Saving the Sand Dunes

DEVELOPER: mySci

GRADE: 2 **|** **DATE OF REVIEW:** September 2023

Saving the Sand Dunes

EQuIP RUBRIC FOR SCIENCE EVALUATION

OVERALL RATING: E

TOTAL SCORE: 9

CATEGORY I: NGSS 3D Design Score	CATEGORY II: NGSS Instructional Supports Score	CATEGORY III: Monitoring NGSS Student Progress Score
3	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	**Adequate**	**A.**	Monitoring 3D Student Performances	**Adequate**
B.	Three Dimensions	**Extensive**	**B.**	Student Ideas	**Extensive**	**B.**	Formative	**Extensive**
C.	Integrating the Three Dimensions	**Extensive**	**C.**	Building Progressions	**Extensive**	**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	**Adequate**	**E.**	Coherence Assessment System	**Adequate**
F.	Math and ELA	**Extensive**	**F.**	Teacher Support for Unit Coherence	**Adequate**	**F.**	Opportunity to Learn	**Adequate**
			G.	Scaffolded Differentiation Over Time	**Adequate**			

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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 many areas, including providing coherent experiences for students and authentically incorporating literacy instruction.

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

- **Supporting student use of practices and Crosscutting Concepts (CCCs)**. Students are currently supported to connect their Disciplinary Core Idea (DCI)-related learning to their problem solving throughout the unit, but they are not yet supported to connect their Science and Engineering Practices (SEP)- or CCC-related learning to problem solving.
- **Clarifying language to avoid misconceptions**. Some parts of the unit currently include inaccurate or potentially misleading language. Consider clarifying the language and models used throughout the unit to ensure they are accurate and grade appropriate.
- **Supporting teacher tracking of student progress over time for all learning goals**. Currently, not all assessments are connected to unit learning goals, and teachers are not yet supported to monitor student progress toward all learning goals.

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 argument for that Extensive rating.

Unless otherwise specified, page numbers in the document refer to the page numbers in the Teacher Guide (TG).

CATEGORY I

NGSS 3D DESIGN

Saving the Sand Dunes

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 because learning is driven by students figuring out an anchor phenomenon, investigative phenomena, and completing a design challenge related to a problem to solve. Student questions are elicited at the beginning of the unit and are often revisited and added to throughout the learning sequence. However, some learning may seem teacher driven, and the engineering focus in the second part of the unit also is not always integrated with developing science DCIs.

The materials organize the six lessons in the unit into two sections, and an anchoring problem is clearly identified as the anchor for the entire unit. The first section in the unit focuses on students understanding the problem, and the second section focuses on students developing a design as a solution to the problem. Related evidence includes:

- In the beginning of the unit, the teacher is told that the anchoring problem is “The Sleeping Bear Dunes are changing” (page 5).
- The anchoring problem is introduced to students. Students are shown photos and videos of the Sleeping Bear Dunes (page 9). “Orient students to where the dunes are located; along Lake Michigan. Ask students what they notice about the images” (page 10). Students can see from the infographic that the sand dune heights have changed, but they are not explicitly supported to understand what problems this is causing in the world (to the plants, animals, community, etc.). Thus, it is not clear that they fully understand why the change in sand dune height is truly a problem that someone wants to change.
- Lesson 1: Students are supported to see that the anchoring problem is important to people: “‘We learned that the Sleeping Bear Dunes are also important to people. Let’s add that into our Summary Chart. Why else might the changing sand dunes be a problem, now that you know the dunes are important to people?’ (People might be sad if the dunes change, the dunes are important to peoples’ history and that should be protected.)” (page 22).

- Lesson 2: Students observe differences in the dunes over time in images, focusing in on the phenomenon underlying the anchor problem (page 28). They investigate how wind and water can affect sand dunes. This helps students understand what factors are causing the sand dunes to change and helps them understand the problem facing the sand dunes. When the teacher fills out the Lesson 2 Summary Chart as a class, students answer the question, "What does this tell us about the Sleeping Bear Dunes problem?" (page 30).
- Lesson 2: Students engage in an investigation, and then discuss the results. "'What might this experiment tell us about the sand dunes?' (The waves can change the shape of the sand. The stronger the waves, the more the sand changes. The wind caused the sand to shift locations. The stronger wind caused more sand to move at once.) 'How do you think these activities explain how water and wind affect the land?' (These activities show that wind and water can change the shape of sand on the beach.)" (page 31). Students are therefore supported to begin explaining the phenomenon behind the anchor problem. Students are told to, "use evidence from their investigations and the class discussion to update earlier explanations and drawings to explain how wind and water can change the Sleeping Bear Dunes" (page 31). Students review their initial drawings of the Sleeping Bear Dunes which told them to, "Draw or Write about the Sleeping Bear Dunes" to make these changes. However, note that these instructions in the student journal are not focused on sense-making of the problem, so they may not result in students engaging in sense-making.
- Lesson 3: Students investigate how the sand dunes can change quickly or slowly. This also helps students understand what factors are causing the sand dunes to change and helps them understand the problem facing the sand dunes. "What does this tell us about the Sleeping Bear Dunes problem? (The Sleeping Bear Dunes can change quickly, like in a storm. They can also change slowly over time from the gently movement of water)" (page 45).
- Lesson 4: Students begin to design a solution to protect the sand dunes from wind and water. Students test different materials to see how well they resist water and wind, and then select materials to use in their solutions. "Once they have gathered information on the problem, engineers use what they've learned to design solutions. What have we learned about why the sand dunes change?" (page 51). As the conversation proceeds, students understand that in this lesson, they will be designing a solution for the changing sand dunes.
- Lesson 6: At the end of the unit, students compare their solutions to the anchor problem and then update and present their final designs. Students are asked, "'We started this unit learning about the changing Sleeping Bear Dunes, and how the changes were causing problems. What was causing the dunes to change? How do we know?' (Wind and water were causing the dunes to change. We saw this in our investigations.)…. 'How did we make sure our dune solutions would help the Sleeping Bear Dunes?' (We used everything we've learned to work through the engineering design process and develop, test, and present our dune solutions)" (page 80). The teacher is also told, "To support student sensemaking across the unit, orient students back to the DQB. Ask students: 'Did we answer any of the questions on our Driving Question Board? Are there any questions we haven't answered?'" (page 81).

Student questions about the problem are elicited. A Driving Question Board (DQB) is developed at the beginning of the unit, and the teacher returns to the DQB at the beginning of each lesson to try to connect to and drive the learning in the lesson. Related evidence includes:

- In the beginning of the unit, driving questions are given to teachers, but use of students' own questions is encouraged. "These questions are provided for you as model driving questions to support categorizing individual student questions and organize the learning progression. Each section is designed to answer this larger question. You can use these questions to guide your instruction, however, you are encouraged to adapt these questions to more closely match the language your students surface" (page 5).
- "Introducing the Anchoring Problem and Driving Questions" section: The teacher is told how to set up a DQB and when to revisit it. "You will revisit it at the beginning of each lesson to make connections between student questions and upcoming learning. You will also revisit it after each lesson and add new questions based on what has been learned" (page 10).
- "Introducing the Anchoring Problem and Driving Questions" section: Students set up a DQB. "As students are sharing their observations and questions, provide them with the sentence stem 'Now I'm wondering about…' to model how we can use observations to develop questions. Ask: What do you wonder about the dunes? Now that students have their questions, you will guide students in creating categories for their questions on the DQB using the following steps…. Once categories are created, guide the class in collapsing categories into bigger categories that have closer alignment to the driving questions provided in the unit" (page 11).
- At the beginning of each lesson, the teacher is prompted to revisit the DQB. Guidance is provided for what type of questions to look for to connect to the lesson. This helps students feel as if their questions are driving the learning. However, after this step, the teacher shows the engineering design cycle in the slides and often tells students what they are still doing or what they will be doing next. This may result in students feeling as if the teacher is directing the learning. At the end of each lesson, students return to the DQB to see which questions they've answered (e.g., page 63). Related evidence includes:
    - Lesson 1: The lesson begins with revisiting the DQB. The teacher is told to, "Highlight questions connected to the learning goals of this lesson by calling attention to questions about what are sand dunes, why sand dunes are important, and what is the problem with the changing dunes. If no questions directly relate, use prompts to build on student questions, supporting them to think about what the problem with changing dunes might be" (page 16). Students are therefore supported to understand how their ideas and questions connect to the activity, but support is not provided to facilitate students to consider which questions they should answer first.
    - Lesson 1: At the end of the lesson, the teacher is told to orient students back to the DQB. "Ask students: Did we answer any of the questions on our Driving Question Board? What additional questions do you have now?" (page 24).
    - Lesson 2: In the beginning of the lesson, the class revisits the DQB, and the teacher is told, "Highlight questions connected to the learning goals of this lesson by calling attention to questions about what is causing the dunes to change, why the dunes are changing, and how the dunes are changing. If no questions directly relate, use prompts

to build on student questions, supporting them to think about what might be causing the dunes to change. Say to students: Today we are going to start investigating this/these question(s)" (page 28). Students are therefore supported to see a connection between their questions and the following activity, but support is not provided to facilitate students to consider which questions they should answer first.

- Lesson 2: "Remind students of the Engineering Design Cycle and their progress toward solving the problem. Show the Engineering Design Cycle in the slides. Say to students: 'The next step in our engineering process is to gather more information about the problem in order to help solve it. I noticed you asked questions about why the dunes are changing. As engineers we are going to gather more information to find out the answer to that question.' Share the Sleeping Bear Dunes: Then and Now photos in the slides" (page 28). Although teacher-driven, the use of the engineering design cycle as the organizer for the unit may help students feel as if the steps of activities in instruction are logical and may help them feel some ownership over the ordering.
- Lesson 2: "Say to students 'We have some ideas about what might be causing the dunes to change. How could we investigate these ideas to see if they're correct?' (We could test them, or look at weather data.)" (page 30). Student ideas are therefore connected to the next activity.
- Lesson 3: In the beginning of the lesson, students are asked, "'What else could we ask to figure out more about how the dunes are changing?' (Accept all responses.) 'What other questions do you have about the dunes changing?' (Accept all responses.) Add these questions to the Driving Question Board. Highlight questions connected to the learning goals of this lesson by calling attention to questions about how quickly the dunes change. If no questions directly relate, use prompts to build on student questions, supporting them to think about how fast or slow the dunes change. Remind students of the Engineering Design Cycle and their progress toward solving the problem. Show the Engineering Design Cycle in the slides. Let students know they are still researching the problem and gathering information" (page 41). However, support is not provided to facilitate students to consider how to research the problem and gather information.
- Lesson 4: "Begin the lesson by revisiting the Driving Question Board. Highlight questions connected to the learning goals of this lesson by calling attention to questions about solving the problem or helping the dunes. If no questions directly relate, use prompts to build on student questions. Say to students: We've done a lot of research on the problem of the Sleeping Bear Dunes changing. What could we do next?" (page 55). Students are therefore supported to engage in thinking about how to drive the instructional sequence. However, the teacher is then told to introduce a reading without connecting it to the discussion about what to do next or to students' ideas. "We've learned a lot about the Sleeping Bear Dunes, why they're important, and why the changing dunes are a problem. Let's review some of what makes the Sleeping Bear Dunes so special" (page 55). The reading activity is therefore unlikely to seem to be driven by students. However, the Read Aloud guide includes a connection to the storyline. "Introduce the book as an A-B-Cs of Sleeping Bear. Let students know you are

going to explore more of the region and what makes it so special. This is helpful for engineers to think about when solving problems" (U10 Appendix, page 6).
    - Lesson 5: "Begin the lesson by revisiting the Driving Question Board. Highlight questions connected to the learning goals of this lesson by calling attention to questions about testing their ideas. If no questions directly relate, use prompts to build on student questions…Show the engineering design cycle in the slides. Remind students of the engineering design cycle and their progress toward solving the problem. Let students know they are moving ahead in the process. The next step is to build their ideas so they can test them" (page 62).
    - Lesson 6: "Begin the lesson by revisiting the Driving Question Board. Highlight questions connected to the learning goals of this lesson by calling attention to questions about making a solution better. If no questions directly relate, use prompts to build on student questions. Say to students 'We've created and tested a first draft of a solution. Some parts worked and some parts didn't. What could we do next in order to have a final solution for the Sleeping Bear Dunes?'" (page 76). "'Your team just tested to see if your design worked. What do you think we should do next that could help us figure out what works best to protect the dunes?' (If students struggle to come up with ideas you can suggest looking at other groups' solutions)" (page 77).

