Pushes and Pulls

DEVELOPER: Great Minds

GRADE: Kindergarten **|** **DATE OF REVIEW:** December 2022

Educators Evaluating Quality Instructional Products

NextGen Science WestEd

Pushes and Pulls

EQuIP RUBRIC FOR SCIENCE EVALUATION

OVERALL RATING: E/I
TOTAL SCORE: 6

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

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	Adequate	**A.**	Relevance and Authenticity	Adequate	**A.**	Monitoring 3D Student Performances	Adequate
B.	Three Dimensions	Adequate	**B.**	Student Ideas	Adequate	**B.**	Formative	Adequate
C.	Integrating the Three Dimensions	Extensive	**C.**	Building Progressions	Inadequate	**C.**	Scoring Guidance	Adequate
D.	Unit Coherence	Adequate	**D.**	Scientific Accuracy	Adequate	**D.**	Unbiased Tasks/Items	Adequate
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	Extensive	**F.**	Opportunity to Learn	Inadequate
			G.	Scaffolded Differentiation Over Time	Adequate			

Summary Comments

Thank you for your commitment to students and their science and engineering education. NextGenScience is glad to partner with you in this continuous improvement process. The unit is strong in several areas, including its attention to realistic expression expectations for young learners. Sample student responses are provided, and a variety of correct, incorrect, and partially correct answers are offered. The lessons have been sequenced with purpose to support students in building understanding toward the targeted *Next Generation Science Standards* (*NGSS*) Performance Expectations (PEs). The use of sidebar call-outs throughout the unit materials not only structures information to make it more palatable to the user, but this structure also highlights key components like the alignment to or use of three-dimensional elements which will likely support educators to engage students in three-dimensional learning.

During revisions, the reviewers recommend paying close attention to the following areas:

- **Considerations for dependence on verbal expression.** While it is not only appropriate but preferred that the fine motor skill (writing and/or drawing) demand is low during the learning sequence because of the grade level, a dependence on verbal expression comes with a need for careful attention to additional explicit educator guidance. Specifically, the following:
    - ***Momentum of Learning:*** Because most student ideas are collected through verbal means, it is likely that a small number of select students may end up driving the momentum of learning. Students that are more comfortable with or capable of spoken language, or students who are more proficient with the discipline will likely be the first to contribute and educators may move instruction forward without considering or addressing other students' ideas.
    - ***Assessment:*** In the instances during which verbal communication is depended on for formal assessment (summative) and/or determining the pace of instruction (formative), it is necessary to build in time and guidance for educators to collect evidence from *all* students.
    - ***Educator Presentation:*** While some references to using Spanish cognates are made when highlighting vocabulary instruction, all questions posed by the educator throughout the unit are presented in spoken English. Added guidance to prompt educators to present questions verbally, written, and through gestures would help to support all learners including, but not limited to multilingual learners and students who struggle with auditory processing.
    - ***Student Response:*** Most suggested student responses to the educator's verbal questions are in spoken English. Differentiation guidance for students with limited spoken English (whether they are multilingual learners or not) as well as offering a variety of formats in which students may respond to a verbal question (e.g., sample verbal response, sample gestured response, sample drawn response, sample response using assistive technology) would expand who is seen as being able to participate in discussions.

  - ***Extension Options:*** For those students that are proficient with writing and/or drawing there are limited opportunities offered for them to apply their strengths.
- **Opportunity for students to revise thinking**. Feedback loops are lacking throughout the learning sequence. This results in very limited guidance to prompt and support teacher to student feedback, peer to peer feedback, or student self-assessment paired with time for students to revise their thinking based on feedback and reflection. Regular and clear guidance about when and how to provide feedback aligned to student performance in the targeted three dimensions will help educators make informed decisions about when to add scaffolds, and when to pull away.
- **Leveraging coherence structures to drive learning from student perspective**. The use of structures intended to ensure coherence is inconsistent. Lessons 4, 7, 11, 17–20, 22, and 23 (39% of lessons) do not incorporate any of the following three structures:
  - ***Anchor Model:*** Developed in Lesson 2 and not used again until Lesson 6, and then again in Lessons 8, 10, 12–14, and 21.
  - ***Driving Question Board (DQB):*** Developed in Lesson 3 and not returned to again until Lessons 9, 10, 13, 16, and 21. This is a significant missed opportunity.
  - ***Anchor Chart:*** Created in Lesson 5, and then only used in Lessons 6, 8, 12, 15, and 21.
- **Phenomenon as the application of learning, rather than a reason for learning.** The phenomenon is presented as "tugboats moving cargo ships," with a unit essential question of "How do tugboats move cargo ships through a harbor?" Students are presented with this question in Lesson 3, Learn (TE, page 27), but they have already, in both Lesson 1 and Lesson 2, been expected to give responses such as, "The tugboat pulls the big ships" and, "We pushed the cargo ship with the tugboat." Students may feel as though they have "figured out" the phenomenon before the question is even posed in Lesson 3. Students will likely feel they can answer the unit's essential question as soon as it is asked.

Page numbers in this report refer to the current version of the Teacher Edition (TE) unless otherwise stated. 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 the criterion was not met.

CATEGORY I

NGSS 3D DESIGN

I.A. EXPLAINING PHENOMENA/DESIGNING SOLUTIONS

I.B. THREE DIMENSIONS

I.C. INTEGRATING THE THREE DIMENSIONS

I.D. UNIT COHERENCE

I.E. MULTIPLE SCIENCE DOMAINS

I.F. MATH AND ELA

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

The reviewers found adequate evidence that learning is driven by students making sense of phenomena because learning is driven by students progressively building layers of explanation related to an anchor phenomenon, investigative phenomena, and completing a design challenge related the unit theme. However, there are missed opportunities in the learning sequence to create a sense of need — from the students' perspectives — to motivate learning and for students to feel as if their contributions are driving the learning.

Students' questions and prior experiences inconsistently drive the pace of the learning sequence. Related evidence includes, but is not limited to:

- Lesson 2, Learn, Model Tugboats in New York Harbor: "Explain to students that they should use the materials to show how a tugboat might move a cargo ship through the harbor. As students work, circulate, and ask groups the following questions: How are you using the tugboat to move the cargo ship through the harbor? How does the model help you understand how tugboats move cargo ships? Record at least one response from each group to refer to when developing the anchor model and the driving question board" (TE, page 23).
- Lesson 3, Learn, Build Driving Question Board: "As students share, record their questions on individual sticky notes. Tell students they will use their questions to build a driving question board. Write the Essential Question across the top of a sheet of chart paper, and post the sticky notes with student questions below the Essential Question. Explain to students that they will return to this driving question board throughout the module as they try to answer their questions and ask new ones" (TE, page 28). While students return to the DBQ in six of the 23 total lessons, there are several missed opportunities in multiple lessons for the teacher and/or students to return to the DBQ to connect to, reflect on, and/or add new student questions.
- Lesson 5, Learn, Create Anchor Chart: "Summarize student responses to conclude that objects need a push or a pull to start moving…Confirm that sometimes pushes and pulls can cause objects to start moving and sometimes they cannot. Tell students that to keep track of their

learning throughout the module, the class will develop an anchor chart. Summarize students' new learning on a sentence strip, and place the sentence strip on the anchor chart" (TE, page 45). While the Anchor Chart serves to summarize and track students' learning experiences using conclusion statements, it is not regularly incorporated (only used into six of 23 lessons: 5, 6, 8, 12, 15, and 21), nor is it consistently leveraged to motivate a need to move onto the next lesson.

- Lesson 9, Land: "Display the driving question board, and read aloud the question on each sticky note. Have students use a nonverbal signal to show whether they can now answer each question. If students signal that they can answer a question, place the sticky note with that question in a new column below the Essential Question. If students cannot answer a question, leave that sticky note under Unanswered Questions. What do you notice about our new group of questions?…Build on student responses to introduce the Concept 1 Focus Question: What causes objects to start moving? Record the Focus Question at the top of the new column of questions" (TE, page 77). Students are not prompted to answer the questions, nor is guidance provided for if and when some students indicate that they can, and others indicate they cannot answer the question. Additionally, students are not provided an opportunity to ask new questions based on their learning so far in the learning sequence.
- Lesson 10, Launch: "Invite students to share their questions about how a tugboat turns a cargo ship to move it in different directions. Add these questions to the driving question board, and build on them to introduce the Phenomenon Question How can tugboats turn a cargo ship?" (TE, page 86).
- Lesson 13, Launch: "As students share what they wonder, record their questions on individual sticky notes, and add the sticky notes to the driving question board" (TE, page 108).
- Lesson 13, Land, Teacher Note: "To encourage students to share about prior experiences that may have informed their plan, consider asking the following questions: Can you think of a time when you tried to stop a moving object? What worked then? What did not work?" (TE, page 112).
- Lesson 14, Learn, Make Predictions with Water Model, Check for Understanding: "Listen for students to support their predictions with prior events or experiences (SEP.3). If students do not mention personal experiences, prompt them with questions such as these: What have you noticed before that can help you make a prediction? Have you ever used a push or a pull to stop something from moving?" (TE, page 116).
- Lesson 16, Land: After organizing existing questions on the DQB students are asked, "What do you notice about our new group of questions?" and the educator is prompted to "Use student responses to develop the Concept 2 Focus Question: What causes moving objects to change direction or stop? Record the Focus Question at the top of the second column" (TE, page 132).

The focus of most of the unit is in service of students describing a central phenomenon as claimed by the materials. While the claimed phenomenon — "tugboats moving cargo ships" — is an observable event, it may not be specific enough to create a need for students to want to "figure out." Lessons are sequenced so students regularly return to the claimed phenomenon to add layers of description to how tugboats move cargo ships. Related evidence includes, but is not limited to:

- Module Overview, Introduction: "Throughout this module, students study the anchor phenomenon — tugboats moving cargo ships — and build an answer to the Essential Question: How do tugboats move cargo ships through a harbor?" (TE, page 1).
- Module Overview, Introduction: "In Lesson 3, students review the anchor model and the importance of asking relevant questions, and then they develop a driving question board. They revisit the driving question board and anchor model throughout the module to build a coherent understanding of how tugboats move cargo ships through a harbor" (TE, page 2).
- Lesson 1, Objective: "Explore what tugboats do in harbors" (TE, page 16).
- Lesson 1, Learn, Read Aloud Tugboat: "Build on student responses to summarize that the tugboat uses a push or pull every time it moves a big ship" (TE, page 18). This summary answers for students the claimed unit essential question, "How do tugboats move cargo ships through a harbor?" before the unit even begins.
- Lesson 1, Learn, Introduce Tugboats in New York Harbor: "To introduce the anchor phenomenon—tugboats moving cargo ships through a harbor—show students the New York Harbor Knowledge Deck poster…Continue to display the photograph, and read aloud the text on the back of the poster. Then ask students to Think–Pair–Share about how tugboats help cargo ships in the harbor" (TE, page 18). The text on the back of the image mentions items that a cargo ship may transport and that "Thanks to tugboats, cargo ships can deliver their goods," but there is no further discussion about the importance of cargo ships quickly and safely making it to terminal. There is a missed opportunity to emphasize the reason for the students to learn, especially from the students' perspective.
- Lesson 2, Objective: "Construct an anchor model of a tugboat moving a cargo ship" (TE, page 21).
- Lesson 2, Learn, Develop Anchor Model: "Bring the class back together to develop the anchor model. Explain that the class will add to the anchor model throughout the module as they learn about how tugboats move cargo ships through a harbor" (TE, page 23). The Anchor Model serves as the most concrete artifact with which students can track their understanding. While iterative opportunities — within eight of the 23 total lessons — are provided for students to add layers of explanation using the Anchor Model, it is not consistently incorporated throughout the learning sequence. After being created in Lesson 2, the Anchor Model is not returned to until Lesson 6. Then, it is only used in Lessons 8, 10, 12–14, and 21. This consequently leaves missed opportunities in several lessons for students to synthesize their learning and for the educator to help students make connections between their previous, current, and future understandings.
- Lesson 3, Objective: "Ask questions about tugboats moving cargo ships" (TE, page 26).
- Lesson 6, Objective: "Apply new understanding of pushes and pulls to the anchor phenomenon" (TE, page 47).
- Lesson 10, Objective: "Plan an investigation to determine how tugboats can turn a cargo ship" (TE, page 84).
- Lesson 11, Objective: "Investigate how tugboats use pushes and pulls to turn a cargo ship" (TE, page 92).

- Lesson 12, Objective: "Apply new learning about changing the direction of an object's movement to the anchor model" (TE, page 96).
- Lesson 13, Objective: "Plan an investigation to explore how a tugboat can make a cargo ship slow down and stop" (TE, page 107).
- Lesson 14, Objective: "Investigate how a tugboat uses pushes and pulls to make a cargo ship slow down and stop" (TE, page 114).
- Lessons 17–20, Objectives: "Apply the engineering design process to create a model cushion that helps a tugboat stop close to a dock" (TE, pages 139–162).
- Lesson 21, Objective: "Explain how tugboats use pushes and pulls to help move cargo ships" (TE, page 170).

