING GUIDE	
E	**Example of high quality NGSS design—**High quality design for the NGSS across all three categories of the rubric; a lesson or unit with this rating will still need adjustments for a specific classroom, but the support is there to make this possible; exemplifies most criteria across Categories I, II, & III of the rubric. (total score ~8–9)
E/I	**Example of high quality NGSS design if Improved—**Adequate design for the NGSS, but would benefit from some improvement in one or more categories; most criteria have at least adequate evidence (total score ~6–7)
R	**Revision needed—**Partially designed for the NGSS, but needs significant revision in one or more categories (total ~3–5)
N	**Not ready to review**—Not designed for the NGSS; does not meet criteria (total 0–2)