Students' prior learning related to the anchor problem are elicited. Related evidence includes:

- The anchoring problem is introduced to students together with activation of students' prior knowledge. "Ask students what they notice about the images, and to share any prior knowledge of sand dunes, beaches, or sand…. Has anyone ever been to a sandy spot? Have you ever walked on sand or played in sand at the beach? (Accept any response.) What do you know about sand? (Accept any response.)" (page 10).
- Lesson 2: "Support students to come up with ideas around wind, water, or the beach changing the dunes. If no students suggest this, connect to prior knowledge, for example: leaves blowing in the wind on an autumn day, or sand castles on the beach. Ask: 'Have you ever played in a sandbox? How does sand change in the sandbox?' (The sand moves around when I move. Sometimes the wind blows the sand in my face.)" (page 29).
- Lesson 3: Students connect their sense-making to related phenomena. "'What is an example in nature of when water is gentle (moving slowly)? What is an example of when water is forceful (moving fast)?' (Water moves slowly when it moves in and out of the shore at a beach. Water moves quickly during a storm.) 'How do you think this relates to how and why the sand dunes change?' (Faster moving water might cause more sand to move further.)" (page 43).

The engineering ideas in the unit are introduced early on, so they are not initially developed separately from the science ideas. However, the engineering focus in the second part of the unit is not always integrated with developing DCIs from life and Earth and space sciences. For example, in Lesson 5, students develop and test their sand dune solutions to address the anchor problem. As the teacher circulates when students are testing their designs, the teacher may use the following questions: "What parts of your solution are working well at protecting against slow changes? Fast changes? (The [X] at the bottom of the dune is stopping the water from going up the hill.)" and "What parts of your solution are not working well at protecting against slow changes? Fast changes? (The [X] at the top of the dune is falling over in the wind.)" (page 64). Students are therefore asked to apply their science learning in their engineering solutions, but they do not develop new understanding.

Suggestions for Improvement

- Consider supporting students to participate in the process of choosing what and how to investigate next more often.
- As students develop their engineering design solutions, consider providing additional ways students can show new science learning through their work rather than only applying science learning from earlier in the unit.

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	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials give students opportunities to build understanding of grade-appropriate elements of the three dimensions. Students have opportunities to develop and use most, but not all, of the claimed SEP, DCI, and CCC elements in the unit.

Science and Engineering Practices (SEPs) | Rating: Extensive
The reviewers found extensive evidence that students have the opportunity to use the SEPs in this unit. Students have opportunities to develop and use many SEPs, but there is a slight mismatch between claims and evidence of student use. There is also a slight mismatch between elements claimed in the NGSS MLS Progressions document and those claimed at the beginning of the lessons.

Asking Questions and Defining Problems

- This SEP is claimed as a focal SEP in Section 1 of the unit (Lessons 1–3).
- *Ask questions based on observations to find more information about the natural ~~and/or~~*

~~designed world(s)~~.

- Lesson 1: This element is claimed. Students are told, "After scientists make observations they can ask questions based on what they observed." The teacher is then instructed to, "Have students use their research to write in their student journal and pair-share 1 question they have about the sand dunes changing" (page 19). Students ask questions based on their observations to find out more information about the sand dunes.

- *Define a simple problem that can be solved through the development of a new or improved object or tool.*
    - Lesson 1: This element is claimed. Students are shown the engineering design cycle, the first step of which says to, "Identify Need/Problem". Students are also supported to see that the anchoring problem is important to people: "'We learned that the Sleeping Bear Dunes are also important to people. Let's add that into our Summary Chart. Why else might the changing sand dunes be a problem, now that you know the dunes are important to people?' (People might be sad if the dunes change, the dunes are important to peoples' history and that should be protected.)" (page 22). Students also respond to the prompt "What problems could the changing Sleeping Bear Dunes cause?" in their Student Journals (U10 Student Science Journal, page 5).
    - Lesson 4: This element is not claimed but is mostly used during the read aloud. The students are asked, "Think like an engineer! What do you notice about this sandy area? What might be dangerous if the sand shifts too much? (The bridge could shift and make it unsafe for people)" (U10 Appendix, page 6).
    - Lesson 6: This element is claimed. However, students already defined the problem in Lesson 1 and do not do the work of defining a new simple problem again in this lesson.

Developing and Using Models

- This SEP is claimed as a focal SEP in Section 2 of the unit (Lessons 4–6).
- *Distinguish between a model and the actual object, process, and/or events the model represents.*
    - Lesson 3: This element is not claimed but is used. Students are asked, "'What does the slow shaking movement represent with the sand dunes? What does the fast shaking movement represent with the sand dunes?' (The slow movement represents waves moving in and out on a beach, or waves with only a little bit of force. The fast movement represents a storm on the beach, or waves with a lot of force.)" (page 45).
- *Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).*
    - Lesson 2: This element is not claimed but is used when students are asked to, "Draw and write: Why are the sand dunes changing?" The answer key says, "Student drawing includes wind and waves. It also includes labels and arrows" (U10 Student Science Journal Key, page 9).
- *Develop a simple model based on evidence to represent a proposed object ~~or tool.~~*
    - Lesson 4: This element is claimed. "'Now that you have some ideas, you are going to create a model that represents those ideas. Why do you think scientists make models?' (Accept all responses) 'Models can help us describe or explain something to others'"

(page 56). Students are therefore supported to build toward an understanding of this element. Based on their findings from the materials stations in the Explore section, students choose which materials they want to use for their solutions (page 57). In their student journals, students are told to, "Draw or update your earlier solution idea using your selected materials" (Student Journal, page 25). Based on the limited guidance provided in student facing materials, all students may not develop simple models.
  - Lesson 5: This element is claimed. Students draw and compare diagrams of their proposed design solutions. They also build a physical model for their proposed solutions (page 63). Students build this model based on their findings from testing the different materials in the previous lesson.
  - Lesson 6: This element is claimed. Students work in groups to update their designs using a new combination of materials (page 74). Students use evidence from the class investigations to select the materials and draw their updated solution in the Final Solutions student journal page. However, revising or updating models is not expected of all students in Grade 2.

Planning and Carrying Out Investigations

- *Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal.*
  - Lesson 5: This element is not claimed but is used. Students construct their proposed design, test their design, and then record their firsthand observations to determine if their designs meet the goal of the solution (pages 63–64).

Analyzing and Interpreting Data

- This SEP is claimed as a focal SEP in Section 2 of the unit (Lessons 4–6).
- *Record information (observations, thoughts, and ideas).*
  - Lesson 2: This element is not claimed but is used. Students rotate through the stations and record their observations in the Wind and Water Stations student journal pages (pages 27–28).
  - Lesson 3: This element is not claimed but is used. Students rotate through the stations and record their observations in the Sand and Water Stations student journal pages (page 38).
  - Lesson 4: This element is not claimed but is used. Students rotate through the stations and record their observations about each material in their student journal pages (page 52).
- *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.*
  - Lesson 2: This element is claimed in the lesson, but not in the NGSS MLS Progressions document. It is used when students are asked to make sense of the results of their investigations. Students are asked, "What happens when you move the wave block harder?...What happens when the fan is turned on?" (page 30).

- Lesson 3: This element is claimed in the lesson, but not in the NGSS MLS Progressions document. It is used when students are asked to analyze their investigation results. Students are asked "'What happens when you shake the tube really fast or with a lot of force?' (A really fast shake caused the changes to happen quickly. The sand spread out and covered the whole tube.)…'What happens when you shake the tube really slow or with only a little bit of force?' (A really slow shake caused the changes to happen slowly. The longer you shake, the more the sand moves.) Record the student observations in the first row of the summary chart" (page 44).

- *Analyze data from tests of an object or tool to determine if it works as intended.*
  - Lesson 2: This element is claimed in the NGSS MLS Progressions document as being introduced. Students analyze data from their investigations, but they do not test an object or tool to determine if it works as intended. Instead, as students share their observations and identify relationships in the discussion, they engage with pieces of the following SEP element: *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.*
  - Lesson 3: This element is claimed in the NGSS MLS Progressions document as being introduced. Students analyze data from their investigations, but they do not test an object or tool to determine if it works as intended. Instead, as students share their observations and identify relationships in the discussion, they engage with pieces of the following SEP element: *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.*
  - Lesson 4: Most of this element is claimed (not the tool part). Students test different materials and analyze the data from their tests. The Analyze Materials Data student journal page asks students to check off if each material worked well in water and wind. Through these steps, students predict how certain materials will work and then analyze their data from testing the materials to see if the materials did work as they thought.
  - Lesson 5: This element is claimed. Students test different materials and analyze the data from their tests. Students review their observations from testing their designs and then identify the strengths and weaknesses of their design in the Analyze Solutions: Strengths and Weaknesses student journal page (page 65).

Constructing Explanations and Designing Solutions

- This SEP is claimed as a focal SEP throughout the unit.
- *Make observations from several sources to construct an evidence-based account for natural phenomena.*
  - Lesson 2: This element is claimed. The teacher states, "Scientists and engineers test things to answer questions about the natural world and solve problems. During these tests they gather evidence. Does anyone know what evidence is? What is an example of evidence?" (page 27). This discussion helps students build an understanding of what evidence is so that they are able to identify and use evidence in their explanations.

Students engage in an investigation, and then discuss the results. "'What might this experiment tell us about the sand dunes?' (The waves can change the shape of the sand. The stronger the waves, the more the sand changes. The wind caused the sand to shift locations. The stronger wind caused more sand to move at once.) 'How do you think these activities explain how water and wind affect the land?' (These activities show that wind and water can change the shape of sand on the beach.)" (page 31). In the individual student task, students are asked to, "draw and write: Why are the sand dunes changing?"… "I know the sand dunes are changing because __." The answer key says that students get full credit "if they include accurate evidence from both investigations" (U10 Student Science Journal Key, page 9).

- Lesson 3: This element is claimed. Students engage in an investigation and do a reading, and then discuss their findings. They are told to, "draw and write: Draw how the sand dunes are changing quickly or slowly…..Sleeping Bear Dunes can change quickly because ___. Sleeping Bear Dunes can change slowly because___" (U1 Student Science Journal, page 15). Students therefore make and use observations from two sources to explain how the dunes can change slowly and quickly.

- *Generate and/or compare multiple solutions to a problem.*
  - Lesson 4: This element is not claimed but is built toward. Students are asked, "We can't stop the wind from blowing or the waves from moving. But what sorts of things might we be able to do to help protect the dunes?" (page 56).
  - Lesson 6: This element is claimed, except the "Generate" part. "Pair engineering teams up with another team, or jigsaw students so 2 team members are grouped with 2 other students from another team. Have feedback teams use the Compare Solutions Student Journal Pages to compare their solutions. They will be comparing strengths and weaknesses of their solutions, and how well the solution protects the dune against changes due to wind and water. Pairs should take turns sharing about the design of their solutions. They should then use their data to share what worked well or didn't work well in their solution" (page 77). Through this process, students compare multiple solutions to the sand dune problem.

Obtaining, Evaluating and Communicating Information

- *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.*
  - Lesson 6: This element is not claimed but is used. Students use their Final Solutions student journal pages to present their final solutions to the class (page 75). Students communicate their design ideas with the peers orally, and through their models and writing in their journal pages.

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EQuIP RUBRIC FOR SCIENCE EVALUATION

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

The reviewers found adequate evidence that students have the opportunity to use or develop the DCIs in this unit. Students have opportunities to use and/or develop most, but not all of the parts of the targeted DCI elements in the unit.

PS1.A: Structure and Properties of Matter

- *Different properties are suited to different purposes.*
  - Lesson 4: This element is claimed. Students explore the effect of different materials in an investigation and are asked, "'Why do you think material X worked better than material Y? How are those materials different?' (Accept all responses.) 'How might the differences in the materials affect how well they work at protecting the dunes?' (Accept all responses.). Students should be able to describe different properties of materials and how they stood up in wind and water" (page 60). Through this discussion, students begin to build the idea that materials are different and not all of them can be used for the same purpose. The teacher notes state that, "Students should be able to describe different properties of materials and how they stood up in wind and water" and the teacher is reminded that, "Now is a good opportunity to post the properties vocabulary card." The teacher then asks, "How would knowing about the properties or structures of materials help you solve the problem of Sleeping Bear Dunes?" This helps students begin to understand that different properties of materials can result in them working in different ways.
  - Lesson 6: This element is not claimed but is used. Students are asked, "'What objects worked well to protect the dunes against slow changes? How did the properties of those objects help them protect the dunes? What objects worked well to protect the dunes against fast changes? How did the properties of those objects help them protect the dunes?' Have student teams discuss and select their materials in the first page of their Final Solutions Student Journal Pages" (page 78). In answering these questions, students use their understanding of this element.