The focus of a portion of the unit is to support students in solving a problem. Students are tasked with designing a dock cushion as an application of their understanding that "when objects touch, they push on each other and can change each other's movement" (DCI: **PS2.B**). They design a cushion that will allow the tugboat to get close to a dock without being pushed too far away. While the problem is contrived and a solution is already made available to students prior to activity (see Criterion II.A), grade-appropriate science ideas are necessary for students to complete the task. Additionally, because of the different set of materials and how students are asked to use them, it is likely that students will expand their understanding of the science ideas:

- **PS2.A**: *Forces and Motion Pushes and pulls can have different strengths and directions.*
- **PS2.A**: *Forces and Motion Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.*
- **PS2.B**: *Types of Interactions When objects touch or collide, they push on one another and can change motion.*

Suggestions for Improvement

- Consider providing teacher guidance to use student questions and/or prior experiences related to the phenomenon to create a need (from the students' perspectives) for the students to engage in learning throughout the materials.
- Consider increasing the regularity of the use of the DQB throughout the learning sequence. Currently, the DQB is incorporated into only six of 23 lessons. The most effective use of the DQB can be seen in Lesson 10. This process of eliciting, recording, and using student questions to facilitate toward the lesson-level phenomenon question can be repeated regularly to increase the sense that students are driving the learning.

I.B. THREE DIMENSIONS

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

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

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

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

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

The reviewers found adequate evidence that the materials give students opportunities to build understanding of grade-appropriate elements of the three dimensions because students have many opportunities to use elements of most three-dimensional learning targets claimed to make sense of the claimed unit phenomenon.

Science and Engineering Practices (SEPs) | **Rating: Adequate**

The reviewers found adequate evidence that students have the opportunity to use or develop many of the claimed SEPs in this unit. The intended key learning targets for this dimension are unclear because differing claims are made at the unit level and the Science Topic lesson set level. Students are not provided sufficient opportunities to develop proficiency in many of the claimed elements over the course of the learning sequence. Related evidence includes, but is not limited to:

Asking Questions and Defining Problems

- *Ask questions based on observations to find more information about the natural and/or designed world(s).*
    - The element is claimed as a unit level SEP element in the unit front matter (TE, page 6).
    - The element is claimed as a Concept lesson set level SEP element for Lessons 1–3.
        - Lesson 3, Learn, Build DQB: "Remind students that they can look at these to help them think of questions, and explain that the best questions will help them reach their goal of answering the Essential Question. As students share, record their questions on individual sticky notes. Tell students they will use their questions to build a driving question board" (TE, pages 27–28).
    - The element is claimed as a Science Topic lesson set level SEP element for Lesson 9.
        - Lesson 9, Conceptual Checkpoint B: "Tell students that the race is over and that the faster team won. Then read the third question aloud, and meet individually with students to write their oral responses at the end of the Conceptual Checkpoint. What question about strength can you ask to figure out which team was faster?" (TE, page 75).

- This element is not included in the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), so it is unclear if the element claim is intended to be fully addressed in the unit, or just worked toward. There is mismatch between claim and assessment for this element.

Planning and Carrying Out Investigations

- *Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons.*
  - The element is claimed as a unit level SEP element in the unit front matter (TE, page 6).
  - The element is claimed as a Science Topic lesson set level SEP element for Lessons 7–8.
    - Lesson 8, Learn, Revisit Water Model, Check for Understanding: "Students compare the effects of stronger and weaker pushes on the model cargo ship. Elements Assessed: SEP.3: Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons…Evidence: Students use their observations of the water model demonstration to compare the effects of stronger and weaker pushes on an object's movement (SEP.3)" (TE, page 65).
  - The element is claimed as a Science Topic lesson set level SEP element for Lesson 16.
    - Lesson 16, Conceptual Checkpoint: "Elements Assessed: SEP.3: Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons…Evidence… Students compare the three pictures and select the third one (SEP.3). Then they circle Push twice to answer the final two questions, demonstrating that they understand that both objects push on each other (SEP.3, PS2.B)" (TE, page 130).
  - The element is claimed as a Science Topic lesson set level SEP element for Lessons 17–20.
    - Lesson 19, Learn, Improve Dock Cushions: "Invite students to think about their results as well as ways they could improve their cushion...Allow groups time to complete three tests on each of up to two additional versions of their cushion. After groups finish their final tests, direct students' attention to the last row they completed in their Science Logbooks (Lesson 18 Activity Guide). Have students circle the lowest number in that row to indicate the shortest distance that their final cushion pushed the tugboat away from the dock" (TE, page 159). The "think about" prompt is general, and not focused on comparisons. The comparison is limited to students choosing the lowest number in a set.
    - Lesson 20, Learn, Analyze Data: "Then bring the class back together, and explain to students that they will now compare all their results. On a flat surface that all students can see, start a line plot by placing 11 sticky notes in a row and labeling them 1–11. Tell students that they are going to sort their cushions. Explain to students that on one end they will place the cushions that helped the tugboat stop closest to the dock, and on the other end they will place the cushions that pushed the tugboat farthest away from the dock. Ask students whether they

remember how many boxes the class counted after the tugboat bumped into the dock without a cushion. Label another sticky note No Cushion, and place the sticky note under the number that captures how far back the tugboat moved without a cushion in place. Then invite groups to place their cushion under whichever number they circled in their Science Logbooks (Lesson 18 Activity Guide) for that cushion. Ask students to Think–Pair–Share about what they notice when they look at where all the groups placed their cushions." (TE, page 163).

- The element is included in the End-of-Module Assessment Alignment Map (TE, page 192) and the Engineering Challenge Alignment Map (TE, page 232).

- *With guidance, plan and conduct an investigation in collaboration with peers.*
  - This element is not claimed in the unit front matter.
  - The element is claimed as a Science Topic lesson set level element for Lessons 7–8.
    - Lesson 7, Learn, Investigate Pushes, Spotlight on Science and Engineering Pushes: "This investigation is the first one that students conduct collaboratively (SEP.3). During the investigation, guide students to focus on the steps they must follow to succeed. Subsequent lessons in this module give students the opportunity to provide increasing input when planning and conducting investigations" (TE, page 58).
  - The element is claimed as a Science Topic lesson set level SEP element for Lessons 10–12.
    - Lesson 10, Learn, Create Direction Investigation Plan, Spotlight on Science and Engineering Practices: "Throughout this module, students create investigation plans (SEP.3) with increasing independence. In this lesson set, students work with the teacher to plan the steps of the investigation. In their groups, students decide where to place each tugboat and how each tugboat will push or pull on the cargo ship to turn it" (TE, page 86).
    - Lesson 10, Learn, Create Direction Investigation Plan: "Inform students that they will work together to create an investigation plan to help answer the Phenomenon Question How can tugboats turn a cargo ship?" (TE, page 86).
    - Lesson 10, Learn, Create Direction Investigation Plan: "Build on students' responses to establish that one tugboat can move the cargo ship forward while the other tugboat turns the ship so it moves in the correct direction. On the investigation plan, summarize the role of each tugboat, and add a final step to remind students where the cargo ship needs to go" (TE, page 89).
  - The element is claimed as a Science Topic lesson set level SEP element for Lessons 13–15.
    - Lesson 13, Learn, Plan Stopping Investigation, Spotlight on Science and Engineering Practices: "In this lesson set, students continue to develop their investigation planning skills (SEP.3). To provide additional guidance, ask questions such as the following: What question are we trying to answer? How

can we use the map model to help us answer the question? What steps should we include in our plan?" (TE, page 110).

- The element is not included in the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), so it is unclear if the element claim is intended to be fully addressed in the unit, or just worked toward. There is mismatch between claim and assessment for this element

- *Make predictions based on prior experiences.*
  - The element is not claimed in the unit front matter.
  - The element is claimed as a Science Topic lesson set level SEP element for Lessons 13–15.
    - Lesson 14, Learn, Make Predictions with Water Model: "Gather students around the water model, and ask the following question. Do you think the tugboat can stop the moving cargo ship by pushing on the front of the ship? Why or why not?" Check for Understanding: "Students will spend the next several minutes making predictions. Listen for students to support their predictions with prior events or experiences (SEP.3)" (TE, page 116).
  - The element is not included on the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), so it is unclear if the element claim is intended to be fully addressed in the unit, or just worked toward. There is mismatch between claim and assessment for this element which makes the expectation for student use and development unclear.
- *Make observations (firsthand or from media) and/or measurements of a proposed object, tool, or solution to determine if it solves a problem or meets a goal.*
  - The element is not claimed in the unit front matter.
  - The element is claimed as a Science Topic lesson set level SEP element for Lessons 17–20
    - Lesson 19, Learn, Test Dock Cushions: "…and one student counts the number of boxes between the cushion and the front of the tugboat (including the box that the front of the tugboat is in) and announces the number for the group to record… Then point out the three empty boxes in the same row, under Bounce. Explain to students that they will write a number in each box to show how far the tugboat bounces in each of their three tests… Remind students to record in their Science Logbooks (Lesson 18 Activity Guide) how far the tugboat bounces after each test" (TE, pages 157–158).
  - This element is not included on the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), so it is unclear if the element claim is intended to be fully addressed in the unit, or just worked toward. There is mismatch between claim and assessment for this element which makes the expectation for student use and development unclear.

Analyzing and Interpreting Data

- *Record information (observations, thoughts, and ideas).*
    - The element is claimed as a unit level SEP element in front matter (TE, page 6).
    - The element is claimed as a Science Topic lesson set level SEP element for Lessons 4–6.
        - Lesson 4, Learn, Sort Actions: On a class chart, students work collectively to group images of various toys into groups based upon if they move by pushing or by pulling. "Explain to students that they will describe each way they moved a toy as either a push or a pull…After each group demonstrates an action, ask the class whether that action is a push or a pull…Then tape a matching toy icon card (Lesson 4 Resource B) to the chart in the agreed-upon column" (TE, page 38).
        - Lesson 5, Learn, Draw Pushes and Pulls: "Place students in pairs, and distribute one sticky note to each pair. Tell students to look around the classroom for objects they could move with a push or a pull and to work with their partners to choose one of these objects. Instruct one student from each pair to place a sticky note on the object they have chosen." Teachers are directed to, "Point out that students have started to look at the world around them as scientists do, searching for pushes and pulls and trying to explain what they see. Explain that scientists also record what they observe to figure out how the world around them works" (TE, page 42).
        - Lesson 5, Learn, Draw Pushes and Pulls: "Tell students that they will now record what they just observed. Ask students to draw their observations in their Science Logbooks (Lesson 5, Activity Guide)" (TE, page 43).
- *Use and share pictures, drawings, and/or writings of observations.*
    - The element is not claimed in unit front matter.
    - The element is claimed as a Science Topic lesson set level element for Lessons 7–8.
        - Lesson 7, Learn, Investigate Pushes: Students complete an investigation and record observations in Logbooks. "Explain to students that they will follow the steps and then record their observations in their Science Logbooks (Lesson 7 Activity Guide) to show the speed of the ball" (TE, page 58).
    - The element is not included on the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), so it is unclear if the element claim is intended to be fully addressed in the unit, or just worked toward. There is a mismatch between claim and assessment for this element which makes the expectation for student use and development unclear.

Using Mathematics and Computational Thinking

- *Use counting and numbers to identify and describe patterns in the natural and designed world(s).*
    - The element is claimed as a unit level SEP element in the unit front matter (TE, page 6).
    - The element is claimed as a Science Topic lesson set level SEP element for Lessons 17–20.
        - Lesson 17, Learn, Demonstrate Testing Procedure: "Show students the measurement paper (Lesson 17 Resource E). Have them consider how they could

use the color zones on the paper to note how far back the tugboat bounces after each bump. Slide the measurement paper into its position under the rulers. Then invite two volunteers to help demonstrate how to use the measurement paper to describe how far the tugboat bounces after hitting the dock" (TE, pages 145–146).

- Lesson 18, Learn, Imagine Dock Cushions: Strips of measurement paper with green, yellow, and red zones are placed under rulers. Students use color zones to measure and analyze group data. "Remind students that if the tugboat stops close to the dock, its front will be in the green zone; if it stops a little farther away from the dock, its front will be in the yellow zone; and if it stops far away from the dock, its front will be in the red zone" (TE, page 149).
- Lesson 18, Learn, Imagine Dock Cushions: Students use measurement to analyze results "analyze the results with students to designate a single color zone for each material. Start by pointing to the first material on the results chart. Ask the class to look at the results and to decide on the color zone for this material: green, yellow, or red. If students need support, work with them to count how many green sticky notes, yellow sticky notes, and red sticky notes are in the column. Then suggest selecting the most frequent result from all three or six tests. After the class has determined the color zone for each material, mark a sticky note with that color, and attach the sticky note to the illustration of the material" (TE, page 151).
- Lesson 18, Learn, Imagine Dock Cushions: Students are encouraged to think about how they could compare cushions that cause a tugboat to stop in the same color zone and the need for numbers. "If the tugboat stopped in the same color zone with two different materials, how do we know which material worked better?...Highlight the importance of measuring with numbers to compare the distance the tugboats bounce back, and tell students that they will use a new measuring paper when they test their cushions" (TE, page 152).
- Lesson 19, Launch: "Show students the lined measurement paper (Lesson 19 Resource). Point out that the boxes match up with the numbers, and count the rows from 1 to 11 with the class. Emphasize that boxes 1, 2, and 3 are in the green zone; boxes 4, 5, 6, and 7 are in the yellow zone; and boxes 8, 9, 10, and 11 are in the red zone. Tell students that when the tugboat stops twice in the same color zone, they can use the boxes to figure out which time the tugboat stopped closer to the dock. Gather students around the testing station, and invite two volunteers to help demonstrate how to measure the distance that the tugboat bounces without a dock cushion. Follow the testing station procedure (Lesson 17 Resource F). Then demonstrate how to measure the distance from the dock to the front of the tugboat by counting the number of boxes in front of the tugboat, including the box that the front of the tugboat is in" (TE, page 156).
- Lesson 19, Learn, Test Dock Cushions: "…and one student counts the number of boxes between the cushion and the front of the tugboat (including the box that the front of the tugboat is in) and announces the number for the group to record… Then point out the three empty boxes in the same row, under Bounce. Explain to

students that they will write a number in each box to show how far the tugboat bounces in each of their three tests…Remind students to record in their Science Logbooks (Lesson 18 Activity Guide) how far the tugboat bounces after each test" (TE, pages 157–158).

- The element is not included on the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192).

- *Decide when to use qualitative vs. quantitative data.*
  - The element is not claimed in the unit front matter.
  - The element is claimed as a Concept lesson set level SEP element for Lessons 17–20.
    - There is no explicit evidence that learning materials are aligned to or highlight this element in Lessons 17–20.
  - This element is not included on the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), so it is unclear if the element claim is intended to be fully addressed in the unit, or just worked toward. There is mismatch between claim and assessment for this element which makes the expectation for student use and development unclear.

Developing and Using Models

- *Distinguish between a model and the actual object, process, and/or events the model represents.*
  - The element is not claimed in unit front matter.
  - The element is claimed as a Science Topic lesson set level SEP element for Lessons 1–3.
    - Lesson 2, Land, Check for Understanding: "Students explored the similarities and differences between models and the phenomena they represent (SEP.2) in the previous module. Look for evidence that students understand: how the harbor map anchor model is similar to the phenomenon and how the model is different from the phenomenon. If students need support to identify similarities and differences between the model and the phenomenon, consider providing examples. Then invite students to share their own examples of similarities and differences" (TE, page 25). Demonstration (use and development) of this SEP element is limited to verbal contributions from a potentially limited number of students.
  - The element is claimed as a Science Topic lesson set level SEP element for Lessons 10–12.
    - Lesson 12, Learn, Revisit Water Model, Check for Understanding: "Students describe how pushes and pulls cause the model cargo ship to change direction, and they consider whether real tugboats turn cargo ships by using pushes and pulls in the same way. Elements Assessed…SEP.2: Distinguish between a model and the actual object, process, and/or events the model represents. Evidence…Students recognize that testing their ideas with the water model can help them consider how real tugboats use pushes and pulls to turn cargo ships (SEP.2, PS2.A)" (TE, page 98). Demonstration (use and development) of this SEP

element is limited to verbal contributions from a potentially limited number of students.

- The element is not included on the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), so it is unclear if the element claim is intended to be fully addressed in the unit, or just worked toward. There is mismatch between claim and assessment for this element which makes the expectation for student use and development unclear.

Constructing Explanations and Designing Solutions

- *Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.*
  - The element is not claimed in the unit front matter.
  - The element is claimed as a Science Topic lesson set level SEP element in Lessons 17–20. However, there is no explicit evidence that learning materials align to or highlight this specific element in Lessons 17–20.
  - The element is not included on the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), but a reference to this element is made in the Engineering Challenge Alignment Map (TE, page 232).

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.*
  - The element is not claimed in the unit front matter.
  - The element is claimed as a Science Topic lesson set level SEP element in Lessons 21–23.
    - Lesson 21, Learn, Engage in Socratic Seminar, Check for Understanding: "As students engage in the Socratic Seminar, note how they provide details about scientific ideas and practices (SEP.8)" (TE, page 171).
  - This element is not included on the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), so it is unclear if the element claim is intended to be fully addressed in the unit, or just worked toward. There is mismatch between claim and assessment for this element which makes the expectation for student use and development unclear.

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

The reviewers found extensive evidence that students have the opportunity to use or develop the DCIs in this unit because student learning is aligned to most of the claimed elements. There is a disproportionate amount of time spent addressing two of the five claimed elements (**ETS1.A** and **ETS1.B**). However, it is understood that these ETS core ideas are associated with K–2 grade-band PEs so there will very likely be other opportunities in future grades to build understanding related to these learning targets. Related evidence includes, but is not limited to:

PS1.A: Structure and Properties of Matter

- *Different properties are suited to different purposes.*
    - Lesson 18, Learn, Imagine Dock Cushions, Spotlight on Crosscutting Concepts: "Students use the results from these tests to decide which materials would be most effective for stopping the tugboat close to the dock" (TE, page 150). Although students develop toward this DCI element, this activity is more aligned to the Grade 2 NGSS PE **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 and therefore the expectation is above grade-level for kindergarten learners.*

PS2.A: Forces and Motion

- *Pushes and pulls can have different strengths and directions.*
    - The element is claimed as a unit level DCI element in the unit front matter (TE, page 7).
    - The element is claimed as a Science Topic lesson set level DCI element for Lessons 7–8.
        - Lesson 7, Learn: Students carryout an "investigation to figure out how they can make an object move at different speeds." They "try to make the ball roll at different speeds: faster and slower." They use cutouts representing stronger and weaker pushes to answer the questions, "What happened when you used a weaker push? What happened when you used a stronger push?" (TE, pages 57–61).
    - The element is claimed as a Science Topic lesson set level DCI element for Lesson 9.
        - Lesson 9, Conceptual Checkpoint: Students complete a three-question assessment to show understanding of the question, "How can a push or a pull help in a skateboard race?"
            - Conceptual Checkpoint Part A, Question 1: "Will a push or a pull cause each rider to move toward the finish line?" (TE, page 75).
            - Conceptual Checkpoint Part B, Question 3: "What question about strength can you ask to figure out which team was faster?" (TE, page 76).
    - The element is claimed as a Science Topic lesson set level DCI element for Lessons 10–12.
        - Lesson 10, Learn, Create Direction Investigation Plan: "Point out that the cargo ship will need to turn to reach the port. Do you think a tugboat can turn a cargo ship by pushing or pulling on it?...Model students' ideas, and demonstrate the challenge of using a single tugboat to move the cargo ship along the curved path. Ask students to think about ways to help the tugboat change direction." (TE, page 86).
        - Lesson 11, Learn, Investigate Direction: "Instruct students to use their two tugboats to gently push or pull the cargo ship so that it turns around the island and moves toward the port. After several minutes, ask students to pause the investigation and share their observations" (TE, page 93).
        - Lesson 12, Launch: "Select another student, and tell this student to try to change the direction of the ball's movement instead of catching it. Before rolling

the ball, ask the class how the student can make the ball change direction without stopping it" (TE, page 96).

- The element is claimed as a Science Topic lesson set level DCI element for Lessons 13–15.
  - Lesson 15, Learn, Explore Collisions with Water Model: Students observe the teacher pushing a wooden cargo ship in a bin of water and are asked to notice what happens when the teacher pushes it hard against the side of the bin. "Place the wooden block cargo ship in the bin, and push the cargo ship hard so that it hits one side of the bin and bounces backward. Ask students to Think–Pair–Share about what they noticed, and highlight responses that mention the cargo ship bouncing back after hitting the side of the bin" (TE, page 121). Demonstration (use and development) of this DCI element is limited to verbal contributions from a potentially limited number of students.
- The element is claimed as a lesson-level DCI element for Lesson 16.
  - Lesson 16, Conceptual Checkpoint: "Elements Assessed…PS2.A: Pushes and pulls can have different strengths and directions. Evidence…Students draw lines showing how the ball moves away from Player A to Player B and away from Player B to Player C. Then students glue two push cutouts onto the picture: one next to Player A that points toward Player B and another next to Player B that points toward Player C (PS2.A, CC.2)" (TE, page 130).
- The element is claimed as a Science Topic lesson set level DCI element for Lessons 17–20.
  - There is no evidence that teaching and learning in Lessons 17–20 aligns to or highlight this element.
- This element is not included on the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), so it is unclear if the element claim is intended to be fully addressed in the unit, or just worked toward. There is mismatch between claim and assessment for this element which makes the expectation for student use and development unclear.

- *Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.*
  - The element is claimed as a unit level DCI element in the unit front matter (TE, page 7).
  - The element is claimed as a Science Topic lesson set level DCI element for Lessons 1–3.
    - Lesson 1, Learn, Read Aloud Tugboat, Check for Understanding: "This task is a pre-assessment. Use students' responses to gauge their prior and developing knowledge of how pushes and pulls can cause objects to move as well as how observations can reveal patterns. Elements Assessed: PS2.A: Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it…Evidence: After observing multiple instances of the tugboat moving ships, students recognize a pattern (CC.1): The tugboat always uses a push or a pull to move another vessel (PS2.A)" (TE, page 18). Demonstration (use and

development) of this DCI element is limited to verbal contributions from a potentially limited number of students.

- Lesson 3, Learn, Build DQB, Check for Understanding: "As students share their questions, listen for evidence that they connect their questions to their observations. Elements Assessed..PS2.A: Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. Evidence: Students use what they have noticed to ask questions (SEP.1) about how tugboats help move cargo ships through a harbor (PS2.A)" (TE, page 29). Demonstration (use and development) of this DCI element is limited to verbal contributions from a potentially limited number of students.

- The element is claimed as a Science Topic lesson set level DCI element for Lessons 4–6.
  - Lesson 6, Land: Students answer the question "How do tugboats make cargo ships start to move?" Teachers are provided with sample responses, "Tugboats can pull cargo ships to make them start moving. Tugboats can also get cargo ships to start moving by pushing them." and told to, "Summarize student responses by stating that tugboats can use pushes and pulls to make cargo ships start moving" (TE, page 51).
- The element is claimed as a Science Topic lesson set level DCI element for Lessons 7–8.
  - Lesson 7, Learn, Compare Results: "After students finish gluing the cutouts into their Science Logbooks, invite pairs to share their observations with the class." Check for Understanding: "Listen for students to make connections between push strength and the movement of the ball. Encourage students to explain that pushing the ball caused it to start moving (PS2.A, CC.2)" (TE, page 61). Note that the phrase "encourage students to" is vague and may lead educators to tell students what to say.
- The element is claimed as a Science Topic lesson set level DCI element for Lesson 9.
  - Lesson 9, Conceptual Checkpoint: "Elements Assessed…PS2.A: Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it…Evidence: Students circle A push to indicate the action that will cause each rider to move toward the finish line (PS2.A, CC.2). Students circle the picture of the rider moving on the skateboard to indicate the effect of the push (PS2.A, CC.2)" (TE, page 76).
- The element is claimed as a Science Topic lesson set level DCI element for Lessons 10–12.
  - Lesson 12, Learn, Revisit Water Model, Check for Understanding: "Students describe how pushes and pulls cause the model cargo ship to change direction, and they consider whether real tugboats turn cargo ships by using pushes and pulls in the same way. Elements Assessed: PS2.A: Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it…Evidence: Students describe a sideways push or pull from the second model tugboat as the cause of the change in direction for the model cargo ship (PS2.A, CC.2)…" (TE, page 98). Demonstration (use and development) of this DCI

element is limited to verbal contributions from a potentially limited number of students.

- The element is claimed as a Science Topic lesson set level DCI element for Lessons 13–15
  - Lesson 13, Learn, Plan Stopping Investigation: Students plan and carry out an investigation to determine how a tugboat can make a cargo ship slow down or stop. "Distribute one small tugboat cutout, one small push cutout, and one small pull cutout to each student. Instruct students to glue a tugboat cutout in the second column to show where they will place the tugboat. Then tell students to glue either a push cutout or a pull cutout next to the tugboat cutout to show how they plan to use the tugboat to stop the cargo ship" (TE, page 111).
  - Lesson 15, Learn, Update Anchor Chart: Students "Sit in a circle on the floor, and show them the Hall's car. Push the car toward a student, and tell that student to stop the car. Then ask the class how the student used a push or a pull to make the car stop" (TE, page 121).
- The element is claimed as a Science Topic lesson set level DCI element for Lesson 16
  - Lesson 16, Conceptual Checkpoint: "Elements Assessed…PS2.A: 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 it. Evidence…Students draw lines showing how the ball moves away from Player A to Player B and away from Player B to Player C. Then students glue two push cutouts onto the picture: one next to Player A that points toward Player B and another next to Player B that points toward Player C (PS2.A, CC.2)" (TE, page 130).
- The element is claimed as a Science Topic lesson set level DCI element for Lessons 17–20.
  - There is no evidence that teaching and learning in Lessons 17–20 is aligned to or highlights this element.

- The core idea category, **PSA.2 Forces and Motion**, is claimed for Lessons 21–23 (TE, page 168) Science Topic lesson set, but explicit elements are not indicated.
  - The core idea is included in the End-of-Module Assessment Rubric, Meets Expectations (TE, pages 190–191).
  - The End-of-Module Assessment Alignment Map claims the element as being assessed in items 1, 3a, and 4 (TE, page 192).