PS2.A: Forces and Motion

- *Pushes and pulls can have different strengths ~~and directions~~. Pushing or pulling on an object can change ~~the speed or direction of~~ its motion ~~and can start or stop the object.~~*
  - Lesson 2: This element is claimed. Students discuss strong versus gentle waves and strong versus gentle wind. In the wind station, students investigate how stronger wind (a hair dryer on a higher setting) can cause the sand to change more than weaker wind (pages 27–28). In the water station, students investigate how stronger waves (a block moving "harder" in the water) can cause the sand to change more than a gentle wave. In the class discussion in the Explain section, the teacher asks, "What did you observe when you modeled strong waves? Gentle waves?" (page 29). Students are expected to answer with the idea that the waves pulled sand into the water. The teacher continues to ask, "How did waves with a lot of force cause the dunes to change? How did waves with a little bit of force cause the dunes to change." Students are not explicitly

scaffolded in building or using an understanding that pushes and pulls can have different directions, as claimed in the lesson front matter (but in strikeout text in the NGSS MLS Progressions document).

- Lesson 3: This element is claimed. Students investigate shaking tubes, and their data analysis relates to this element. "'Why do you think the sand moves farther when you shake it harder?' (The water is moving faster. The water pushes the sand.)" (page 43). Students are not explicitly scaffolded in building or using an understanding that pushes and pulls can have different directions, as claimed in the lesson front matter (but in strikeout text in the NGSS MLS Progressions document).

ESS1.C: The History of Planet Earth

- *Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.*
    - Lesson 3: This element is claimed. Students are asked, "'How might the force of the wind or water affect how quickly the sand moves?' (Maybe stronger wind or water might change the sand faster.)" (page 42). Students are expected to make the connection that slow movements represent waves on the beach and fast movements represent storms or waves with a lot of force. The teacher is told, "Students should be able to explain that changes to the sand can happen quickly or slowly. Probe students to use evidence from their investigations to support their findings; for example, how the force of the winds or waves in the sand and water tubes affect the rate of change" (page 42). Through this discussion, students are beginning to build the idea that changes in sand dunes can happen slowly or quickly due to different events. Note that the emphasis on force is not an expectation for students at this grade level in the NGSS, and this difference is not mentioned to teachers. Students read The Sun, the Wind, and the Rain and then complete the Fast and Slow Changes Details and Evidence pages in the student journal (Student Journal, page 12–15). In the journal pages, students identify fast vs. slow changes and then describe one way the Sleeping Bear Dunes and the Earth are changing quickly and one way they are changing slowly. Through the reading and journal pages, students continue to build an understanding that some changes happen slowly, and some happen quickly. Students do not have an opportunity to build an understanding of the last part of the element, that events can happen over a time period much longer than one can observe.

ESS2.A: Earth Materials and Systems

- *Wind and water can change the shape of the land.*
    - Lesson 2: This element is claimed. Students investigate the effects of wind and waves on sand. "'What might this experiment tell us about the sand dunes?' (The waves can change the shape of the sand. The stronger the waves, the more the sand changes. The wind caused the sand to shift locations. The stronger wind caused more sand to move at once.) 'How do you think these activities explain how water and wind affect the land?' (These activities show that wind and water can change the shape of sand on the

beach.)" (page 31).

ETS1.A: Defining and Delimiting Engineering Problems

- *A situation that people want to change or create can be approached as a problem to be solved through engineering.*
    - Lesson 1: This element is claimed. Students are shown the engineering design cycle. The teacher is told to say, "Engineers use the engineering design cycle to explore and solve problems" (page 16). Students could therefore build toward this idea.
    - Lesson 6: This element is claimed. In a class discussion, students are asked, "'We started this unit learning about the changing Sleeping Bear Dunes, and how the changes were causing problems. What was causing the dunes to change? How do we know?' (Wind and water were causing the dunes to change. We saw this in our investigations.)… 'We used what we learned about the changing dunes to design a dune solution. How did we make sure we got materials that could work for our solution?' (We tested materials in wind and water to find the best ones.) 'How did we make sure our dune solutions would help the Sleeping Bear Dunes?' (We used everything we've learned to work through the engineering design process and develop, test, and present our dune solutions.)" (page 80).
- *Asking questions, making observations, and gathering information are helpful in thinking about problems.*
    - Lesson 1: This element is claimed. Students are asked, "How might asking questions, making observations, and gathering information be helpful in learning about a problem? (We can ask questions, make observations, and gather information to help understand a problem more)" (page 17).
    - Lesson 2: This element is not claimed but is partially built toward. The teacher states, "The next step in our engineering process is to gather more information about the problem in order to help solve it. I noticed you asked questions about why the dunes are changing. As engineers we are going to gather more information to find out the answer to that question" (page 26).
- *Before beginning to design a solution, it is important to clearly understand the problem.*
    - Lesson 1: This element is claimed. Students are asked, "Why do you think it is important for engineers to fully understand a problem before they try to solve it? (That way they make sure the solution works. They know everything about a problem so the[sic] know what a solution needs to do)" (page 17).
    - Lesson 2: This element is not claimed but it is built toward. In the beginning of the lesson the teacher tells students, "The next step in our engineering process is to gather more information about the problem in order to help solve it" (page 28).
    - Lesson 4: This element is not claimed but it is built toward. Students are told, "Once they have gathered information on the problem, engineers use what they've learned to design solutions" (page 56).

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.*
    - Lesson 4: This element is claimed. Students are asked, "'Why do you think scientists make models?' (Accept all responses) 'Models can help us describe or explain something to others'" (page 56).
    - Lesson 5: This element is claimed. Students are told, "It's not possible for engineers to build and test EVERY design they can think of, but they can work together to share ideas and come up with one design to test. How can they share their ideas? (They can talk about their ideas. They can use a drawing to show their different ideas)?" (page 74). Later, the teacher is told to, "Have students work in their Engineering Teams to share their drawn models. Teams need to decide on one version of the model to build" (page 75). Students are therefore likely to build toward this element.
    - Lesson 6: This element is claimed. Students share their design ideas and get feedback from peers. Students are told, "In order to share your solution, you need to be able to communicate your ideas. What can you use to communicate your ideas? (We can use the drawing in our Student Journal, or the model we tested.)" (page 87).

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.*
    - Lesson 5: This element is claimed. The teacher asks students, "Once they have done some research and developed ideas to solve a problem, engineers build models to develop and test their ideas. Why might it be important to test a model?" (page 62). The expected student answer is "you need to see if an idea can work before you build it full size." This begins to build the idea that is important to test designs. The teacher is also told, "The goal of this class discussion is for teams to share what worked in their solution, and to hear about other teams' experiences. List the materials and things that worked well from a variety of solutions. Then students can see how this sharing process helps them further refine their designs" (page 71).
    - Lesson 6: This element is claimed. At the beginning of the lesson, the teacher is told to, "Say to students: 'After testing their models and analyzing the data, engineers can make decisions to improve their solutions. Why might data and testing be helpful to improve a solution?' (You can see what works or doesn't work from the testing, then you can fix it so it works better.)" (page 76). Therefore, the second, but not the first, part of the element is developed.

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

The reviewers found extensive evidence that students have the opportunity to use or develop the CCCs in this unit. Students have opportunities to engage with some, but not all of the claimed CCC elements. The teacher tries to explicitly build CCC understanding in some class discussions, but often, the student journal prompts are not written in a way that explicitly asks students to use and show their CCC understanding.

Cause and Effect

- This CCC is claimed as a focal CCC in Section 2 of the unit (Lessons 4–6).
- *Simple tests can be designed to gather evidence to support or refute student ideas about causes.*
    - Lesson 2: This element is claimed. Students are told, "'We have some ideas about what might be causing the dunes to change. How could we investigate these ideas to see if they're correct?' (We could test them, or look at weather data.) 'Scientists and engineers test things to answer questions about the natural world and solve problems. During these tests they gather evidence" (page 30). Students go on to investigate how wind and water affect sand dunes. Through these questions, students understand that testing things is important to gather information and answer questions, and they are trying to identify causes behind the sand dunes changing. Students therefore are supported to build toward an understanding of this element.
    - Lesson 3: This element is claimed. The element isn't explicitly discussed in the lesson, but student's initial ideas are elicited and then students engage in an investigation to gather evidence (e.g., page 42).
    - Lesson 4: The first eight words of this element are claimed. "'Which material(s) do you think might work well as a solution? Why?' (Accept all student responses.) 'How can we find out if they will work or not?' (We can investigate different materials to compare how they work.)" (pages 56–57). After their investigation, students analyze the evidence. "'Did you predict this material would be good to use, or not? What have you seen in the investigation to update your prediction?' (We saw it did not fall apart in the water, so it was good. We saw it fell apart in the water, so it was not good)" (page 58).

Structure and Function

- This CCC is claimed as a focal CCC in Section 2 of the unit (Lessons 4–6).
- *The shape and stability of structures of natural and designed objects are related to their function(s).*
    - Lesson 4: This element is claimed. In the Explore section, students rotate through stations to investigate how well different materials block wind and water. Students are asked, "'What do you think a good material must do to solve our problem?' (The material should protect against the wind and waves. It must keep the sand from moving.) Show the different materials students will be investigating. Ask: 'Which material(s) do you think might work well as a solution? Why?' (Accept all student responses.)" (page 56). Students are also asked, "How might the differences in the materials affect how well they work at protecting the dunes?" Through this discussion,

students begin to build an understanding that certain aspects of objects can be related to their function.

- Lesson 5: This element is claimed. Students test different materials in their design solutions. Students participate in a class discussion in which the teacher asks questions such as, "what combination of materials did you use?" and "What did you notice from the investigations?" (page 66). Later in a class discussion the teacher asks, "What worked well and what didn't work well about your solution?" and "Why do you think these parts worked well? Didn't work well?" (page 67). However, this concept (e.g., the idea of shape and stability) is not discussed explicitly so there is little evidence that all students would use or develop it.
- Lesson 6: This element is claimed. During the class discussion, the teacher asks, "What objects worked well to protect the dunes against slow changes? How did the properties of those objects help them protect the dunes?" (page 73). In answering the question, students may consider how the shape and structure of the objects helped them in their function to protect the dunes, but this concept (e.g., the idea of shape and stability) is not discussed explicitly so there is little evidence that all students would use or develop it.

Stability and Change

- This CCC is claimed as a focal CCC in Section 1 of the unit (Lessons 1–3).
- *Things may change slowly or rapidly.*
  - Lesson 1: This element is not claimed but an **Attending to Equity** margin note states, "To further support students with the CCC element: Things may change slowly or rapidly – connect to students' intuitive ways of knowing and doing science as an entry point. Students will have background experiences with natural changes and consequences" (page 18). However, it is unclear where or how this connection could be made.
  - Lesson 2: This element is claimed, minus the "slowly" part. Students observe rapid changes to piles of sand in their investigations, and therefore are likely to begin building an understanding of this element.
  - Lesson 3: The full element is claimed. Students are asked, "'How might the force of the wind or water affect how quickly the sand moves?' (Maybe stronger wind or water might change them faster.)" (page 42). Students read *The Sun, the Wind, and the Rain* and then complete the *Fast and Slow Changes Details and Evidence* pages in the student journal, students identify if changes are fast or slow (Student Journal, pages 12–15). In the journal pages, students identify fast vs. slow changes and then describe one way the Sleeping Bear Dunes and the Earth are changing quickly and one way they are changing slowly. Through the reading and journal pages, students build an understanding that some things change rapidly and some change slowly, although they are expected to use the concept of changes that take millions of years (U10 Student Science Journal Key, page 12), which may be too large of a number for students to understand.
  - Lesson 6: The full element is claimed. Students are asked, "What objects worked well to protect the dunes against slow changes? How did the properties of those objects help

them protect the dunes? What objects worked well to protect the dunes against fast changes? How did the properties of those objects help them protect the dunes?" (page 78).

Suggestions for Improvement

Science and Engineering Practices

- Consider modifying the SEP claims for Lessons 2 and 3. Changing the target SEP element to *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* could help make the claims more accurate.