PS2.B: Types of Interactions

- *When objects touch or collide, they push on one another and can change motion.*
  - The element is claimed as a unit level DCI element in the unit front matter (TE, page 7).
  - The element is claimed as a Science Topic lesson set level DCI element for Lessons 13–15.
    - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 13.

- There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 14.
- Lesson 15, Learn, Update Anchor Chart, Spotlight on DCIs: "In Concept 2 and during the Engineering Challenge, students explore the idea that when objects touch, they push on each other (PS2.B). To support student understanding, consider sharing other examples of pushes students can feel when they bump into an object or when an object bumps into them" (TE, page 123).

- The element is claimed as a Science Topic lesson set level DCI element for Lesson 16.
  - Lesson 16, Conceptual Checkpoint: Students complete an assessment to demonstrate understanding of the question, "How do people use pushes and pulls when they play soccer?" (TE, page 127).
    - Conceptual Checkpoint Part B, Question 2: "Point out the black rectangle on the right side of each picture, and explain to students that this is a wall. Then read aloud the following scenario, and instruct students to circle one of the three pictures. While the players are playing soccer, one player kicks the ball at a wall. What happens when the ball hits the wall?" (TE, page 129).
    - Conceptual Checkpoint Part B, Question 3: "Does the ball push or pull on the wall?" (TE, page 129).
    - Conceptual Checkpoint Part B, Question 4: "Does the wall push or pull on the ball?" (TE, page 130).
  - Lesson 16, Conceptual Checkpoint: "Elements Assessed…PS2.B: When objects touch or collide, they push on one another and can change motion…Evidence… Then they circle Push twice to answer the final two questions, demonstrating that they understand that both objects push on each other (SEP.3, PS2.B)" (TE, page 130).
- The element is claimed as a Science Topic lesson set level DCI element for Lessons 17–20.
  - Lesson 17, Learn, Demonstrate Testing Procedure: Students are asked as a whole group, "Why do both tugboats bounce away from the dock?" Check for Understanding: "Listen for evidence…that students identify a pattern: The dock pushing on the tugboats causes the tugboats' movement to change (CC.1, PS2.B)" (TE, page 145). Demonstration (use and development) of this DCI element is limited to verbal contributions from a potentially limited number of students.
  - Lesson 18, Learn, Imagine Dock Cushions: "Which materials do you think will make the best cushion? Why do you think so?" Check for Understanding: "Listen for responses that mention how well each material might work to solve the problem (SEP.3) by causing the tugboat to travel a shorter distance after the bump (CC.2, PS2.B)" (TE, page 152). Demonstration (use and development) of this DCI element is limited to verbal contributions from a potentially limited number of students.

- Lesson 19, Learn, Test Dock Cushions: "Revisit the class problem and solution chart, and explain that engineers need to test the solutions they create to find out whether they work. Review the testing process with the class: One student holds the cushion against the dock (while keeping fingers away from where the tugboat will hit), one student releases the tugboat from the mark on the ramp, and one student counts the number of boxes between the cushion and the front of the tugboat (including the box that the front of the tugboat is in) and announces the number for the group to record." Spotlight on Three-Dimensional Integration: "Students recognize that when objects bump, the objects push on one another, which can change their movement (PS2.B)" (TE, page 157).
- Lesson 20, Learn, Analyze Data: "Which material do you think works best for a dock cushion? Why?" Check for Understanding: "Listen for responses that…recognize that the data show how each cushion changed the movement of the tugboat (PS2.B)…" (TE, page 164). Demonstration (use and development) of this DCI element is limited to verbal contributions from a potentially limited number of students.
- Engineering Challenge Rubric, Ask, Meets Expectations: "The student…identifies the pattern that when the model tugboats touch the dock, their movement changes (CC.1, PS2.B)" (TE, page 229)
- Engineering Challenge Rubric, Imagine, Meets Expectations: "The student conducts tests…to determine how each material causes the movement of the model tugboat to change (CC.2, PS2.B)" (TE, page 229).

- The core idea category — **PS2.B Types of Interactions** — is claimed for Lessons 21–23 (TE, page 168) Science Topic lesson set, but no element(s) are indicated.
  - The core idea is included in the End-of-Module Assessment Rubric, Meets Expectations: "The student watches the video and records the observation (SEP.4) that the ball pushed on the wall (PS2.B, CC.2)" (TE, page 191).
  - The End-of-Module Assessment Alignment Map claims the element as being assessed in items 3a and 3b (TE, page 192).

PS3.C: Relationship Between Energy and Forces

- *A bigger push or pull makes things speed up or slow down more quickly.*
  - The element is claimed as a unit level DCI element in the unit front matter (TE, page 7).
  - The element is claimed as a Science Topic lesson set level DCI element for Lessons 7–8.
    - Lesson 7, Learn, Investigate Pushes: Students conduct an investigation "to figure out how they can make an object move at different speeds." "Place students in pairs. Show the class a set of investigation materials (a table tennis ball and craft sticks). Explain that pairs will practice using the craft sticks to roll the ball back and forth, and then pairs will try to make the ball roll at different speeds: faster and slower" (TE, page 57).

        - Lesson 7, Learn, Compare Results: "Distribute a pair of stronger and weaker push cutouts (Lesson 7 Resource) to each student. Then guide students to decide which cutout they should glue to the left of each box in their Science Logbooks (Lesson 7 Activity Guide) so that the push strength on the left corresponds with the ball's speed on the right" (TE, page 61).
        - Lesson 8, Learn, Update Anchor Chart: Students "apply knowledge of stronger and weaker pushes and pulls to the anchor phenomenon." They use a water model to see the effect of stronger and weaker pushes and pulls between the tugboat and cargo ship. "Then lead a discussion to establish that a stronger push or pull can make an object move faster than a weaker push or pull. What happened each time we used a weaker push or pull? What happened each time we used a stronger push or pull?" (TE, page 66).
    - The element is claimed as a Science Topic lesson set level DCI element for Lesson 9.
        - Lesson 9, Conceptual Checkpoint: "Elements Assessed…PS3.C: A bigger push or pull makes things speed up or slow down more quickly…Evidence…Students ask a question (SEP.1) about push strength to determine which team was faster (CC.3), demonstrating an understanding that the strength of a push affects rider speed (PS3.C)" (TE, page 76).
    - The core idea category, **PS3.C Relationship Between Energy and Forces**, is claimed for Lessons 21–23, but no element(s) are indicated (TE, page 168).

ETS1.A: Defining Engineering Problems

- *A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.*
    - The element is claimed as a unit level DCI element in the unit front matter (TE, page 7).
    - The element is claimed as a Science Topic lesson set level DCI element for Lessons 17–20.
        - Lesson 17, Launch: "Ask students to imagine that the tugboat in the photograph is returning to its dock after a day of moving cargo ships through the harbor and that the tugboat captain needs to get back to the dock fast. Tell students that because the captain cannot slow down, the tugboat will bump into the dock" (TE, page 139). This is not a real-world problem.
        - Lesson 17, Learn, Think About Tugboat Docking: "Tell students that the class needs to figure out a way to change how the dock pushes on the tugboat without changing how fast the tugboat is moving when it bumps into the dock" (TE, page 142).
        - Lesson 19, Learn, Test Dock Cushions: "Revisit the class problem and solution chart, and explain that engineers need to test the solutions they create to find out whether they work." Spotlight on Three-Dimensional Integration: "In this lesson, students gain experience solving problems through engineering (ETS1.A)" (TE, page 157).

        - Lesson 20, Learn, Analyze Data: "Which material do you think works best for a dock cushion? Why?" Check for Understanding: "Listen for responses that…recognize that the data show how each cushion changed the movement of the tugboat (PS2.B), and students should use the data to explain which cushions best solved the problem (ETS1.A)" (TE, page 164). Demonstration (use and development) of this DCI element is limited to verbal contributions from a potentially limited number of students.
    - This element is not included on the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), but is included in a separate Engineering Challenge rubric (TE, page 231) and Alignment Map (TE, page 233).

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.*
    - The element is claimed as a unit level DCI element in the unit front matter (TE, page 7).
    - The element is claimed as a Science Topic lesson set level DCI element for Lessons 17–20.
        - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 17.
        - Lesson 18, Learn, Plan Dock Cushions, Check for Understanding: "Students draw their plans for using the materials the class tested to make their dock cushions. Then students predict how their cushions will affect the movement of the model tugboat. Elements Assessed…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. Evidence: Students draw a cushion they plan to build to stop the tugboat closer to the dock. Students select materials for their design to solve this specific problem (SEP.6, ETS1.B)"
        - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 19.
        - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 20.
    - This element is not included on the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), but is included in a separate Engineering Challenge rubric (TE, page 230) and Alignment Map (TE, page 232).

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

The reviewers found adequate evidence that students have the opportunity to use or develop the CCCs in this unit because, while there are a sufficient number of CCC learning targets for the length of the material, just over half are addressed over the course of the learning sequence and the explicit incorporation of the majority of claimed elements is inconsistent and is often limited to students' verbal contributions and/or educator explanation.

Related evidence includes, but is not limited to:

Patterns

- *Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.*
    - The element is claimed as a unit level CCC element in the unit front matter (TE, page 7).
    - The element is claimed as a Science Topic lesson set level CCC element for Lessons 1–3.
        - Lesson 1, Learn, Read Aloud Tugboat, Spotlight on CCCs: "Throughout this module, students will look for patterns (CC.1), or repeated events, and will use them as evidence of cause and effect relationships (CC.2). Take this opportunity to note the patterns that students identify in how tugboats help move big ships" (TE, page 18). The educator identifying/summarizing patterns for students is not evidence of student use or development of this element.
        - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 2.
        - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 3.
    - The element is claimed as a Science Topic lesson set level CCC element for Lessons 4–6.
        - Lesson 4, Learn/Land: "Agree that each time students made a toy move across the paper, they pushed or pulled it. Explain that when we notice something that happens the same way many times, we can describe the repeating event as a pattern. Then remind students that they can use a pattern to predict what is likely to happen. Place the toy car in a visible spot, and ask students to briefly Think–Pair–Share in response to the following question. What do you think will happen if I push this toy car? Push the toy car, and tell students that they used the pattern they have observed to predict when an object will start moving. Explain that this pattern is a clue that suggests students have found a cause and effect relationship" (TE, page 40).
        - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 5.
        - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 6.
    - The element is claimed as a Science Topic lesson set level CCC element for Lessons 17–20.
        - Lesson 17, Learn, Demonstrate Testing Procedure: "Release the Hall's car down the ramp so that it hits the bin and bounces back. Point out that the Hall's car bounced back just as the wooden block tugboat did. Why do both tugboats bounce away from the dock?" Check for Understanding: "Listen for evidence that students recognize the similarities in how the two model tugboats move after bumping into the dock (SEP.3) and that students identify a pattern: The dock pushing on the tugboats causes the tugboats' movement to change (CC.1,

PS2.B). If students do not recognize this pattern, repeat the demonstrations, and ask students to notice similarities between the two" (TE, page 145).
    - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 18.
    - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 19.
    - Lesson 20, Learn, Analyze Data: "Ask students to Think–Pair–Share about what they notice when they look at where all the groups placed their cushions. How did using numbers help you decide which materials worked better than others? Which material do you think works best for a dock cushion? Why?" Check for Understanding: "Listen for responses that mention numerical patterns in the data (CC.1, SEP.5)" (TE, pages 163–164).
- This element is not included on the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), so it is unclear if the element claim is intended to be fully addressed in the unit, or just worked toward. There is mismatch between claim and assessment for this element.

Cause and Effect

- *Events have causes that generate observable patterns.*
    - The element is claimed as a unit level CCC element in the unit front matter (TE, page 7).
        - Lesson 1, Learn, Read Aloud Tugboat, Spotlight on CCCs: "Throughout this module, students will look for patterns (CC.1), or repeated events, and will use them as evidence of cause and effect relationships (CC.2). Take this opportunity to note the patterns that students identify in how tugboats help move big ships" (TE, page 18). However, students are not prompted to reference patterns and not all students will be providing a response, nor is the educator informed about students' prior experiences with patterns. Therefore, there is not enough support to have this moment serve as a reliable example of use or development by students.
    - The element is claimed as a Science Topic lesson set level CCC element for Lessons 4–6.
        - Lesson 4, Land: "Place the toy car in a visible spot, and ask students to briefly Think–Pair–Share in response to the following question. What do you think will happen if I push this toy car? Push the toy car, and tell students that they used the pattern they have observed to predict when an object will start moving" (TE, page 40). Demonstration (use and development) of this CCC element is limited to verbal contributions from a potentially limited number of students.
        - Lesson 4, Land, Spotlight on CCCs: "If necessary, repeat the toy car demonstration, and work with students to emphasize that patterns can be evidence of a cause and effect relationship. Support students' understanding that they always need to use a push or a pull to cause an object to start moving" (TE, page 40). It is stated only "if necessary." How will the teacher know if it is necessary? "Work with and emphasize" implies telling, so this, along with

teacher demonstration, would not be evidence of students using or developing this element.

- Lesson 5, Learn, Draw Pushes and Pulls, Check for Understanding: "Students record their observations of how the object started moving, identify the action as either a push or a pull, and orally demonstrate an understanding of what caused the object to move. Elements Addressed… CC.2: Events have causes that generate observable patterns…" (TE, page 44). Students are not made aware that they are engaging in or being assessed on this CCC element.
- Lesson 6, Learn, Introduce Water Model: "Demonstrate the different interactions between the tugboat and cargo ship as students suggest them. Guide students to think about how this model could help them better understand the Phenomenon Question How do tugboats make cargo ships start to move? In our water model, how can the tugboat get the cargo ship to start moving?" Check for Understanding: "Listen for students to identify that the tugboat can use a push or a pull to cause the cargo ship to start moving (CC.2)" (TE, page 49). Demonstration (use and development) of this CCC element is limited to verbal contributions from a potentially limited number of students. Students are not made aware that they are engaging in or being assessed on this CCC element.

- The element is claimed as a Science Topic lesson set level CCC element for Lessons 7–8.
  - Lesson 7, Learn, Compare Results: "After students finish gluing the cutouts into their Science Logbooks, invite pairs to share their observations with the class." Check for Understanding: "Listen for students to make connections between push strength and the movement of the ball. Encourage students to explain that pushing the ball caused it to start moving (PS2.A, CC.2)" (TE, page 61). Using the phrase "encourage students to" is vague and may lead educators to tell students what to say.
  - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 8.
- The element is claimed as a Science Topic lesson set level CCC element for Lesson 9.
  - Lesson 9, Conceptual Checkpoint: "Elements Assessed… CC.2: Events have causes that generate observable patterns…Evidence: Students circle A push to indicate the action that will cause each rider to move toward the finish line (PS2.A, CC.2). Students circle the picture of the rider moving on the skateboard to indicate the effect of the push (PS2.A, CC.2)" (TE, page 76).
- The element is claimed as a Science Topic lesson set level CCC element for Lessons 13–15.
  - Lesson 13, Land: Based upon patterns observed in previous lessons, students design a plan for stopping a cargo ship. "Remind students that when people notice a pattern in their observations, they can use that pattern to make predictions, or figure out what is likely to happen. Record a few predictions that

students agree about at the bottom of the investigation plan, and tell students that they will follow the investigation plan in the next lesson" (TE, page 113).
    - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 14.
    - Lesson 15, Learn, Update Anchor Chart: Students sit in a circle and push a car to observe patterns of starting and stopping the motion of the car. "Instruct the student to push the car toward a second student, and have that student stop the car and push it along to a third student. Allow this sequence to continue for a few rounds so students can observe a pattern of events that their classmates' actions caused" (TE, Page 122).
  - The element is claimed as a Science Topic lesson set level CCC element for Lesson 16.
    - Lesson 16, Conceptual Checkpoint: "Elements Assessed… CC.2: Events have causes that generate observable patterns…Evidence: Students draw lines showing how the ball moves away from Player A to Player B and away from Player B to Player C. Then students glue two push cutouts onto the picture: one next to Player A that points toward Player B and another next to Player B that points toward Player C (PS2.A, CC.2)" (TE, page 130).
  - The element is claimed as a Science Topic lesson set level CCC element for Lessons 21–23.
    - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 21.
    - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 22.
    - Lesson 23, Learn, Reflect on CCC in Module Learning: "Select a student work product related to students' responses to this question, and model how to discuss the work product by using the lens of Cause and Effect… Have the rest of the class find a partner who is standing next to a work product, and instruct pairs to discuss the following question: How did the lens of Cause and Effect help you understand this phenomenon?...Ask students to switch roles, choose different work products, and repeat this process." Check for Understanding: "Listen for students to connect the concept that events have causes that can help people identify patterns (CC.2) with other aspects of their learning throughout the module, including the phenomena they explored, the investigations they conducted, the practices they applied, and the scientific ideas they developed" (TE, page 179).
- *Simple tests can be designed to gather evidence to support or refute student ideas about causes.*
  - The element is not claimed in the unit front matter.
  - The element is claimed as a Science Topic lesson set level CCC element for Lessons 10–12.
    - There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 10.

- Lesson 11, Learn, Investigate Direction: "After several minutes, ask students to pause the investigation and share their observations…What have you noticed about turning the cargo ship?...How have you used pushes or pulls in your investigation?...Did the plan you made in your Science Logbook work to turn the cargo ship?" Check for Understanding: "Listen for evidence that students used their knowledge of pushes and pulls to make their cargo ship change direction. Also listen for student responses that mention the cause of the cargo ship's movement and the effects of the tugboats' pushes and pulls (CC.2)" (TE, page 93). Demonstration (use and development) of this CCC element is limited to verbal contributions from a potentially limited number of students. Students are not made aware that they are engaging in or being assessed on this CCC element.
- Lesson 12, Learn, Revisit Water Model, Check for Understanding: "Students describe how pushes and pulls cause the model cargo ship to change direction, and they consider whether real tugboats turn cargo ships by using pushes and pulls in the same way. Elements Assessed… CC.2: Simple tests can be designed to gather evidence to support or refute student ideas about causes. Evidence: Students describe a sideways push or pull from the second model tugboat as the cause of the change in direction for the model cargo ship (PS2.A, CC.2)" (TE, page 98). Demonstration (use and development) of this CCC element is limited to verbal contributions from a potentially limited number of students. Students are not made aware that they are engaging in or being assessed on this CCC element.

- The element is claimed as a Science Topic lesson set level CCC element for Lessons 17–20.
  - Lesson 17, Learn, Demonstrate Testing Procedure, Spotlight on CCCs: "Throughout the Engineering Challenge, students will repeatedly assess how effective their cushions are at stopping the tugboat close to the dock (CC.2)" (TE, page 145). Described as a connection to CCC 2, and based on claims in lesson-level front matter, it can be implied that this is the CCC element that is intended. However, this is not a match, Students assessing how effective their solutions are would be **SEP.7 Engaging in Argument from Evidence**: *Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence*, or **SEP.4 Analyzing and Interpreting Data**: *Analyze data from tests of an object or tool to determine if it works as intended.*
  - Lesson 18, Learn, Imagine Dock Cushions, Spotlight on CCCs: "Designing and conducting simple tests can provide students with evidence that they can use to inform their ideas about causes and effects (CC.2). Students use the results from these tests to decide which materials would be most effective for stopping the tugboat close to the dock" (TE, page 150). This indicates that students will be engaged in pursuits that are above grade level: **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.

- Lesson 18, Learn, Plan Dock Cushions, Check for Understanding: Students draw their plans for using the materials the class tested to make their dock cushions. Then students predict how their cushions will affect the movement of the model tugboat. "Elements Assessed…**CC.2**: *Simple tests can be designed to gather evidence to support or refute student ideas about causes*. Evidence… Students glue their tugboat cutout closer to the dock than the model tugboat stopped during the demonstration without a cushion. By predicting that the tugboat will stop closer to the dock, students exhibit an awareness that their cushion should cause the tugboat to bounce back less than it would without their cushion present (**CC.2**)" (TE, page 154).
- Lesson 19, Learn, Test Dock Cushions, Spotlight on Three-Dimensional Integration: "Revisit the class problem and solution chart, and explain that engineers need to test the solutions they create to find out whether they work… From simple tests, students gather evidence that the material the tugboat bumps into determines how the tugboat moves (CC.2)" (TE, page 157).
- There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 20.

- This element is not included on the End-of-Module Assessment Rubric (TE, pages 190–191) or the Alignment Map (TE, page 192), so it is unclear if the element claim is intended to be fully addressed in the unit, or just worked toward. There is mismatch between claim and assessment for this element.

Scale, Proportion, and Quantity

- *Relative scales allow objects and events to be compared and described (e.g., ~~bigger and smaller, hotter and colder,~~ faster and slower).*
  - The element is claimed as a unit level CCC element in front matter (TE, page 7).
    - Lesson 5, Learn, Create Anchor Chart: Students are asked to, "Think-Pair-Share about objects they can push or pull on but cannot move." Teachers are provided with sample student responses including, "I can't move my brother. He's too big" (TE, page 45).
    - Lesson 12, Launch, Content Area Connection, Mathematics: "Students may describe size or weight differences between the ball and a cargo ship. Although this lesson does not provide details of these measurable attributes, students can use their observations to infer that the ball is smaller and lighter than a cargo ship" (TE, page 97).
  - The element is claimed as a Science Topic lesson set level CCC element for Lessons 7–8.
    - Lesson 7, Land/Learn: Students watch a video of a tugboat pushing a cargo ship. They discuss why if they think the cargo ship is moving fast or slow. Teachers are advised to "Introduce the term speed explicitly. Students can focus on using the words faster and slower, relative terms that describe speed. Consider reminding

students of the relative scale they learned about in the previous module when they described temperature as warmer and cooler." Teachers demonstrate how to add movement lines to represent when an object moves faster or slower. "After students finish the investigation, demonstrate on the board how adding movement lines to a drawing of an object can indicate the object's speed. Show students that drawing a lot of longer lines next to an object makes the object look as if it is moving faster, whereas drawing a few shorter lines next to an object makes it look as if it is moving slower" (TE, pages 57–58).

- Lesson 7, Learn, Compare Results: "After students finish gluing the cutouts into their Science Logbooks, invite pairs to share their observations with the class." Check for Understanding: "Listen for students to make connections between push strength and the movement of the ball. Encourage students to explain that pushing the ball caused it to start moving (PS2.A, CC.2) and that stronger and weaker pushes (CC.3) resulted in the ball moving at different speeds (PS3.C)" (TE, page 61). Using the phrase "encourage students to" is vague and may lead educators to tell students what to say.
- Lesson 8, Learn, Revisit Water Model, Check for Understanding: "Students compare the effects of stronger and weaker pushes on the model cargo ship. Elements Assessed… CC.3: Relative scales allow objects and events to be compared and described (e.g., bigger and smaller, hotter and colder, faster and slower). Evidence…Students identify that stronger (CC.3) pushes cause the model cargo ship to move more quickly, whereas weaker pushes cause it to move more slowly (PS2.A)" (TE, page 65). Demonstration (use and development) of this CCC element is limited to verbal contributions from a potentially limited number of students. Students are not made aware that they are engaging in or being assessed on this CCC element.

- The element is claimed as a Science Topic lesson set level CCC element for Lesson 9.
  - Lesson 9, Conceptual Checkpoint: "Elements Assessed…CC.3: Relative scales allow objects and events to be compared and described (e.g., bigger and smaller, hotter and colder, faster and slower). Evidence… Students ask a question (SEP.1) about push strength to determine which team was faster (CC.3)" (TE, page 76).
- The element is claimed as a Science Topic lesson set level CCC element for Lessons 13–15.
  - Lesson 14, Learn, Explore Difference between Models: "Tell students to pay attention to which cargo ship stops first and to compare how far the cargo ships move. How is one cargo ship's movement different from the other cargo ship's movement?" Check for Understanding: "Listen for students' use of comparative language when they describe the difference in how the cargo ships move on water and on the map (CC.3)" (TE, page 109). Demonstration (use and development) of this CCC element is limited to verbal contributions from a potentially limited number of students.

- There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 14.
- There is no evidence that teaching and learning is aligned to or highlights this element in Lesson 15.

Suggestions for Improvement

Overall, consider ensuring that there is consistency in the element claims that appear in the unit front matter and the front matter of the separate Science Topic lesson sets, as well as how what claims are represented in the unit's summative assessment. For example, there are individual SEP elements claimed in Concept lesson sets front matter that are not associated with the claimed PEs.

Science and Engineering Practices

- It is recommended that the discrepancy between SEP elements claimed at the unit level, elements claimed at the Concept lesson set level, and elements included in the rubrics be clarified to ensure that the intended key learning experiences and goals are being fully addressed and assessed.
- Consider revisions that ensure that students have multiple, iterative opportunities throughout the learning sequence to use and develop each claimed element.

Disciplinary Core Ideas

- Consider clarifying for educators what DCI elements are expected to be fully addressed by the conclusion of the unit, and which elements students will continue to work toward (e.g., **ETS1.A**, **ETS1.B**), or consider how all claimed DCI elements may be meaningfully incorporated over the course of the unit. It may be difficult for students to build understanding of and demonstrate proficiency with elements that are only addressed through a select set of lessons.

Crosscutting Concepts

- Consider incorporating more direct, observable events in which all students can demonstrate use and/or development of the targeted CCC elements in service of sense-making, instead of limiting most opportunities to whole group or partner verbal exchanges.

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 or designing solutions to problems because there are numerous events where students are expected to figure out phenomena and solve a problem in ways that require grade-appropriate elements of the three dimensions working together.