Disciplinary Core Ideas

- Consider removing the references to "force" and explicitly using the terms "pushes" and "pulls" instead to make the unit more grade appropriate.
- Consider clarifying to teachers the use of the Kindergarten-level DCI from **PS2.A** in this unit and related expectations for students' prior learning.
- Consider explicitly discussing some of the ETS elements with students. Currently, students are doing some of them as actions, but they are not supported to understand the reasoning behind their actions, as intended by the DCI elements.

Crosscutting Concepts

- Consider providing students with explicit opportunities to discuss the idea of shape and stability.
- Consider changing the language and discussions in the unit so that students understand the difference between "slowly and rapidly" in terms of time and the words "more" and "less" or "faster and slower" in terms of moving water. As the instructions and prompts are currently written during investigations that involve fast or slow interventions (e.g., rapid shaking), students may build an inaccurate understanding of the CCC element: *Things may change slowly or rapidly.*

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. Students have several opportunities throughout the unit to use multiple dimensions together to solve a problem.

Related evidence includes:

- Lesson 2: Students engage in an investigation, and then discuss the rapid changes they saw in the sand dunes. "'What might this experiment tell us about the sand dunes?' (The waves can change the shape of the sand. The stronger the waves, the more the sand changes. The wind caused the sand to shift locations. The stronger wind caused more sand to move at once.) 'How do you think these activities explain how water and wind affect the land?' (These activities show that wind and water can change the shape of sand on the beach.)" (page 31). In this activity, students integrate the following elements of the three dimensions:
  - SEP: *Make observations from several sources to construct an evidence-based account for natural phenomena.*
  - CCC: *Things may change ~~slowly or~~ rapidly.*
  - DCI: **ESS2.A.** *Wind and water can change the shape of the land.*
- Lesson 3: Students make and use observations from two sources to explain how the dunes can change slowly and quickly. Students are asked, "'How might the force of the wind or water affect how quickly the sand moves?' (Maybe stronger wind or water might change the sand faster)" (page 42). In this activity, students integrate the following elements of the three dimensions:
  - SEP: *Make observations from several sources to construct an evidence-based account for natural phenomena.*
  - CCC: *Things may change slowly or rapidly.*
  - DCI: **ESS1.C**. *Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.*
- Lesson 4: After their investigation, students analyze the evidence. " 'Did you predict this material would be good to use, or not? What have you seen in the investigation to update your prediction?' (We saw it did not fall apart in the water, so it was good. We saw it fell apart in the water, so it was not good)" (page 58). In this activity, students integrate the following elements of the three dimensions:

- SEP: *Analyze data from tests of an object or tool to determine if it works as intended.*
- CCC: *Simple tests can be designed to gather evidence to support or refute student ideas about causes.*
- DCI: **ESS2.A.** *Wind and water can change the shape of the land.*

Suggestions for Improvement

Applying the suggestions for improvement in Criteria I.A and I.B would provide more opportunities for students to use the three dimensions in service of sense-making.

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 Performance Expectations (PEs). Students can see how activities and lessons tie back to the topic of sand dunes. Student questions are elicited with the introduction of the anchor phenomenon, these questions are revisited frequently, and new questions are elicited. The activities also help students develop toward proficiency in most of the targeted learning.

Coherent topical connections are made between lessons and activities, as all lessons are focused on either understanding or saving sand dunes. In addition, student questions are elicited at the beginning of the unit and used to develop a DQB. These questions are revisited at the beginning of each lesson to see which ones connect to the learning in the lesson. The questions are also revisited at the end of each lesson in order for students to see which ones have been answered and if they have additional questions to add. Related evidence includes:

- Introducing the Anchoring Problem and Driving Questions: Students view photos and videos of the Sleeping Bear Dunes (page 9). After making observations, students use the observations to ask questions (page 10). The teacher develops the class DQB using student questions about the sand dunes (page 10).

- At the beginning of each lesson, the teacher revisits the DQB to find student questions that link to the learning in the lesson. Examples of this can be found in the following lessons:
  - Lesson 1 Engage (page 15)
  - Lesson 2 Engage (page 26)
  - Lesson 3 Engage (page 37)
  - Lesson 4 Engage (page 50)
  - Lesson 5 Engage (page 62)
  - Lesson 6 Engage (page 71)
- At the end of each lesson, students return to the DQB to see if they answered any of their questions and if they have additional questions. Examples of this can be found in the following lessons:
  - Lesson 1 Evaluate (page 22)
  - Lesson 2 Evaluate (page 32)
  - Lesson 3 Evaluate (page 44)
  - Lesson 4 Evaluate (page 58)
  - Lesson 5 Evaluate (page 67)
  - Lesson 6 Evaluate (page 76)
- Student questions are also elicited outside of the regular routine of returning to the DQB. For example, in Lesson 1, the teacher is told to, "Have students use their research to write in their student journal and pair-share 1 question they have about the sand dunes changing" (page 17).
- Lesson 3: In the beginning of the lesson, the class reviews their investigation findings from the prior lesson. "'What did you observe when we put water on the sand? What did you observe when we blew air on the sand?' (We saw that water moved the sand or made paths in the sand. We saw that wind moved the sand.) 'What does this tell us about why the sand dunes are changing?' (Water and wind are causing the dunes to change.) 'What else could we ask to figure out more about how the dunes are changing?' (Accept all responses.)" (page 41).
- Lesson 5: "Say to students: We have some ideas on how to design a dune solution, and we've tested materials to choose the best material to use. But how would we know if our solution actually works? Show the engineering design cycle in the slides. Remind students of the engineering design cycle and their progress toward solving the problem. Let students know they are moving ahead in the process. The next step is to build their ideas so they can test them" (page 67).

The following PEs are claimed as being addressed in the unit. Students have opportunities to develop toward proficiency in most of the SEP elements associated with the target PEs, but they do not have as many opportunities to engage with the DCI and CCC elements.

- **2-ESS1-1**. *Use information from several sources to provide evidence that Earth events can occur quickly or slowly.*
- **2-ESS2-1**. *Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*
- **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.*

In addition, Missouri PE **2.PS2.A.1** is claimed as being partially addressed in the unit. Note that the DCI for this PE corresponds mostly to a Kindergarten-level NGSS PE (**K-PS2-1**), although it also includes the concept of applied force, which isn't used in the NGSS until grade 3 (e.g., **3-PS2-1**).

Suggestions for Improvement

Consider providing additional opportunities for students to build proficiency in all of the PEs claimed as goals for the unit.

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. Both physical science and Earth and space science DCIs are identified as learning targets in the unit, and both science domains are necessary for sense-making. However, the usefulness of CCCs to make sense of phenomena across science domains is not made explicit to students in the unit.

In the unit, the Earth and space sciences elements are necessary for students to understand what problems the Sleeping Bear Dunes are facing, and the grade-appropriate physical science elements are necessary for students to develop an appropriate solution. However, it is not always clear to students how the ideas from both of these domains work together to help them develop an appropriate solution.

Suggestions for Improvement

Consider supporting students to explicitly connect CCC ideas to two different science domains, potentially including the ESS and PS ideas in this unit or connecting to prior learning in other units and domains.

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, English language arts (ELA), history, social studies, or technical standards. The materials explicitly identify connections to ELA and social studies standards that are used in the lessons, and students have multiple opportunities to engage in these connections.

Connections to CCSS in ELA are listed at the beginning of each lesson, along with connections to social studies standards. The lesson instructions also include margin notes that support teachers in making connections to these standards, and students have many opportunities to practice reading, writing, and speaking skills. Related evidence includes:

- **RI.2.1**. *Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.*
    - This standard is claimed in Lesson 1. A teacher side bar comment helps students build toward this standard: “While students are reading the article, provide them with ‘who, what, where, when, why, and how’ question prompts to help them identify key details in the text (RI.2.1 [2.R.1.A.b]). Also have students point out the bold headings and subheadings to help them find key information about the sand dunes (RI.2.5 [2.R.3.A.c])” (page 18).
- **W.2.5**: *With guidance and support from adults and peers, focus on a topic and strengthen writing as needed by revising and editing.*
    - This standard is claimed in Lesson 2. Students provide each other feedback, and also receive feedback from the teacher. They are asked to revise their models and writing (page 36).
- Lesson 3: A “Teaching Tip” in the margin states, “Students should use the images in The Sun, The Wind, and the Rain to help them clarify the meaning of the text (RI.2.7 [2.R.4.A.a])” (page 46).

- Lesson 3: In the read aloud guide, the teacher is prompted to help students begin to see how ELA/literacy can support their science learning. "Encourage them to use the text to support their thinking" (U10 Appendix, page 5).
- Lesson 4: A Teaching Tip in the margin states, "After reading S is for Sleeping Bear Dunes: A National Lakeshore Alphabet, ask students to share information about the characters, setting, and/or plot. Students should refer to words or illustrations that helped them get that information (RL.2.7 [2.R.2.A.a])" (page 55).
- Lesson 4: Speaking: "Have students pair-share to brainstorm ideas for possible solutions" (page 56).
- Lesson 4: "After reading The Most Magnificent Thing, ask students to share information about the characters, setting, and/or plot. Students should refer to words or illustrations that helped them get that information. (RL.2.7 [2.R.2.A.a])" (page 61).
- Lesson 5: "As students share their designs and test results, listen for students to use facts and descriptive details (SL.2.4)" (page 71).
- Some examples of social studies connections include:
    - Lesson 1 Elaborate: A Teaching Tip in the margin states, "The Legend of Sleeping Bear provides an opportunity to introduce students to a Native American Legend that helps them to understand the way of life of other cultures. Review the term culture, if necessary (2.RI.6.C.a)" (page 20).
    - Lesson 4 Engage: A Teaching Tip in the margin states, "This book also provides students with information about the Sleeping Bear Dunes National Park located in Michigan (2.PC.1.F.b)" (page 50).

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

Saving the Sand Dunes

EQuIP RUBRIC FOR SCIENCE EVALUATION

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	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials engage students in authentic and meaningful scenarios that reflect the real world. Students have opportunities to experience most of the problem directly and to make connections to some of their experiences. However, students are not supported to fully understand why solving the problem is relevant or compelling, and the designs for the solution to the problem are not directly connected to real life materials or solutions that can be used to solve the problem.

The unit introduces a problem to students: the Sleeping Bear Dunes are changing. Students have opportunities to directly experience this problem, but they are not explicitly informed about what issues the change is causing, resulting in students most likely not being authentically motivated or curious to solve the problem. Related evidence includes:

- Students are introduced to the anchoring problem as directly as possible by viewing images and a video (page 10).
- Lesson 1: Students are supported to see that the anchoring problem is important to people: "'We learned that the Sleeping Bear Dunes are also important to people. Let's add that into our Summary Chart. Why else might the changing sand dunes be a problem, now that you know the dunes are important to people?' (People might be sad if the dunes change, the dunes are important to peoples' history and that should be protected.)" (page 22).
- Lesson 1: After completing the investigations, students participate in a class discussion to "identify and build a class consensus as to why sand dunes are important, and why we might not want them to change" (page 18).
- Lesson 1: Students are asked, "We noticed that the sand dunes are changing. Do you think the sand dunes changing would be a problem? Why?" (page 19) and "Why else might the changing sand dunes be a problem, now that you know the dunes are important to people?" (page 20). Students also complete the Importance of Sleeping Bear Dunes student journal page in which

the draw and/or write a response to the prompt, "What problems could the changing Sleeping Bear Dunes cause" (page 22). While students are asked why they think the changing sand dunes is a problem, the real-world reasons why the changing sand dunes are a problem right now is not reinforced explicitly. Students can see from the infographic that the sand dune heights have changed, but they are not explicitly told what problems this is causing in the world (to the plants, animals, community, etc.). They do not have opportunities to experience this directly through images, videos, etc. Only student ideas about the issues are gathered. This reduces the authenticity of the problem, and students may not be as curious or motivated to solve the problem if they do not know the effects it is having.