The "Prepare" section of each Concept lesson set includes color-coded descriptions of how students are intended to engage in integrated three-dimensional learning throughout the learning sequence. Related evidence includes, but is not limited to:

- Lessons 1–3 Tugboats Moving Cargo Ships, Prepare: "Throughout this module, students explore how pushes and pulls affect the movement of objects (PS2.A). Lesson 1 introduces the module anchor phenomenon: tugboats moving cargo ships through a harbor. Students first learn about the phenomenon by listening to two readings of Tugboat by Michael Garland (2014). This book features repeated instances of tugboats moving other vessels (CC.1) by pushing or pulling them. In Lesson 2, students explore the phenomenon further by examining a map of New York Harbor. They use wooden blocks and a map of the harbor to model how tugboats might help move cargo ships. Students then use the ideas they generate to develop an anchor model. In Lesson 3, students use their observations from across these first three lessons to ask questions (SEP.1) and to build a driving question board" (TE, page 13). In this activity, students integrate the following dimensions:
  - DCI: *Pushing or pulling on an object can change ~~the speed or direction of~~ its motion ~~and can start or stop it~~.*
  - SEP: *Ask questions based on observations to find more information about the ~~natural and/or~~ designed world(s).*
  - CCC: *Patterns in the ~~natural and~~ human designed world can be observed, used to describe phenomena~~, and used as evidence.~~*
- Lessons 4–6, Making Objects Start to Move, Prepare: "In this lesson set, students explore what causes objects to move, and they develop an understanding that when an object starts moving, it does so because of a push or a pull (PS2.A). In Lesson 4, students use a set of toys to explore ways to start movement. Students find that they can sort their actions into two categories: pushes and pulls. In Lesson 5, students identify pushes and pulls in other contexts and record their observations of those actions (SEP.4). By testing their thinking in a variety of situations,

students recognize the pattern that pushes and pulls cause objects to move (CC.1). Lesson 6 introduces students to a water model that helps them make sense of their learning in the context of the anchor phenomenon" (TE, page 31). In this activity, students integrate the following dimensions:

- DCI: *Pushing or pulling on an object can ~~change the speed or direction of its motion and can~~ start ~~or stop~~ it.*
- SEP: *Record information (observations~~, thoughts, and ideas).~~*
- CCC: *Patterns in the ~~natural and~~ human designed world can be observed, used to describe phenomena, and used as evidence.*

- Lessons 7–8, Pushes and Pull Strength, Prepare: "In Lessons 7 and 8, students explore how stronger and weaker pushes and pulls can affect an object's movement (PS2.A) to build on their knowledge of how tugboats help move cargo ships. In Lesson 7, students plan and carry out an investigation (SEP.3) to determine that a stronger push makes an object move faster, and a weaker push makes an object move slower (CC.3). In Lesson 8, students revisit the water model to explore how pushes and pulls of different strengths affect the movement of an object in water. Students then use their new understanding to update the anchor model" (TE, page 53). In this activity, students integrate the following dimensions:
  - DCI:
    - *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 it~~.*
  - SEP:
    - *Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons.*
    - *With guidance, plan and conduct an investigation in collaboration with peers.*
  - CCC:
    - *Relative scales allow objects and events to be compared and described (e.g., ~~bigger and smaller, hotter and colder,~~ faster and slower).*

Toward the conclusion of the unit, sidebar call-outs are used to highlight instances of intended three-dimensional integration. Integration is limited to:

- Lesson 19, Learn, Test Dock Cushions, Spotlight on Three-Dimensional Integration: "In this lesson, students gain experience solving problems through engineering (ETS1.A). Students recognize that when objects bump, the objects push on one another, which can change their movement (PS2.B). From simple tests, students gather evidence that the material the tugboat bumps into determines how the tugboat moves (CC.2). Students use this information to design a possible solution to a problem (SEP.6). Then they use counting and numbers to analyze data from testing to determine whether their designs work as intended (SEP.5)" (TE, page 157).
- Lesson 21, Land, Spotlight on Three-Dimensional Integration: "Throughout PhD Science®, students apply all three dimensions of the NGSS in concert to make sense of phenomena. This activity highlights the role of Science and Engineering Practices in students' three-dimensional learning throughout the module. This discussion should not isolate Science and Engineering

Practices; rather, it should help students reflect metacognitively on links between phenomena, ideas, concepts, and practices in science and engineering" (TE, page 173).

- Lesson 23, Learn, Debrief End-of-Module Assessment, Spotlight on Three-Dimensional Integration: "Throughout PhD Science, students apply all three dimensions of the NGSS in concert to make sense of phenomena. This activity highlights the role of Crosscutting Concepts in students' three-dimensional learning throughout the module. This discussion should not isolate Crosscutting Concepts; rather, it should help students reflect metacognitively on links between phenomena, ideas, concepts, and practices in science and engineering. This lesson highlights Cause and Effect because this concept plays an especially important role in students making sense of phenomena throughout this module. Highlight connections to other Crosscutting Concepts, Disciplinary Core Ideas, and Science and Engineering Practices in the discussion as they appear" (TE, page 178).

The Appendix B, Module Storyline highlights three-dimensional integration intended in the lesson sets. This includes, but is not limited to:

- Appendix B, Module Storyline, Concept 1, Lessons 4–6, Spotlight on Three-Dimensional Integration: "Students record observations (SEP.4) of moving objects to identify the pattern (CC.1) that pushes and pulls cause objects to start moving (PS2.A)" (TE, page 260).
- Appendix B, Module Storyline, Concept 1, Lessons 7–8, Spotlight on Three-Dimensional Integration: "To explore how stronger and weaker pushes and pulls can affect an object's movement (PS2.A), students plan and carry out an investigation (SEP.3) and determine that a stronger push makes an object move faster and a weaker push makes an object move slower (CC.3)" (TE, page 261).
- Appendix B, Module Storyline, Concept 2, Lessons 10–12, Spotlight on Three-Dimensional Integration: "Students plan and conduct an investigation (SEP.3) to determine how tugboats can use pushes and pulls to cause (CC.2) a cargo ship to change direction (PS2.A)" (TE, page 264).
- Appendix B, Module Storyline, Concept 2, Lesson 16, Spotlight on Three-Dimensional Integration: "Students determine whether pushes or pulls cause (CC.2) a soccer ball to start moving and change direction (PS2.A), and they compare images (SEP.3) to identify what happens when a ball bumps into a wall" (TE, page 268).
- Appendix B, Module Storyline, Application of Concepts, Lessons 17–20, Spotlight on Three-Dimensional Integration: "Students build a device (SEP.6) that changes how a dock and tugboat push on one another when they touch (PS2.B), and students gather evidence about the effects of their designs (CC.2)" (TE, page 269).

Suggestions for Improvement

Consider incorporating the "Spotlight on Three-Dimensional Integration" sidebar call-out throughout the entire unit.

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

The reviewers found adequate evidence that lessons fit together coherently to target a set of PEs. Thematic or content linkages are created across the unit, but these linkages inconsistently assist students in seeing explicit connections between the learning of most lessons. The use of student questions to drive the momentum of learning and connect lessons could be increased to make learning more coherent from the student's perspective. Additionally, lessons work together to provide sufficient opportunities for students to build proficiency in the majority of targeted PEs. However, students do not develop proficiency in some elements of the claimed PEs.

It is recognized and accepted that, at this grade-level, educators will naturally need to orchestrate and drive the sequencing of the lessons and motivate the learning. The unit content can be considered as coherent from a Kindergarten student's perspective because all lessons relate to a strong theme: tugboats pushing and pulling. However, although student questions are elicited to form a DQB related to the anchor phenomenon in Lesson 3, those questions are not returned to again until the end of Lesson 9. This is a significant missed opportunity for educators to artfully leverage student questions to relate to the learning and to elicit new student questions along the way.

- Lesson 3, Learn, Develop Essential Question: "Explain to students that they can think of questions to explore by using what they noticed while developing the anchor model, looking at the New York Harbor Knowledge Deck poster, and reading the book Tugboat. Provide students with the following sentence starter: I noticed...Then prompt students to each think of a question that relates to what they noticed" (TE, page 27).
- Lesson 8, Land: "Draw students' attention to the anchor chart, and emphasize that students have figured out a lot about how tugboats help move cargo ships. Tell students that in the next lesson they will have a chance to update the driving question board and to show what they know in a Conceptual Checkpoint" (TE, page 69).
- Lesson 9, Land: "Display the driving question board, and read aloud the question on each sticky note. Have students use a nonverbal signal to show whether they can now answer each question. If students signal that they can answer a question, place the sticky note with that

question in a new column below the Essential Question. If students cannot answer a question, leave that sticky note under Unanswered Questions. What do you notice about our new group of questions?…Build on student responses to introduce the Concept 1 Focus Question: What causes objects to start moving? Record the Focus Question at the top of the new column of questions" (TE, page 77). Students are not prompted to answer the questions, nor are they provided an opportunity to ask new questions.

- Lesson 10, Launch: "Invite students to share their questions about how a tugboat turns a cargo ship to move it in different directions. Add these questions to the driving question board, and build on them to introduce the Phenomenon Question How can tugboats turn a cargo ship?" (TE, page 86).
- Lesson 13, Launch: "As students share what they wonder, record their questions on individual sticky notes, and add the sticky notes to the driving question board. Highlight the fact that the tugboat is pulling on the cargo ship to try to move it toward the tugboat, and remind students that sometimes pushes and pulls are not strong enough to move an object. Then wonder aloud whether a stronger pull from the tugboat would have been enough to stop the cargo ship from crashing, and introduce the Phenomenon Question How can a tugboat make a cargo ship slow down and stop? Tell students that they will plan an investigation to try to answer this question" (TE, page 108).
- Lesson 16, Land: "Display the driving question board, and read aloud the unanswered questions on each sticky note in the second column. Have students use a nonverbal signal to show whether they can now answer each question. As students respond, keep the newly answerable questions in the second column, and place the questions that still cannot be answered in an open space next to the driving question board. What do you notice about our new group of questions?...Use student responses to develop the Concept 2 Focus Question: What causes moving objects to change direction or stop? Record the Focus Question at the top of the second column" (TE, page 132). Students are not prompted to answer the questions, nor are they provided an opportunity to ask new questions.
- Lesson 21, Land, Teacher Note: "Display the driving question board, anchor chart, and anchor model to help students reflect on how their knowledge has grown" (TE, page 172).
- Lesson 23, Launch: "Draw students' attention to the driving question board, and invite them to reflect on their new knowledge and what else they would like to learn. Begin by asking students to think about questions they answered during the module. Pose questions such as these to facilitate the discussion: What did you do to answer these questions? Which answers surprised you? Why? Which questions relate to each other? How? Then ask students to share new questions they have. Ask students to reflect on these new questions and the unanswered questions next to the driving question board" (TE, page 180). This is one of limited opportunities for students to ask new questions, and the only option presented to explore the new questions is as an extension.

NGSS PEs, along with most of the associated three dimensions and elements are identified as targeted learning goals in the Focus Standards section (TE, page 5) of the unit front matter and in the Prepare section of the lesson sets (Lessons 1–3, Lessons 4–6, Lessons 7–8, Lesson 9, Lessons 10–12, Lessons 13–

15, Lesson 16, Lessons 17–20, and Lessons 21–23) implying that the identified PEs are "present" in this unit. Overall, almost all the elements required for these PEs are used or developed in the learning sequence and evidence related to these elements can be found in Criterion I.B. However, the PEs claimed for the unit have a few associated elements that are not claimed at the unit or Science Topic lesson set level.

- **K-PS2-1** *Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.*
- **K-PS2-2** *Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*
    - The materials have not claimed this SEP element associated with this PE as a learning target: *Analyze data from tests of an object or tool to determine if it works as intended*. Nor has an explanation of this element being addressed in past or future learning been provided.
- **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.*
    - The materials have not claimed this SEP element associated with this PE as a learning target: *Develop a simple model based on evidence to represent a proposed object or tool, n*or has an explanation of this element being addressed in past or future learning been provided.
    - The materials have not claimed the CCC element associated with this PE as a learning target: *The shape and stability of structures of natural and designed objects are related to their function(s)*, nor has an explanation of this element being addressed in past or future learning been provided.

Suggestions for Improvement

- Currently, the Anchor Model, DQB, and/or Anchor Chart are not mentioned and/or used in Lessons 4, 7, 11, 17–20, and 22–23. Consider ensuring that at least one of the three structures is utilized in every lesson to make learning coherent from the students' perspectives.
- Consider increasing the opportunities for students to generate new questions regularly throughout the learning materials. Currently, students are explicitly prompted to ask new questions in only Lessons 1, 3, 10, 13, and 23.
- It is recommended that educators are consistently and explicitly prompted to use what students have figured out (e.g., Anchor Model, Anchor Chart) as context for the next idea to be pursued. Instead of having educators state, "In the next lesson we will [insert un-, or loosely related endeavor with no reasoning as to why]" guidance can be given to have the educator offer to or ask students what might still need to be figured out as a reason to move on to the next lesson.

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 because the identified phenomena driving the learning can be fully addressed within the physical science domain. However, CCCs are not explicitly used to make connections across science domains from previous learning.