- Lesson 1 Evaluate: At the end of the lesson, students answer the question, "What problems could the changing Sleeping Bear Dunes cause?" (page 22).
- Lesson 2: Students view photos of the Sleeping Bear Dunes over time and view the Changing Dunes infographic again (page 26). It may be difficult for students to fully comprehend the change in the height of the sand dunes in the photos they are shown. This could potentially decrease the relevance or engagement of students with the problem.
- Although the second half of the unit (Lessons 4–6) focuses on developing designs to help changing sand dunes, students are not supported in accurately seeing how their designs with classroom materials directly connect to real life materials or solutions that can be used to solve the anchor problem.
- Lesson 4: Students begin to design a solution to protect the sand dunes from wind and water. Students test different materials to see how well they resist water and wind, and then select materials to use in their solutions. However, the materials selected for students do not seem to reflect the properties of materials that would be used in an actual solution to the sand dune problem, and students are not scaffolded in bridging the gap or making connections between class materials and real-life materials. Thus, the connection back to problem solving for a real problem is weak.
- Lesson 5: Students develop and test their sand dune solutions to address the anchor problem. However, there is no explicit conversation about how the student materials/designs represent/are connected to real-world materials/designs.
- Lesson 6: Students compare their solutions to the anchor problem and then update and present their final designs. However, there is no explicit conversation about how the student materials/designs represent/are connected to real-world materials/designs. So, it is unclear if students will be able to make connections between their designs and helping the Sleeping Bear Dunes in real life.

Some suggestions for how to connect to students' lives, communities, and experiences are provided in the unit. Some examples include:

- In the "Introducing the Anchoring Problem and Driving Questions" section, the teacher is told, "Students will find the anchoring problem more compelling if they can connect to it personally. If you want to change the anchoring problem for your context, keep the following questions in mind: Is it going to be relevant to my students' lives and/or particularly engaging to them? By researching online, you can find a beach or shore near your community to use as the subject of the unit. Though a sandy area near a body of water might be easiest, any land area that is changing over time due to wind and water can work" (page 10).

- Lesson 1: A teacher side bar suggests making a more personal connection to the phenomenon. "Sleeping Bear National Lakeshore is a National Park, with a robust network of park rangers, conservationists, scientists, and researchers. You can set up a time to chat with a National Parks Ranger at Sleeping Bear Dunes National Lakeshore here" (page 16).
- Lesson 1: In the Read-Aloud Guide in the Appendix, the teacher is told, "Let students know this legend comes from the Anishinaabe people. They are an indigenous peoples native to the region of Sleeping Bear. Ask students to share any personal connections with indigenous nations or peoples" (U10 Appendix, page 4). The Read-Aloud Guide suggestions also promote respect for the Anishinaabe people. A Teaching Tip in the margin note states that, "The Legend of Sleeping Bear provides an opportunity to introduce students to a Native American Legend that helps them to understand the way of life of other cultures. Review the term culture, if necessary (2.RI.6.C.a)" (page 20).
- Lesson 1: In a side bar related to students discussing sand dunes, the teacher is told to, "Have students explore habitats in your area" (page 20). Because no additional guidance is given, it is unlikely that this suggestion will be used productively in most classrooms.
- Lesson 1: A teacher side bar note says, "The Legend of Sleeping Bear includes immense loss and grief. Be mindful of any students or family connections that might be affected by this. Allow students to feel the sadness in this story but connect to the importance of the legend. The Sleeping Bear Dunes have lasting power" (page 22).
- Lesson 4: A teacher side bar notes says, "Have students explore the careers of Civil Engineers and Landscape Architects" (page 60). Real world connections are therefore made to their classroom explorations.
- Lesson 4: During the read aloud, students are asked, "Have you ever had an experience like this; where you have a great idea but it doesn't turn out like you envisioned?" (U10 Appendix, page 7).

In a few places in the unit, helpful prompts are given to the teacher, but it is not clear that enough support is provided to allow the prompts to be used effectively. For example:

- Lesson 1: "To further support students with the CCC element: Things may change slowly or rapidly – connect to students' intuitive ways of knowing and doing science as an entry point. Students will have background experiences with natural changes and consequences" (page 20). It is unclear that teachers have enough support to follow these directions.
- Lesson 2: "To further support students with the SEP element: *Make observations from several sources to construct an evidence-based account for natural phenomena*, connect to students' intuitive ways of knowing and doing science as an entry point. Through natural curious tendencies, students have experience in asking questions and making observations about the world around them" (page 28). It is unclear that teachers have enough support to follow these directions.

Suggestions for Improvement

- Consider explicitly identifying why the changing sand dunes are a problem. Currently, student ideas are gathered about the problems caused by the changing sand dunes, but students do not get to experience these problems directly through images, videos, etc. Showing them examples of the problems (habitat loss, vegetation change, etc.) can help them authentically connect to the problem and see the relevance of the problem they are solving (why is it a problem in the real world?).
- Consider representing the materials that students use in their design solutions more accurately (see II.D). This could help make the engineering process and the solution more real-world based.
- Consider building in explicit conversations during which students can see exactly how their materials and designs can scale to materials and designs used as solutions for the Sleeping Bear Dunes. This can help make the design process less of a design challenge and more problem solving of a real-world problem.
- Consider including opportunities for teachers to support students in cultivating their questions that are explicitly connected to their experiences.

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 many opportunities to express and justify their ideas, and educators are provided with supports to draw out ideas from students. Students also receive both peer and teacher feedback in the unit.

Students have many opportunities throughout the module to express, clarify, justify and represent their ideas. In the student journals, students respond to prompts through writing and drawing. Some examples include:

- Lesson 1: A teacher side bar note says, “Encourage every student to share an idea either with the class, with you, or a classmate. You will likely have some students that speak out often and others who do not feel comfortable communicating in front of the class. Try to support quieter students by finding the forum they are most comfortable communicating through, which might be one on one. Once they feel confident communicating with you, they might develop skills to communicate more openly with others” (page 16).

- Lesson 1: In the pre-assessment, the teacher is told to, "Allow students to Turn and Talk, then share a few answers with the whole class. Record student ideas on a chart so students can revisit and revise their ideas later. At this point, students might not have accurate ideas. Let students use this brainstorm to explore possibilities. Encourage scientific thinking and creativity. If students share ideas, you can ask them to tell you more about their ideas." (page 17).
- Lesson 1: After students read an article, they are told to express their ideas about sand dunes. The teacher is told to press for students to clarify and justify their ideas. "Circulate and use the following questions to help guide student sense-making:…. 'Why do you think sand dunes are important?' (Animals live in them like the Piping Plover. Other special plants and animals can live in the dunes.) 'What evidence makes you think that?' (They work as a barrier so they can protect surrounding areas against bad conditions like storms or big waves.) 'Can you tell me more about that?'" (page 18).
- Lesson 1: The teacher asks students, "'How do the dunes protect against bad weather conditions?' (Sand dunes protect surrounding areas from dangerous conditions. They can act as a shield against bad waves or storms.) 'How do you know?' (We read about it in our research. We saw photos in the research.)" (page 20). Students are therefore asked to justify their ideas.
- Lesson 1: The teacher is given a chart of possible prompts to help expand and clarify student thinking, or to help students build on each other's thinking. The teacher is told, "As students respond to the questions above, consider using the prompts below to encourage more student talk" (pages 20–21).
- Lesson 2: In a student sense-making discussion, the teacher is given prompts to follow up on student thinking. "Can you say more? Do you all agree? Why? Tell me more? [sic] Why do you think that? (Accept all responses)" (page 31).
- Lesson 4: Follow up questions to a class discussion are given. "Tell me more? [sic] Why do you think that? Can you say more? Do you all agree? Why?" (page 58).
- Lesson 5: Students participate in a class discussion to share their findings from testing their designs (page 66). As students respond, the teacher is told to, "consider using the prompts below to encourage more student talk." The prompts help students expand, clarify, or build upon thinking.
- Lesson 5: "Engineering design is an interactive and social process. Giving space for students to reflect on the strengths and weaknesses of their design allows them to learn through failure. Engaging students across engineering teams in discussions allows students to expand their ideas and ways of thinking" (page 71).

Students are supported to revisit their thinking during the unit. For example:

- Lesson 2: "Have them use evidence from their investigations and the class discussion to update earlier explanations and drawings to explain how wind and water can change the Sleeping Bear Dunes" (page 35).
- Lesson 4: "'Before your investigation, which materials did you think would work better? How did the investigation support or change your earlier predictions?' (We thought {insert material} would work better because of X. We noticed that {insert material} worked better than others.)" (page 60).

Students receive feedback from both peers and the teacher at several points in the unit. Some examples include:

- Lesson 2: “Have students work in pairs to review each other’s models and give feedback. Have them use the Peer Feedback Table Tent to identify one thing they like, one question they have, and one suggestion they have about their partner’s explanation or drawing. Provide feedback (written or orally) on the Earth Changes Student Journal Page. Allow students to revise their explanations based on the feedback they received from you and their peers” (page 36). The Peer Feedback Table Tent says, “I am helping my partner think about their ideas. I can use these phrases. I like __. I wonder __. I would change __ because __.”
- Lesson 4: In the Evaluate assessment, the teacher is told, “For students who create a model that does not show their ideas, ask questions about the model to help them revise. Talk to students about what good models include, and use a teacher or student example that other students can use to support the revision of their own models” (U10 Assessment Tracker, page 10).
- Lesson 6: “Once students have shared, have them use the Peer Feedback Table Tent to identify one thing they like, one question they have, and one suggestion they have about each other’s original solutions” (page 77).
- Several times in the unit, the teacher is told to circulate as students work, which can be places for informal feedback opportunities. However, in these cases, not all students may receive meaningful feedback. For example, in Lesson 2 the teacher is told to, “Circulate as students work through their investigations and use the questions below to help guide student sense-making…” (page 28). The teacher is provided with some prompts they can use as they circulate.

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	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials identify and build on students' prior learning in all three dimensions because students' prior learning of targeted elements of all three dimensions is described for teachers and guidance is provided on how they will be used in the unit.

Related evidence includes:

- Lesson 1: "If students have completed Unit 9: Helping Seeds Travel, review the term habitat and the plants and animals that live in different habitats. If they have not completed Unit 9, introduce the term habitat as a place where plants and animals live" (page 20).
- In the Assessment Tracker document, Lesson 1 Engage states, "Listen for students discussing ideas from previous grade levels and possibly previous units in your class. For example, students might say the sand dunes are a habitat for plants and animals (2-LS4-1, Unit 9)" (Assessment Tracker, page 2). This helps identify one PE where students may have relevant prior knowledge.
- Lesson 2: "Scientists and engineers test things to answer questions about the natural world and solve problems. During these tests they gather evidence. Does anyone know what evidence is? What is an example of evidence? (Accept all responses.) Now is a good opportunity to post the evidence vocabulary card" (page 30). However, understanding of the term "evidence" was already required of students in the prior lesson. Students are asked, "What evidence makes you think that?" (page 18).
- A Standards Progression document is provided that describes prior learning and intended development in the unit of targeted elements of all three dimensions. For example:
    - Regarding the DCI element *Wind and water can change the shape of the land*, the "Connection to Prior Experience" column says, "In grade K, students engage with changes to the environment by plants and animals [K-ESS2-2]. Through natural observations and prior experience, they may understand that the earth changes." The "Developed in Unit" column says, "In Lesson 2, students brainstorm what is causing the dunes to change. They work in stations to investigate the way wind and water can shape the land, and update their earlier predictions. Students identify how different intensities

of water and wind can change the land differently" (U10 NGSS/MLS Progressions, page 2).

- Regarding the SEP element: *Make observations from several sources to construct an evidence-based account for natural phenomena*, the "Connection to Prior Grade Level" column says, "In grade 1 students engage in this SEP element in life science and physical science." However, in the "Developed in Unit" column, it says, "In Lesson 2, students are introduced to this SEP element as they make observations from photos to brainstorm an explanation for changes to the dunes. Then they begin to develop the SEP element as they gather additional evidence through photos and investigations to update their explanations for the changing sand dunes" (U10 NGSS/MLS Progressions, page 3). The learning progression teachers are given is therefore not logical, as it describes students being introduced to and beginning to develop an SEP element in which students were already engaged in a previous year.
- Regarding the CCC element: *Things may change slowly or rapidly*, the "Connection to Prior Grade Level" column says, "This is the first time students will engage with this CCC element. Students may understand that environments can be changed by plants and animals" (U10 NGSS/MLS Progressions, page 3). In the "Developed in Unit" column, it says, "In Lesson 2, students are introduced to this CCC element by investigating the causes for how the sand dunes change, and identifying that they can change quickly. In Lesson 3 students continue to develop this CCC element by investigating and identifying both fast and slow changes to the earth. They apply full understanding of the CCC element at the end of Lesson 3, where they use their learning to explain how the sand dunes may change slowly or rapidly" (U10 NGSS/MLS Progressions, pages 3–4).

Suggestions for Improvement

Consider ensuring that a logical progression of learning is described for all targeted elements of the three dimensions.

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. However, there are several parts of the unit that may promote misconceptions or that have inaccurate information.

Some helpful supports are provided to the teacher to promote accuracy at a grade-appropriate level.

- The teacher is given background information related to the science, cultural background, and engineering connections in the unit (U10 Appendix, page 3).
- Lesson 2: "At this point, students might not have accurate ideas. Let students use this brainstorm to explore possibilities. Encourage scientific thinking and creativity" (pages 28–29).

Lesson 4: Students use different materials in a model of a design solution. However, their model components might lead to misconceptions about real world materials. The difference between the model and real life is discussed with students, but without a deep understanding of the real-life materials (e.g., plant roots), misconceptions might remain. After students investigate several different materials, the teacher is told, "Remember, the materials we were using represent real materials that engineers might use to stop sand from being moved by wind and water. Let's look back at what our pipe cleaners did. Do you think all plants in sand would be moved this way? Why or why not? (No because there is a lot more sand on a beach than what we have in our tray.) If students struggle to make comparisons, show them the image of the plants in sand on the Materials Investigation: Pipe Cleaners Student Journal Page. Repeat this discussion until students have compared the results to how the real material might behave. They should consider how sand fences are anchored down usually, so it would be much more difficult to move them than it was in our investigation. Walls are also built in deeper sand typically so they would not sink or be fully submerged in water. Support beams are typically anchored in deep sand making it unlikely they would float away in the water." The extent to which students will understand the concept of anchoring without physical examples is unclear. For example, many plants on the beach are anchored by root systems, but the root systems are not discussed with or shown to students.

Suggestions for Improvement

Consider clarifying the models used in Lesson 4 to increase their similarities to the real-world materials they represent.

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	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials provide guidance for teachers to support differentiated instruction. The materials provide a lot of support for students who are struggling. However, the materials do not explicitly state how the suggested supports or strategies may also help students who read well below grade level or learners with disabilities in their development of the unit learning goals for all three dimensions. Other than Spanish translations, varied accessibility supports such as reading or listening alternatives, adaptations, and related phenomena are also not provided.

Vocabulary supports are provided in the unit. However, note that the potential student audiences for these supports is not identified. Related evidence includes:

- Lesson 1: Vocabulary cards are introduced after students have discussed the concepts first (page 20).
- The vocabulary slides list all vocabulary words in both English and Spanish.

Some suggestions for how to support struggling students are included in the unit. Some examples include:

- Assessment Tracker Document: For each of the identified assessment opportunities, suggestions for how to support students struggling with the targeted elements are included. For example, Lesson 4 Evaluate states, “Models should be accurate representations of their ideas, but may look different. For students struggling to model their ideas (SEP, DCI), encourage sketching or have partners work together with one drawing. For students who create a model that does not show their ideas, ask questions about the model to help them revise. Talk to students about what good models include, and use a teacher or student example that other students can use to support the revision of their own models. If students are struggling with the CCC and selecting materials, ask questions or lead a class discussion on why students chose the materials they did.

Support students in using evidence from their investigation about materials" (Assessment Tracker, page 10).

- Lesson 1: "Modified Directions: For students who struggle with writing, prompt them only to draw and verbally explain their picture to you" (Student Science Journal Key, page 6).
- Lesson 3: "If students are struggling to make these connections, refer back to the videos in the slides of the stormy waves and the calm waves" (page 45).
- Lesson 4: "If students are struggling to come up with ideas in the brainstorm, ask questions about how they stay dry in the rain, or how they bundle up to protect themselves from the wind. Continue asking questions about trees or other structures in the rain and wind" (page 56).
- Lesson 4: In the Quick Check, a sentence stem is provided for students who struggle. "___is a good material to use because ___" (U10 Student Science Journal Key, page 25).
- Lesson 5: "If students are struggling, invite students to make simple updates to their designs as necessary. They should stick with the combination of materials they selected in Lesson 4. Ask: 'I see that [X] isn't working in your design. Is there another way you could try to use [X]?'" (page 68).
- Lesson 6: "Modified Prompt: For students who struggle to synthesize the learning from previous lessons, direct them to earlier journal pages about the dunes changing, how they are changing, and why this is a problem" (U10 Student Science Journal Key, page 31).

Several extension opportunities are provided in the unit. Many of these opportunities focus on deepening DCI understanding, but there are some opportunities for deepening CCCs and SEPs. Some examples include:

- Lesson 1 Evaluate: The Assessment Tracker, states that, "If students have shown mastery of the standard, allow students to further research the Sleeping Bear Dunes using 'Sleeping Bear Dunes National Lakeshore Michigan' from The NPS. Students can explore the other important aspects of the dunes, including for recreation. They should make observations or gather additional information they can use for the unit" (Assessment Tracker, page 3). This can help deepen DCI understanding and provides an opportunity for students to practice using a non-focal SEP element.
- Lesson 2: At the end of the lesson, an extra activity is included in the student journal. The teacher is told, "There is an extension opportunity to expand student capabilities as part of this formative assessment in the student journal" (page 37). In the activity, students mostly do the same kind of activity as was done previously in the lesson but might extend their data analysis skills as they need to make sense of two aerial photographs of land. However, teacher support is not provided to help students understand what they are looking at and that the different shades of gray indicate land versus water versus vegetation. If students are able to interpret the photos correctly, they could deepen their DCI understanding.
- Lesson 3 Explore: A Differentiation Strategy margin note states, *"*There is an extension opportunity to expand student capabilities as part of this formative assessment" (pages 42–43). The Assessment tracker states, "If students have shown mastery of the standard, have them make new observations about changes to Earth's surface that can happen quickly or slowly, using the following PBS resource: Fast and Slow Changes" (Assessment Tracker, page 6). The

teacher is told to, "Challenge students to make a list of ways things change over time. The changes can be large Earth changes like the ones found in the unit (for example, sand dunes changing shape) or changes from their own lives (for example, a flower growing in the spring, or the seasons changing each year). Have students share their lists to compare how things can change quickly or slowly" (page 43).

- Lesson 3: At the end of the lesson, an extra activity is included in the student journal (U10 Student Science Journal, pages 17–18). It would build students' understanding of an unclaimed grade 3–5 CCC element: *Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.*
- Lesson 5: "Some student groups will build their models quickly, while others might need more time. Groups should be able to easily transition into testing when they are ready. If teams finish building and testing their models before other teams are done, have them review their observations and share what worked or didn't work" (page 69). Note that this additional activity does not extend student learning in any of the three dimensions.
- Lesson 6: At the end of the unit, there is an optional "Extend" opportunity. "If desired, give time for students to build and test their updated models. They can collect data and make any changes before they present their final solutions. As an option for presenting their final solution, students could write letters to a park ranger at Sleeping Bear Dunes National Lakeshore. Use shared writing to construct an example of letter writing with students. Support students to use the scientific vocabulary from the unit as well as transition words as you model. Finally provide students the opportunity to construct their own written explanation using the Sleeping Bear Letter Writing Student Journal Page" (page 82).

Suggestions for Improvement

- Consider providing more extension activities that help students deepen their understanding of CCCs and SEPs.
- Consider explicitly defining what "mastery of standard" looks like for Section 2 of the unit.
- Consider providing explicit supports for learners with disabilities and learners who read well below grade level.

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	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials support teachers in facilitating coherent student learning experiences over time. There are explicit strategies and tools used in the unit to help teachers link learning across lessons and to develop and revisit questions. However, little guidance is provided for helping students see how their SEP and CCC understanding is contributing toward problem solving.

Guidance is provided to teachers to support linking student engagement across lessons. For example:

- A Fast Track Pacing Guide is provided that helps teachers make informed decisions about shortening the materials while maintaining their coherence for students (page 9).
- A “Quick View” is provided for each section of the unit, providing teachers with a table view of student activities, DCI-related learning, and connections to the anchoring problem (termed “Anchoring Phenomenon” in the table) for each of the lessons in the section (e.g., page 12).
- The unit materials provide guidance for how to develop the DQB and when to visit and add to it. Related evidence includes:
    - In the *Introducing the Anchoring Problem and Driving Questions* section, the teacher is provided with guidance for how to use the DQB in the unit, when to generally visit it (beginning and end of lessons), and what materials/tools they can use to develop it (page 9).
    - In the *Introducing the Anchoring Problem and Driving Questions* section, a margin note states, “for more information about setting up and revisiting the DQB, see the mySci Teacher Playbook” (page 9).
    - Introducing the Anchoring Problem and Driving Questions: Guidance is provided for developing the DQB based on student questions about Sleeping Bear Dunes (page 10).
    - At the beginning of each lesson, the teacher is prompted to revisit the DQB. Guidance is provided for what type of question to look for to connect to the lesson. Instructions state, “if no questions directly relate, use prompts to build on student questions.” However, guidance in terms of example prompts that can be used is not provided.

Throughout the unit strategies are provided that allow students to recognize what they have learned about the problem. However, these strategies do not explicitly support students in seeing what else may be missing from them figuring out the problem. Many of the strategies also focus heavily on helping students see the progress in their DCI understanding rather than for all three dimensions, although some support is provided for connecting to students' learning in at least one SEP element and one CCC element. Related evidence includes:

- Unit materials provide Lesson Summary Charts for each lesson. These summary charts help students to summarize what they learned from the activities in the lesson and think about what this learning tells them about the Sleeping Bear Dunes problem. Some examples include:
  - Lesson 1: In the Explain section, students identify why sand dunes are important and why changing sand dunes might be a problem (page 18). The teacher records student responses in the Lesson 1 Summary Chart. In the Elaborate section, after reading *The Legend of Sleeping Bear*, the teacher leads a short class discussion to update the Lesson 1 Summary Chart with new information (page 20). This chart helps students explicitly consider their DCI learning in the lesson.
  - Lesson 2: In the Explain section, students discuss what they observed when they modeled strong waves vs. gentle waves (page 29). The teacher records student responses in the Lesson 2 Summary Chart. This chart helps students explicitly consider their DCI learning in the lesson.
  - Lesson 3: In the Explain section, students discuss what they observed when they modeled quick vs. slow changes (page 40). In the Elaborate section, after reading *The Sun, The Wind, and the Rain*, the teacher leads a short class discussion to update the Lesson 3 Summary Chart with new information (page 42). The teacher records student responses in the Lesson 3 Summary Chart. This chart helps students explicitly consider their DCI learning in the lesson.
- Lesson 2: After the teacher reviews with students what patterns are and what patterns they noticed, students are asked, "What do our observations and the patterns we noticed form these activities tell us about why the sand dunes are changing? (Wind and water can change the shape of sand dunes.)"
- Lesson 3: Students discuss their findings from their investigations. The teacher is told, "The goal of this class discussion is to analyze their data and identify how changes can be made quickly or slowly." Later, the teacher is told to say, "Big and small waves or wind are only some ways the Earth can change. Can anyone think of another way the earth can change quickly?...What about a way the Earth can change slowly?"
- Lesson 6: Students are asked, "What objects worked well to protect the dunes against slow changes? How did the properties of those objects help them protect the dunes? What objects worked well to protect the dunes against fast changes? How did the properties of those objects help them protect the dunes?" (page 78).

Suggestions for Improvement

- Consider making the summary charts span across lessons, so that instead of being individual per lesson, students could collect their DCI understanding in one place across the lessons to see how their learning is building to help them figure out a solution to the problem.
- Consider making summary charts that show students how their SEP and CCC understanding is progressing throughout the unit so that they can see how SEP and CCC understanding is also contributing to problem solving. Alternately, consider providing facilitation supports for teachers to help students explicitly consider the usefulness of their SEP and CCC learning in relation to their problem solving.
- Consider providing some guidance at the end of each lesson to cultivate new student questions that connect to future learning.

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 students have some minimal opportunities to become more proficient and independent with some claimed SEP learning over time, but this does not happen clearly with all targeted SEP elements.