The list provided on the last page of the TE identifies this module as the second Kindergarten module of four total modules. Based on this list as well as Lesson 2, Land: "Remind students that in the previous module they developed an anchor model to guide their learning about the weather at Mesa Verde" (TE, page 25) it is confidently assumed that this module would follow the weather module. Because reviewers do not have access to the weather module, it is also being assumed — based on *NGSS* PEs — that at least **Patterns** and **Cause and Effect** are being highlighted as CCCs in that first module, Weather. These CCCs are also a substantial part of this second module, Pushes and Pulls. There is very limited evidence to support that the unit materials highlight or leverage CCCs to make connections across physical science and Earth and space science domains when there are regular opportunities to do so. Evidence of connections made between science disciplines as related to CCCs are limited to:

- Lesson 4, Learn, Sort Actions, Teacher Note: "Remind students that they found a pattern in the previous module when they observed how the temperature goes up and down throughout each day" (TE, page 40). While there's a connection to previous use of CCCs, there's a missed opportunity to connect science domains using the CCCs.
- Lesson 7, Launch: "Consider reminding students of the relative scale they learned about in the previous module when they described temperature as warmer and cooler" (TE, page 57).

Suggestions for Improvement

Consider supporting students' explicit use of CCC elements and their understanding of the utility of CCC elements to help explain phenomena related to different domains. For example, students could be supported to connect their understanding of patterns in a weather forecasting phenomenon (Earth and space science) to patterns in a pushes and pulls phenomenon (physical science).

I.F. MATH AND ELA

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

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

The reviewers found extensive evidence that the materials provide grade-appropriate connections to the Common Core State Standards (CCSS) in mathematics and English language arts (ELA) because the materials explicitly claim CCSS standards and provide opportunities for students to use them to figure out the unit phenomenon.

Specific mathematics CCSS connections are called out in the sidebar of the material as possible moments to highlight student use. However, lesson materials do not consistently work towards (develop) or fully address these standards. Related evidence includes:

- Module Overview, Building Knowledge and Skills Across Levels: "In the Engineering Challenge, students use counting and numbers (SEP.5) to help them identify patterns in the designed world. Students measure the distance that the model tugboat bounces after bumping into their model dock cushions, and they use their measurements to compare the success of different dock cushion designs" (TE, page 8).
- Lesson 1, Land, Content Area Connection, Mathematics: "Consider using this lesson to address a Measurement and Data standard (CCSS.Math.Content.K.MD.A.1) (NGA Center, CCSSO 2010b) by providing comparisons students can relate to, such as the following: The longest cargo ships stretch the length of more than four football fields. Just one of these giant ships is as long as about 16 tugboats in a line (ZDF Enterprises, n.d.; BC Shipping News 2012)" (TE, page 20). Offering educators to "consider using" is not evidence that the unit materials support educators in accurately and appropriately addressing the standard, only that a potential opportunity exists. Additionally, examples given for context of size comparison are not reliably relatable for young learners.
- Lesson 7, Learn, Compare Results, Content Area Connection, Mathematics: "When students describe the movement of the ball as faster in one situation and slower in another, they are developing the ability to compare measurable attributes (CCSS.Math.Content.K.MD.A.2). Consider pointing out to students that people can use tools to measure an object's speed" (TE, page 59). This suggestion is stated as optional, so it is less likely that all teachers will use it in all classrooms.
- Lesson 12, Launch, Content Area Connection, Mathematics: "Students may describe size or weight differences between the ball and a cargo ship. Although this lesson does not provide

details of these measurable attributes, students can use their observations to infer that the ball is smaller and lighter than a cargo ship (CCSS.Math.Content.K.MD.A.1)" (TE, page 97).

- Lesson 14, Learn, Investigate Slowing Down and Stopping, Content Area Connection, Mathematics: "The position of the tugboat in relation to the cargo ship is integral to stopping the ship. This investigation and the discussions students have about it support students' developing ability to describe the relative positions of objects by using terms such as beside, in front of, behind, and next to (CCSS. Math.Content.K.G.A.1)" (TE, page 115).
- Lesson 16, Learn, Debrief Conceptual Checkpoint, Content Area Connection, Mathematics: "When students reflect on their learning from the module investigations, they recognize patterns in the ways that pushes and pulls affect movement. In doing so, students develop skills that appear in the Standards for Mathematical Practice (CCSS.Math. Practice.MP7)" (TE, page 131).
- Lesson 18, Learn, Imagine Dock Cushions: "Highlight the importance of measuring with numbers to compare the distance the tugboats bounce back, and tell students that they will use a new measuring paper when they test their cushions. Teacher Note: When students test their cushions during the Create stage in Lesson 19, use the lined measurement paper (Lesson 19 Resource), which includes lines and numbers so students can measure distance within each color zone" (TE, page 152).
    - On pages 238–240 the images and directions for the "Engineering Challenge Setup Instructions and Classroom Procedure" indicate that students will be using rulers. However, because students are asked to use sticky notes to mark the color zone in which the vehicle stops (TE, page 242, Step 3b), it is unclear if the rulers are being used for measuring purposes, or if they are simply being used to create a track of sorts to contain the moving object. This may unnecessarily cause confusion for educators and leave them thinking that students should engage with above-grade mathematics tasks.
- Lesson 19, Learn, Improve Dock Cushions, Content Area Connection, Mathematics: "To select the number that shows the smallest bounce the materials produced, students must compare numbers between 1 and 11 presented as written numerals (CCSS.Math.Content.K.CC.C.7)" (TE, page 159).
- Lesson 19, Land, Content Area Connection, Mathematics: "When students consider their cushion's performance before and after making changes, they directly compare measurable attributes to see which design has 'less of' that attribute (CCSS.Math.Content.K.MD.A.2). For example, students identify which of their designs caused the tugboat to bounce back fewer boxes" (TE, page 161).

Specific CCSS ELA connections are called out in the sidebar of the material as possible moments to highlight for student use. However, there are few explicit claims that the learning materials actively work towards or fully address (develop) these standards. While the unit lacks opportunity for students to practice reading and writing directly, the learning sequence does include frequent opportunities for students to practice speaking and listening skills. Related evidence includes, but is not limited to:

- Lesson 1, Learn, Introduce Tugboats in the New York Harbor, Content Area Connection, English: "Consider either offering students guidelines for engaging in collaborative conversation or

developing such guidelines as a class. When students work in pairs, encourage them to take turns speaking and to acknowledge the thoughts that their partners express (CCSS.ELA-Literacy.SL.K.1) (NGA Center, CCSSO 2010a)" (TE, page 19). Because this is written as optional, it is less likely that it will be used in all classrooms.

- Lesson 4, Learn, Sort Actions, Content Area Connection, English: "When students act out, discuss, and compare different pushes and pulls, they explore word relationships and nuances in word meanings (CCSS.ELA-Literacy. L.K.5)" (TE, page 38).
- Lesson 7, Learn, Compare Results, Content Area Connection, English: "If time allows and students are able, consider prompting students to add words to their sketches. Students can later use their words and sketches to help them recall information from this investigation to answer future questions (CCSS.ELA-Literacy.W.K.8)" (TE, page 61). This is all very circumstantial and time dependent, thus it does not serve as evidence that the actual unit addresses the standard.
- Lesson 9, Learn, Debrief Conceptual Checkpoint, Content Area Connection, English: "As students present their knowledge and ideas, listen for opportunities to support their speaking skills. Consider offering reminders and feedback on speaking audibly and on expressing thoughts and ideas clearly (CCSS.ELA-Literacy.SL.K.6)" (TE, page 77).
- Lesson 12, Learn, Update Anchor Chart, Content Area Connection, English: "Consider pairing students with partners who were not in their investigation groups and having them share their ideas while following classroom rules for discussions. Reflecting on new learning with peers helps students deepen their conceptual understanding and allows them to practice speaking and listening (CCSS.ELA-Literacy.SL.K.1)" (TE, page 101). Because this is written as optional, it is less likely that it will be used in all classrooms.
- Lesson 13, Land, Content Area Connection, English: "Develop students' language skills by encouraging students to use complete sentences to describe their plans for stopping a cargo ship (CCSS.ELA-Literacy.L.K.1.F)" (TE, page 112).
- Lesson 17, Launch, Content Area Connection, English: "When revisiting pages 8–9 of the book Tugboat, consider reading the text aloud while displaying the illustration. Students may not be familiar with the words captain, crew, and board. By hearing these words in context and by using them in their responses, students build their vocabulary and improve their comprehension of the Engineering Challenge scenario (CCSS.ELA-Literacy. L.K.4)" (TE, page 139). Because this is written as optional, it is less likely that it will be used in all classrooms.
- Lesson 20, Learn, Share Dock Cushions, Content Area Connection, English: "Students may enjoy learning how they can use other words from the Engineering Challenge, such as dock and board, as nouns and verbs as well (CCSS.ELA-Literacy.L.K.4.A)" (TE, page 163). Because this is written as optional, it is less likely that it will be used in all classrooms.
- Lesson 21, Learn, Prepare for Socratic Seminar, Content Area Connection, English: "The Socratic Seminar allows students to use their speaking and listening skills to express and deepen their science content knowledge. In a Socratic Seminar, students participate in a collaborative, evidence-based, academic conversation. In this discussion, students should work toward grade-level expectations for collaborative conversations (CCSS.ELA-Literacy.SL.K.1)" (TE, page 171).

Suggestions for Improvement

- Consider incorporating additional and varied reading materials (e.g., additional fictional stories, non-fiction text, articles, or infographics) to be read aloud. Additionally, consider offering opportunities for students to engage directly with grade-appropriate readings.
- Consider adding grade-appropriate writing opportunities. For example, students could be prompted to add letters or words as labels for cut-and-glue/drawn diagrams.

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

CATEGORY II

NGSS INSTRUCTIONAL SUPPORTS

II.A. RELEVANCE AND AUTHENTICITY

II.B. STUDENT IDEAS

II.C. BUILDING PROGRESSIONS

II.D. SCIENTIFIC ACCURACY

II.E. DIFFERENTIATED INSTRUCTION

II.F. TEACHER SUPPORT FOR UNIT COHERENCE

II.G. SCAFFOLDED DIFFERENTIATION OVER TIME

II.A. RELEVANCE AND AUTHENTICITY

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

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

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

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

Rating for Criterion II.A. Relevance and Authenticity	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 because students are able to experience the unit and lesson level phenomena as directly as possible and they have some opportunity to make basic connections between phenomena and prior experience, but the drive to figure out the phenomena and solve the unit's problem is teacher directed. Additionally, the problem presented is contrived.

Students are given multiple opportunities to experience the anchor phenomenon — tugboats moving cargo ships — through media and model representations (e.g., toys/blocks, photographs, pictures, videos). However, it should be noted that while tugboats moving cargo ships in a harbor is a real-world scenario, it is not clear that Kindergarteners would individually feel authentically motivated to figure out the movement of cargo ships by a tugboat, or that they would be supported in realizing the importance. Related evidence includes, but is not limited to:

- Module Overview, Introduction: "Next, to apply their learning in the context of the anchor phenomenon, students observe how a plastic tugboat can push and pull a wooden block cargo ship in water" (TE, page 2).
- Module Overview, Introduction: "Lesson 1 introduces students to the module anchor phenomenon by using the book Tugboat by Michael Garland (2014) and the New York Harbor Knowledge Deck™ poster. In Lesson 2, students examine a map of New York Harbor and use a set of wooden blocks to model how tugboats could help move cargo ships through part of the harbor" (TE, Page 1).
- Lesson 1, Learn, Read Aloud Tugboat: "Read the book aloud…To prepare students for the second reading of the book, introduce the Phenomenon Question What do tugboats do? As students listen this time, have them use a nonverbal signal whenever they notice a tugboat helping a big ship. Pause every few pages, and ask students to whisper to a partner what they saw the tugboat do" (TE, page 17).

- Lesson 7, Launch: "Play the video of a tugboat pushing a cargo ship (http:/phdsci.link/1577). Explain that the video shows a part of New York Harbor that is close to the port that appears on the anchor model" (TE, page 56).

Students are given multiple opportunities to directly interact with the investigative phenomena and make observations of media representations (e.g., photographs, illustrations, videos). Related evidence includes, but is not limited to:

- Lesson 1, Launch: "Choose a big object, such as a reading table or a rolling bookcase, that students could move safely with assistance. Have students brainstorm different ways they could move the object across the classroom. How could we move the reading table from the back of the room to the front of the room? After students share ways to move the object, ask them whether moving the object would be easy or difficult and to explain why" (TE, page 16).
- Lesson 2, Launch: Teachers are prompted to ask, "How is this problem similar to moving the reading table in our classroom?" (TE, page 22).
- Lesson 4, Learn, Explore Movement: "Place students in groups, and distribute a set of toys and a sheet of chart paper to each group…Invite students to explore the different ways that they can make the toys move across the paper" (TE, page 34).
- Lesson 5, Land: "Introduce the ballet video (Royal Opera House 2015) (http:/phdsci.link/1576). Tell students that as they watch, they should use the push and pull movements that the class agreed upon in Lesson 4 to indicate when they notice a push or a pull happening. Play the first 40 seconds of the video" (TE, page 45).
- Lesson 9, Learn, Prepare for Conceptual Checkpoint: "Display the photograph of children with a skateboard (Lesson 9 Resource A), and tell the class that people can race on skateboards" (TE, page 74).
- Lesson 16, Launch: "Show students the video of children playing soccer" (TE, page 127).
- Lesson 16, Launch, Teacher Note: "If possible, partner with the physical education teacher to arrange for students to play soccer before this lesson" (TE, page 127).