Claimed focal elements include:

- *Develop a simple model based on evidence to represent a proposed object ~~or tool.~~*
  - This SEP is claimed as a focal SEP in Section 2 of the unit (Lessons 4–6). Throughout the unit students slightly deepen their proficiency in this element by considering it explicitly in Lesson 4, comparing diagrams with others in Lesson 5, and revising their models in Lesson 6.
  - Lesson 4: "'Now that you have some ideas, you are going to create a model that represents those ideas. Why do you think scientists make models?' (Accept all responses) 'Models can help us describe or explain something to others'" (page 56). Students are therefore supported to build toward an understanding of this element. Based on their findings from the materials stations in the Explore section, students choose which materials they want to use for their solutions (page 57). In their student journals, students are told to, "Draw or update your earlier solution idea using your

  selected materials" (Student Journal, page 25). Based on the limited guidance provided in student facing materials, not all students may develop simple models.
  - Lesson 5: Students draw and compare diagrams of their proposed design solutions. They also build a physical model for their proposed solutions (page 63). Students build this model based on their findings from testing the different materials in the previous lesson.
  - Lesson 6: Students work in groups to update their designs using a new combination of materials (page 74). Students use evidence from the class investigations to select the materials and draw their updated solution in the Final Solutions student journal page. As students revise their models, the expectations increase compared to those in Lesson 5. However, note that model revision is not expected of all students in Grade 2.
- *Analyze data from tests of an object or tool to determine if it works as intended.*
  - This SEP is claimed in Lessons 2–5 but is only claimed as a focal SEP in Section 2 of the unit (starting at Lesson 4). However, student scaffolding does not change between Lessons 4 and 5, the lessons in which this element is claimed.
  - Lessons 2–3: Students analyze data from their investigations, but they do not test an object or tool to determine if it works as intended. Instead, as students share their observations and identify relationships in the discussion, they engage with pieces of the following SEP element: *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.*
  - Lesson 4: Most of this element is claimed (not the tool part). Students test different materials and analyze the data from their tests. The Analyze Materials Data student journal page asks students to check off if each material worked well in water and wind. Through these steps, students predict how certain materials will work and then analyze their data from testing the materials to see if the materials did work as they thought.
  - Lesson 5: This element is claimed. Students test different materials and analyze the data from their tests. Students review their observations from testing their designs and then identify the strengths and weaknesses of their design in the Analyze Solutions: Strengths and Weaknesses student journal page (page 65).
- *Make observations from several sources to construct an evidence-based account for natural phenomena.*
  - This SEP is claimed as a focal SEP throughout the unit. Students have slightly less scaffolding to engage with this element in Lesson 3 as compared to Lesson 2.
  - Lesson 2: This element is claimed. The teacher states, "Scientists and engineers test things to answer questions about the natural world and solve problems. During these tests they gather evidence. Does anyone know what evidence is? What is an example of evidence?" (page 27). This discussion helps students build an understanding of what evidence is so that they are able to identify and use evidence in their explanations. Students engage in an investigation, and then discuss the results. "'What might this experiment tell us about the sand dunes?' (The waves can change the shape of the sand. The stronger the waves, the more the sand changes. The wind caused the sand to shift

locations. The stronger wind caused more sand to move at once.) 'How do you think these activities explain how water and wind affect the land?' (These activities show that wind and water can change the shape of sand on the beach.)" (page 31). In the individual student task, students are told to, "draw and write: Why are the sand dunes changing?"…"I know the sand dunes are changing because __." The answer key says that students get full credit "if they include accurate evidence from both investigations" (U10 Student Science Journal Key, page 9).

- Lesson 3: This element is claimed. Students engage in an investigation and do a reading, and then discuss their findings. They are told to, "draw and write: Draw how the sand dunes are changing quickly or slowly…..Sleeping Bear Dunes can change quickly because ___. Sleeping Bear Dunes can change slowly because___" (U1 Student Science Journal, page 15). Students therefore make and use observations from two sources to explain how the dunes can change slowly and quickly.

Suggestions for Improvement

For all claimed SEP learning goals, consider clearly reducing the amount of scaffolding students receive throughout the unit such that students are expected to engage more independently over time.

OVERALL CATEGORY II SCORE: **2** (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

III.B. FORMATIVE

III.C. SCORING GUIDANCE

III.D. UNBIASED TASK/ITEMS

III.E. COHERENT ASSESSMENT SYSTEM

III.F. OPPORTUNITY TO LEARN

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	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials elicit direct, observable evidence of students using practices with DCIs and CCCs to make sense of phenomena and design solutions. Assessments are based on real-world scenarios and focus on sense-making. Individual, multi-dimensional student artifacts are collected throughout the unit in the Student Journal. However, many assessments only require students to use two of the three dimensions, and there is a mismatch between many of the assessment goals in the unit and the assessment of the three dimensions.

Student artifacts are mainly produced through the pages and assessments they complete in their Student Journals. Students produce artifacts in the form of writing and drawing. These artifacts elicit some direct, observable evidence that students are integrating multiple dimensions in service of sense-making or problem solving. Some examples include:

- Lesson 4 Evaluate: Students complete the Design a Solution student journal page. On this page, students are prompted to select materials they would like to use for their solution and are asked "why?" They are then provided with the following prompt: "Draw or update your earlier solution idea using your new selected material" (Student Journal, page 25). Students use the following elements of the three dimensions in their artifact:
    - SEP: *Develop a simple model based on evidence to represent a proposed object ~~or tool.~~* Note that some students might not develop a new model based on the student prompt given.
    - DCI: **PS1.A.** *Different properties are suited to different purposes.*
    - CCC: *The shape and stability of structures of natural and designed objects are related to their function(s).* Note that the first part of this element is not elicited in student responses, although it is claimed.
- Lesson 6 Evaluate: The Assessment tracker document identifies the "Performance Task" as a summative assessment opportunity (page 12). Some of the prompts in the task require students to use multiple dimensions together to solve a problem. Students use the following elements of the three dimensions in their artifact for each prompt:
    - Prompt: "Draw or update your earlier solution idea using your new selected materials."
        - SEP: *Develop a simple model based on evidence to represent a proposed object ~~or tool.~~*
        - DCI: **PS1.A**. *Different properties are suited to different purposes.*

        - DCI: **ETS1.B**. *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.* Student responses do not require an understanding of this element.
        - CCC: *The shape and stability of structures of natural and designed objects are related to their function(s).* Note that the first part of this element is not elicited in student responses, although it is claimed.
    - Prompt: "Why do the Sleeping Bear Dunes need a solution like this?"
        - DCI: **ESS2.A** *Wind and water can change the shape of the land.*
    - Prompt: "Draw how your solution protects the dunes against wind. Draw how your solution protects the dunes against the waves."
        - SEP: *Develop a simple model based on evidence to represent a proposed object ~~or tool.~~*
        - DCI: **ESS2.A**. *Wind and water can change the shape of the land.*
        - DCI: **PS1.A**. *Different properties are suited to different purposes.*
        - CCC: *The shape and stability of structures of natural and designed objects are related to their function(s).* Note that the first part of this element is not elicited in student responses, although it is claimed.

Students are asked to apply their learning to new contexts. In Lesson 4, students are prompted, "'Imagine you were using these materials to solve a totally different problem: that you wanted to build a building. How would you test the materials to choose which ones to use for your building?' (We would see which ones can be combined together in the best way) 'What about if you wanted to dig a hole? How would you test the materials to see which ones to use?' (We would use the different materials to try digging a hole)" (page 60). However, students are asked to share their answers with their peers and some students share with the whole class, so it is unlikely that the teacher would be able to gather student artifacts from every student at the same time.

Suggestions for Improvement

- Consider ensuring that assessment prompts require student use of all three targeted elements.
- Consider providing guidance for the teacher to collect evidence of individual student artifacts during whole class discussions.

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. Formative assessment opportunities are explicitly identified in unit materials and are regularly integrated in the instructional sequence. The materials provide support for modifying instruction for struggling students and those who are proficient.

Throughout the unit, formative assessment opportunities are described in the Assessment Tracker. In the Teacher Guide, the margins include a green check mark symbol and a formative assessment note to identify where in the instructional sequence the formative assessment occurs. For each identified formative assessment opportunity, the Assessment Tracker document includes assessment opportunity name, PE, the elements assessed, how the teacher can assess student progress, and suggestions for adjusting instruction. Some formative assessment opportunities include:

- Lesson 1: After students collect information, they are asked to express their ideas about it and to ask questions. The Assessment Tracker says, “For students who are struggling, pull out examples of strong questions, and discuss what makes a good scientific question. If students have shown mastery of the standard, have them sort their questions into categories” (U10 Assessment Tracker, page 3).
- Lesson 2: “If students are struggling with the DCI about force, pushes, and pulls, gather the class and have them draw models of pushes and pulls from the wind and water. Identify how wind and water movements can act as a push or a pull. If students are struggling to analyze data from their investigations (SEP), bring the class together to model how to analyze the data they collected. You can do this by displaying one student’s before and after drawings and asking students what they notice about the two pictures. Have students describe what happened during the experiment by looking at the differences between the two drawings. If necessary, you can do the entire investigation as a class demo and model how you would analyze the data. To support students with the CCC, ask students how they were able to gather evidence from the tests they used. If students have shown mastery of the standard, they can redo the investigations with a focus on the direction of the forces. Have students change the direction of the wind or the waves to determine the effects” (U10 Assessment Tracker, page 4). Note that the DCI in question does not mention forces at this grade level, so the formative assessment support might be confusing for teachers.

- Lesson 2 Evaluate: The suggestions for adjusting instruction state, “If they are struggling with the SEP constructing explanations, model how to construct a complete explanation for the class. Support students to understand that an explanation includes observations from the stations, and the science ideas these observations teach us. To support this, it may be helpful to reintroduce the model and help students identify their observations (that the sand moved when the wind blew and the water moved), and what this tells us (wind and water can change the sand dunes). This also supports students who are struggling with the DCI and/or CCC. It can also be helpful to pick student examples, and have students discuss which explanations are strong, and why. They then can compare their explanations to the student examples, in order to self assess how to improve their explanations. If students have shown mastery of the standard, provide students with the Mississippi Delta example of wind and water changing Earth's surface. This is found in the Student Journal, and indicated with the gear icon.” In the Teacher Guide, the teacher is instructed to, “provide feedback (written or orally) on the Earth Changes Student Journal Page.” Students receive an opportunity to revise their explanations based on the peer and teacher feedback.
- Lesson 4: “If students are struggling to analyze data from their investigations (SEP), bring the class together to model how to analyze the data they collected. If necessary, you can analyze the materials data together as a class. If they are struggling with the DCI, have students describe the properties of the materials. Support students to do this by giving an example of what a property is. Next, discuss the purpose for the different materials. Then look at the data and discuss how the properties of the materials helped that material protect the sand dune. If they are struggling with the CCC, ask students how the investigation provided evidence that some materials are better than others because of materials properties. If students have shown mastery of the standard, have students design another test using a single material that is available in the classroom, to determine if it would help in their sand dune solution” (U10 Assessment Tracker, page 8).
- Lesson 4: “Support students in using evidence from their investigation about materials” (U10 Assessment Tracker, page 10). This is unlikely to be sufficient guidance for a teacher to know how to provide this kind of support.

Suggestions for Improvement

Consider ensuring that teachers are supported to help all students build toward proficiency in all targeted learning goals.

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. General answer keys are provided for student journal pages, but there is often not enough guidance to support teachers in interpreting student performance and understanding what proficiency looks like for individual targeted elements of all three dimensions. Also, a varied range of student responses are not described to support teachers in providing more individualized support.

The Assessment Tracker Document identifies the elements of the three dimensions that are the assessment targets and provides an answer key to help score student responses. For example:

- Lesson 1: After students collect information, they are asked to express their ideas about it and to ask questions. The Assessment Tracker lists an SEP element from **Asking Questions** and a DCI element from **ETS1.A** that can be assessed (although note that the DCI is not fully assessed as claimed) (U10 Assessment Tracker, page 3).
- Lesson 3 Evaluate: Assessment targets are identified at the element level for each dimension. The targets are identified for the task in general, and not for each prompt in the task (U10 Assessment Tracker, pages 6–7).
- Lesson 4: The suggestions for adjusting instruction include support for both struggling students and students who have shown mastery of the standard. However, what the teacher needs to see for "mastery of standard," is not explicitly described (U10 Assessment Tracker, page 10).
- Lesson 5 Evaluate: The Assessment tracker document identifies a summative assessment opportunity for "Discussion" (U10 Assessment Tracker, page 11). Assessment targets are identified at the element level for DCIs and SEPs. To assess student progress, the teacher is told to, "Listen for students to share observations based on their data. Notice which students connect to data from their investigations or comparing how solutions worked" (Assessment Tracker, page 9). However, noticing "which students connect data from their investigations…" is unlikely to assess student understanding of the claimed SEP assessment target: *Analyze data from tests of an object or tool to determine if it works as intended*.
- Lesson 6: The "Performance Task" is identified as a summative assessment opportunity (U10 Assessment Tracker, page 12). A rubric is provided for this performance task. The rubric identifies the five PEs addressed by the task. However, the organization of the rubric does not allow for a clear interpretation of which assessment targets are associated with which prompts

in the task. The rubric organizes the rows by the PE addressed by the task. The row for each PE then contains: the three-dimensional element(s) that are targeted, an answer key, and total points possible. For example, the row for K–2 **ETS1-1** identifies a SEP and DCI element and then for the answer key the box states, "Student explains the problem and why their solution solves the problem. 1 pt: explains the problem and why the dune solution solves the problem; 1 pt: explains any reasons to protect the dunes: plants, animals, or people." It is unclear which prompt this answer and the points refer to. There is no explicit identification of which prompts are associated with the rows in the rubric.

The "Assessing Student Progress" section in each lesson describes what the teacher can look for to assess student progress. However, there is often not explicit identification of what students need to do to show proficiency for the individual targeted elements. Also, sometimes the language used in the section does not provide enough guidance for how to interpret student progress. Some examples include:

- Lesson 1 Explore: "Review student responses in the student journal. Sort student responses into three piles or tally them based on how well they use observations to ask questions" (Assessment Tracker, page 3). "How well" does not provide specific guidance for the teacher to interpret SEP understanding.
- Lesson 4 Explore: "Circulate during pair-share or collect written responses. Sort written responses into three piles or tally them based on how well they use data as evidence for choice" (Assessment Tracker, page 9). "How well" does not provide specific guidance for the teacher to interpret SEP understanding.
- Lesson 6 Explore: "Review student responses. Use the Student Journal Answer Key to score student responses" (Assessment Tracker, page 12). The answer key does not provide explicit guidance as to what students need to include in their answers to show proficiency, and assessment targets are not identified for each prompt. The answer key also does not include a possible range of student responses.

A Student Science Journal answer key is provided to help teachers score student responses throughout the unit. The key provides correct answers for the prompts in the journal. For example:

- Often when the prompts ask students to make drawings, the answer is provided in writing and not as a drawing. There is often not enough guidance to see exactly what components students should be including. Some examples include:
    - Lesson 4 Solution Brainstorm page: Students are prompted to, "Draw and label a possible sand dune solution" (Student Science Journal Answer Key, page 18). The correct answer states, "Drawing of anything that could support or hold up the dunes. Accept all possibilities." This answer does not provide the teacher with sufficient guidance to allow monitoring of student progress.
    - Lesson 6 Final Dune Solutions page: This page is identified as a summative assessment. The student is prompted to, "Draw or update your earlier solution idea using your new selected materials" (Student Science Journal Answer Key, page 30). The answer key states, "Drawing of a solution using 2 or 3 materials. Solution should use the materials

that they selected. Drawing should include a sand dune and something on top of or supporting it. Drawing should include labels or arrows to show their thinking." This answer does not provide the teacher with sufficient guidance to monitor student progress for the targeted three dimensions.

- A range of student answers is often not provided. When provided, the key provides a "1 point answer" and a "2 point answer."
- Lesson 1: Students are told to, "Draw or write about the Sleeping Bear Dunes." The answer key for drawings says, "Drawing of the dunes, shows them next to a lake. Should include plants and animals" (U10 Student Science Journal Key, page 3).
- Lesson 2 Explain: The assessment targets listed are grade appropriate (U10 Assessment Tracker, page 4), but the actual discussion prompts use the vocabulary word "force" that isn't part of the K–2 student expectations in the NGSS. The assessment targets listed in the scoring guidance therefore might be slightly confusing for teachers, as they don't exactly match what students are asked to do. However, the scoring guidance itself does not require student use of the word force. For example, it says, "Might include force or big changes and small changes" (U10 Student Science Journal Key, page 4).
- Although the scoring guidance for most formative assessment opportunities lists targeted elements of the three dimensions, teacher "look fors" are typically not identified as being associated with a particular element or dimension. However, in Lesson 3, an extra table is included in the answer key with a "description of performance" for each of the three dimensions. For example, the "Description of Performance for CCC" says, "Student identifies at least one way Earth can change slowly and one way Earth can change quickly" (U10 Student Science Journal Key, page 16). In addition, in the Assessment Tracker, a rubric is provided with color coding for student performances in relation to the three dimensions. However, the prompts related to these three dimensions are not identified, and a range of student answers is not provided.
- Lesson 5: In the Explain formative assessment, students are asked to, "Review your observations from the investigations. What are some strengths and weaknesses of your solution?" (U10 Student Science Journal, page 29). The prompt and scoring guidance for this assessment do not elicit student understanding of the DCI element, **ETS1.C**: *Because there is always more than one possible solution to a problem, it is useful to compare and test designs is listed as an assessment target*.

Suggestions for Improvement

- Identifying the assessment targets for each prompt in the rubrics and answer keys would strengthen the evidence for this criterion.
- Consider reorganizing the rubric for the summative performance task so that it is organized by prompt and each prompt clearly identifies the assessment targets (at the element level) and a range of student answers.
- Consider adding to scoring guidance so that a range of student responses and interpretation guidance is described to support teachers in providing ongoing targeted feedback to individual students.

- Consider consistently providing scoring guidance for student progress in all three dimensions.

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. The text volume in the student assessments are grade-level appropriate and representations are fair and unbiased.

Materials and prompts provided to students are accessible and unbiased. Related evidence includes:

- Students are provided with a mix of text and visuals throughout the unit, including in tasks.
- The teacher reads the books out loud to the students, and the unit materials provide read-aloud guides for the books.
- The student journal pages divide prompts into manageable, grade-appropriate prompts.
- The representations in the unit are fair and unbiased.
- The materials recognize that the sand dunes in the anchoring problem are specific to a region, and they state that, “By researching online, you can find a beach or shore near your community to use as the subject of the unit. Though a sandy area near a body of water might be easiest, any land area that is changing over time due to wind and water can work” (page 9).

Support is provided for students to respond to assessment prompts using multiple modalities. Related evidence includes:

- Throughout the unit, students are told to respond to prompts in different ways: talking about their learning with groups and the class, writing their answers, and drawing.
- Lesson 1: In the student journal, students have options for modality of response. “Draw or write about the Sleeping Bear Dunes” (U10 Student Science Journal, page 3).
- Throughout the unit, in the Student Science Journal answer key, when students are told to, “draw and write,” the teacher is told, “Modified Directions: For students who struggle with writing, prompt them only to draw and verbally explain their picture to you” (e.g., U10 Student Science Journal Key, page 9).

- Lesson 4: Multiple modalities are available for student responses. “Quick-check: Have students pick one material from their investigations and write or draw and/or pair-share if that material would work as a good dune solution” (page 58).
- Lesson 5: “Modified Directions: For students who struggle with writing, prompt them to verbally explain the strengths and weaknesses of their solutions and the other teams[sic] solutions” (U10 Student Science Journal Key, page 29).

Suggestions for Improvement
N/A

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	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials include pre-, formative, summative, and self-assessment measures that assess three-dimensional learning. The materials claim to include pre-, formative, and summative assessments, and an Assessment Tracker is provided that pulls together information about all of the formal assessment opportunities in the unit, including pre-, formative, summative, and peer assessment. However, not all of these assessment opportunities connect to the claimed learning goals.

Two pre-assessment opportunities are identified in the unit materials:

- “Introducing the Anchoring Problem and Driving Questions” section: The teacher is told, “The driving question board is a chance to informally pre-assess your students. See the Assessment Tracker for further guidance” (page 11). In the Assessment Tracker, the teacher is told that this activity assesses an **Asking Questions and Defining Problems** SEP, but to also listen for possible connections to the unit’s DCIs and CCCs (Assessment Tracker, page 2). A suggestion for adjusting instruction is included. However, this suggestion seems to help adjust instruction to get student questions tailored more toward the unit-level driving questions than helping students develop the **Asking Questions** SEP element.

- Lesson 1: The teacher is told, "The discussion is a chance to informally pre-assess your students. See the Assessment Tracker for further guidance" (page 17). In the Assessment Tracker, the teacher is told that this discussion could connect to the unit's DCIs (U10 Assessment Tracker, page 2). The teacher is instructed to circulate during the discussion and to listen for them discussing ideas from previous grade levels or units. However, the specific ideas to listen for are not identified and a circulation of the room does not ensure that all students will receive a pre-assessment check.

Formative Assessment:

- See related evidence under Criterion III.B.

A few self-assessment opportunities are identified in the unit, although sufficient self-assessment opportunities through which students could assess their progress in learning in the three dimensions are not explicitly identified or integrated in the unit materials. Related evidence includes:

- Lessons 3 and 6: Students are given a Self-Check Form (e.g. page 48). However, the form does not support students in monitoring learning in relation to specific learning goals. Most of it focuses on student self-monitoring of emotions.
- In the Assessment Tracker, in the Lesson 2 Evaluate formative assessment opportunity, the Suggestions for Adjusting Instruction section suggests that, "It can also be helpful to pick student examples, and have students discuss which explanations are strong, and why. They then can compare their explanations to the student examples, in order to self assess how to improve their explanations" (Assessment Tracker, page 5).

Several Summative Assessment opportunities are identified in the unit. Related evidence includes:

- Lesson 3: The teacher is told to, "Refer to the Section 1 Performance Levels to summatively assess student progress for this section" (page 48). Note that a separate task is not associated with this assessment guidance, although teachers are asked to look in four different places for cumulative evidence of student performance (U10 Assessment Tracker, page 7). In this summative task, the first prompt asks students to, "Draw and Write: Draw how the sand dunes are changing quickly or slowly." Most students are probably using the three dimensions together to complete this prompt.
- Lesson 4 Explain: This assessment is marked as being summative (page 60). The teacher is told to, "listen for students to share ideas based on their data during the pair share. Notice which students connect to data from their investigations, or to how the material would be used to solve a problem" (U10 Assessment Tracker, page 10). Note that since this is a pair–share activity, it is unlikely that summative assessment data could be collected for each student.
- Lesson 5: This assessment is marked as being summative (page 72). The teacher is told to, "Listen for students to share observations based on their data. Notice which students connect to data from their investigations or comparing how solutions worked" (U10 Assessment Tracker, page 11). However, not all students may participate, reducing the evidence that summative assessment data could be collected for each student.

- Lesson 6: "Have them use their Final Solutions Student Journal Pages to develop their presentation. These pages and their final models will be their summative performance task" (page 79). An answer key and rubric are provided for this task. Some of the prompts in the task require students to use multiple dimensions together to solve a problem.

Suggestions for Improvement

- Consider including rationale for how the different types of assessments work together to provide feedback to teachers.
- Consider designing and including pre-assessments that test students' expected prior knowledge related to all focal learning goals in the unit. Identifying the prior knowledge at the element level for each dimension and designing assessment prompts to target each element could help the teacher see with what understanding students are coming into the unit.
- Consider modifying the scoring guidance for the summative assessments so that it is clear to the teacher which prompts are associated with which assessment targets. This could help the summative assessment better align with the learning goals for the unit.
- See evidence under Criterion III.B for possible ways of strengthening the integration of formative assessments in the unit.

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	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate 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 opportunities to apply feedback and improve their performance in at least one SEP element and two DCI elements. However, these kinds of opportunities are not explicit for CCCs and for other focal SEPs.

Students have multiple iterative opportunities to get feedback on their use of one of the **Developing Models** SEP elements as well as on two of the focal DCIs in the unit. Related evidence includes:

- Lesson 4: In the Evaluate assessment, the teacher is told, "For students who create a model that does not show their ideas, ask questions about the model to help them revise. Talk to students about what good models include, and use a teacher or student example that other students can use to support the revision of their own models" (U10 Assessment Tracker, page 10).

- Lesson 4: After receiving feedback, in their student journals, students are told to, "Draw or update your earlier solution idea using your selected materials" (Student Journal, page 25).
- Lesson 5: Students draw and compare diagrams of their proposed design solutions. They also build a physical model for their proposed solutions (page 63). Students build this model based on their findings from testing the different materials in the previous lesson.
- Lesson 6: Students work in groups to update their designs using a new combination of materials (page 74). Students use evidence from the class investigations to select the materials and draw their updated solution in the Final Solutions student journal page.

Suggestions for Improvement

Consider providing students with explicit opportunities to get feedback on their performance in all focal learning goals in all three dimensions, and to apply the feedback to revise their performance.

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

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)