Students are offered opportunities to connect their homes, neighborhoods, communities and/or cultural experiences to their learning. Related evidence includes, but is not limited to:

- Lesson 1, Launch: "Encourage students to think about times when they saw people move something similar to the chosen object" (TE, page 16).
- Lesson 1, Learn, Read Aloud Tugboat: "Allow students to briefly share with the class what they already know about tugboats" (TE, page 17).
- Lesson 1, Learn, Introduce Tugboats in New York Harbor: "Provide context for the photograph on the poster by showing students the school's location and the location of New York Harbor on a map" (TE, page 18).
- Lesson 2, Launch: "Before introducing the map of Staten Island and New York Harbor, consider showing students a map of the United States and pointing out the school's location" (TE, page 21).
- Lesson 3, Learn, Build DQB, Teacher Note: "Leave space at the bottom of the driving question board for a Related Phenomena section. The Related Phenomena section provides students

with a chance to think about how other experiences in their lives connect with the anchor phenomenon. When students share experiences or prior knowledge related to pushes, pulls, and movement, record their responses on sticky notes, and post the notes in this section. As students' understanding of the anchor phenomenon grows, they can reflect on these related phenomena to practice applying their new knowledge to the world around them…What are some other examples of something or someone moving an object with a push or pull? Add student ideas to the bottom of the driving question board under Related Phenomena" (TE, page 28).

- Lesson 3, Land: "Explain to students that they can investigate how tugboats help move cargo ships not only by modeling a tugboat, a cargo ship, and a harbor but also by exploring other examples of using pushes or pulls to move an object. What are some other examples of something or someone moving an object with a push or pull?" (TE, page 29).
- Lesson 4, Launch: "Show students the set of toys (table tennis ball, plastic puck, sticky hand, and toy car) that they will use to explore pushes and pulls. Invite students to share their experiences playing with toys like these" (TE, page 34).
- Lesson 9, Learn, Prepare for Conceptual Checkpoint: "Ask students what they know about racing" (TE, page 74).
- Lesson 9, Learn, Debrief Conceptual Checkpoint: "Acknowledge that it is helpful for students to find out whether their learning in one situation applies in other situations. When else do you use pushes and pulls to move an object?...Explain to students that they can use their science knowledge to better understand what is happening whenever they move objects" (TE, page 77).
- Lesson 10, Launch: "Have a volunteer demonstrate walking from one point to the other. Then invite a second student to take a different path between the same two points…Point out that neither student walked in a straight line. Explain to the class that both students had to turn and change direction as they walked to avoid bumping into furniture" (TE, page 84).
- Lesson 13, Land, Teacher Note: "To encourage students to share about prior experiences that may have informed their plan, consider asking the following questions: Can you think of a time when you tried to stop a moving object? What worked then? What did not work?" (TE, page 112).
- Lesson 14, Learn, Make Predictions with Water Model, Check for Understanding: "Listen for students to support their predictions with prior events or experiences (SEP.3). If students do not mention personal experiences, prompt them with questions such as these: What have you noticed before that can help you make a prediction? Have you ever used a push or a pull to stop something from moving?" (TE, page 116).
- Lesson 15, Learn, Update Anchor Chart, Spotlight on DCIs: "In Concept 2 and during the Engineering Challenge, students explore the idea that when objects touch, they push on each other (PS2.B). To support student understanding, consider sharing other examples of pushes students can feel when they bump into an object or when an object bumps into them. Examples may include bumping into a desk and catching a ball. Invite students to share a time when they pushed on an object and felt a push from that object" (TE, page 123). Because this is a sidebar call-out and it is in the description to "consider," this could easily be missed or

skipped, so it does not serve as a guaranteed piece of evidence that students will have an opportunity here to make connections to their lives.

- Lesson 16, Learn, Debrief Conceptual Checkpoint: "Help students recall all the different ways they have investigated pushes and pulls: by using the water model, the map model, the toys, the Hall's car, and their hands and by watching videos of dancers, tugboats, and soccer players" (TE, page 131).
- Lesson 16, Launch: "Tell students that in this lesson they will think about pushes and pulls in a game of soccer. Invite students to share what they know about soccer and to describe their experiences playing the game" (TE, page 127).
- Lesson 17, Learn, Set Up Problem and Solution Chart, Differentiation: "Ask students whether they have ever worn helmets or safety pads when bicycling, skating, or riding a skateboard. Help students understand that when they bump into an object, these cushions protect them by making the push from the object feel weaker" (TE, page 144).

The premise of the Engineering Design challenge in Lessons 17–20 is contrived and thus inauthentic for students. However, the challenge is well connected to the overall theme of the unit, tugboats. Related evidence includes:

- Lesson 17, Launch: "Ask students to imagine that the tugboat in the photograph is returning to its dock after a day of moving cargo ships through the harbor and that the tugboat captain needs to get back to the dock fast. Tell students that because the captain cannot slow down, the tugboat will bump into the dock" (TE, page 139). Students are not given an accurate reason for why the captain cannot slow down.
- Lesson 17, Launch, Teacher Note: "To encourage student engagement, consider telling the class to imagine that the tugboat captain is hurrying back to the dock for a specific reason. For example, the captain could be rushing to get to a birthday party or to bring a sick crew member back to shore" (TE, page 139). Regardless of what the captain is rushing for, they can use the boat's motor to slow down the boat quickly and move it safely to the dock.
- Lesson 17, Learn, Think About Tugboat Docking: "Remind students that the tugboat needs to stop close to the dock so that people can get on and off the boat safely but that the captain is also in a hurry and cannot slow down. Tell students that the class needs to figure out a way to change how the dock pushes on the tugboat without changing how fast the tugboat is moving when it bumps into the dock" (TE, page 142). Boats have motors that can be used to slow them when needed. If the motor was broken, another boat would need to tow the first boat. It is contrived to present the problem that the captain cannot slow down.
- Lesson 17, Learn, Think About Tugboat Docking: "Guide students to notice the tires and to think about how the tires might help soften the bump between a tugboat and its dock… How could we stop the tugboat from bouncing so far away from the dock?...Maybe we could put something like the tires on the dock or the tugboat to make the tugboat bounce less. Build on student responses to suggest that adding a cushion to the dock would soften the bump between the tugboat and the dock. If needed, revisit the photograph of a tugboat at a dock (Lesson 17 Resource D) to develop the idea that students can create a cushion that helps the tugboat stop closer to the dock" (TE, pages 142–143). Because a solution is already provided,

students will not be compelled in developing authentic solutions based on their own ideas and learning.

Suggestions for Improvement

- To increase a sense from the student perspective that the phenomenon is important to figure out, it would be helpful to further emphasize the information presented on the back of the Knowledge Deck during Lesson 1 (TE, page 19) (i.e., what cargo ships carry and why cargo ships are important). If students discuss why it would be a problem if cargo ships could not make it into the harbor, they may better understand the need to learn about the movement of these ships by tugboat.
- Consider revising the anchor question for the unit from "How do tugboats move cargo ships through a harbor" to "How do tugboats move cargo ships quickly and safely through a harbor?" This simple revision adds a layer of criteria for the movement that would more deeply define what it is that students are figuring out, instead of just concluding that tugboats push and pull cargo ships. The revision would also connect to the importance of cargo ships in that people want the goods transported by cargo ships to arrive, and to arrive in a timely manner.
- Consider revising the scenario presented in Lessons 17–20 to provide an accurate and authentic problem for students to solve. Additionally, it is suggested that students are not shown the solution (i.e., tires, rubber bumpers) that already exists for tugboats to safely collide with the vessels they are moving and/or the dock.
- Moving the video presented in the beginning of Lesson 7, or another video of tugboats maneuvering big ships to be paired with the read aloud earlier in the unit will provide a realistic representation of the phenomenon, including a better sense of the scale of the ship and how close the shore is.
- Consider incorporating one or more opportunities for students to share their personal experiences with boats, not just asking them what they know about tugboats. For example, a student may have been on a cruise ship that needed to be docked by a tugboat, a student may be part of a family who makes their living in the fishing industry, and/or a student may have been in a canoe or kayak.
- Consider adding a note regarding how educators may increase relevancy for students if their community happens to be located near a major harbor. What could educators near the harbors of New York, NY, Dundalk, MD, Norfolk, NC, or San Francisco, CA do to connect their students more directly to the phenomenon?
- Consider providing guidance for educators to contact a Harbor Master, Naval Engineer, or even a local fisherman (if available to them) to help increase authenticity by adding a human element.

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

The reviewers found adequate evidence that the materials provide students with opportunities to both share their ideas and thinking because students are regularly prompted to share ideas with peers, and educators are provided with supports to draw out ideas from students. However, opportunities for students to receive and respond to educator and peer feedback, as well as revise their thinking based upon the feedback is limited.

There is an abundance of opportunity for students to express their thinking verbally and nonverbally to educators and to peers. Related evidence includes, but is not limited to:

- Lesson 1, Learn, Introduce Tugboats in New York Harbor: "Ask students to Think–Pair–Share about how tugboats help cargo ships in the harbor. Have a few students share their ideas with the class" (TE, page 19).
- Lesson 4, Learn, Sort Actions: "Ask each group to demonstrate to the class one way they were able to move their toy" (TE, page 38).
- Lesson 4, Land: "Place the toy car in a visible spot, and ask students to briefly Think–Pair–Share in response to the following question What do you think will happen if I push this toy car?" (TE, page 40).
- Lesson 5, Launch: "Have students Think–Pair–Share to brainstorm the different ways they could get the stroller to move" (TE, page 41).
- Lesson 5, Learn, Draw Pushes and Pulls: "Place students in pairs, and distribute one sticky note to each pair. Tell students to look around the classroom for objects they could move with a push or a pull and to work with their partners to choose one of these objects. Instruct one student from each pair to place a sticky note on the object they have chosen" (TE, page 42).
- Lesson 7, Learn, Investigate Pushes: "Then instruct students to complete the first two prompts in their Science Logbooks (Lesson 7 Activity Guide) by drawing movement lines in the two boxes, to the left of the ball illustrations" (TE, page 58).
- Lesson 10, Learn, Create Direction Investigation Plan: "Have a few students move their fingers across the map to show different paths the cargo ship could take to reach the port" (TE, page 87).
- Lesson 11, Land: "Invite students to share additional observations with the class" (TE, page 95).
- Lesson 12, Learn, Revisit Water Model: "Ask students to Think–Pair–Share in response to the following question: How can we make the cargo ship change direction when it is moving?" (TE, page 97).

- Lesson 13, Learn, Plan Stopping Investigation: "Instruct students to glue a tugboat cutout in the second column to show where they will place the tugboat. Then tell students to glue either a push cutout or a pull cutout next to the tugboat cutout to show how they plan to use the tugboat to stop the cargo ship" (TE, page 11).
- Lesson 16, Launch: "Tell students they will now watch another soccer video. Instruct them to use a nonverbal signal when they notice a pull" (TE, page 127).
- Lesson 17, Learn, Think About Tugboat Docking: "Display the photograph of a tugboat at a dock (Lesson 17 Resource D). Have students Think–Pair–Share about what they notice" (TE, page 142).

As compared to the opportunity for students to simply express their thinking, there are more limited opportunities for students to justify or clarify their thinking throughout the learning sequence. Related evidence includes:

- Lesson 1, Launch: "After students share ways to move the object, ask them whether moving the object would be easy or difficult and to explain why" (TE, page 16).
- Lesson 2, Learn, Develop Anchor Model: "Invite students to use a set of wooden blocks on the map to demonstrate as they explain their ideas" (TE, page 23).
- Lesson 5, Learn, Draw Pushes and Pulls: "Have students return to their seats, and invite a few students to explain how they could use pushes or pulls to move their objects" (TE, page 42).
- Lesson 10, Learn, Plan Tugboat Placement: "Next, invite groups to decide where they want to place their second tugboat so they can start to turn the cargo ship. Have each student glue the second tugboat cutout on the map in their Science Logbooks (Lesson 10 Activity Guide). Have a few volunteers share their reasoning…" (TE, page 90).
- Lesson 15, Learn, Update Anchor Chart: "Then ask the class how the student used a push or a pull to make the car stop" (TE, page 121).
- Lesson 17, Learn, Think About Tugboat Docking: "What do you predict will happen when the tugboat bumps into the dock? Why do you think that?" (TE, page 141).
- Lesson 18, Learn, Plan Dock Cushions, Check for Understanding, Next Steps: "Ask students to explain why they think their cushion will help solve the problem" (TE, page 154).
- Collaborative conversation prompts are provided in an "Implementation Guide" format as a separate document. The guide includes a set of clarification, reasoning, evidence, and collaboration prompts and a reference to additional "reading on science discussions in the classroom" (Collaborative Conversation Prompts). However, educators are never explicitly prompted to reference this document during the learning sequence presented in the TE.

Educator and peer feedback is infrequent, inconsistently framed to support improvement of student performance, and not specific to students' responses. Additionally, students are not provided with opportunities to respond to feedback. Related evidence includes, but is not limited to:

- Lesson 7, Launch: "Use the questions below to drive a discussion about the cargo ship's speed. After each student response, ask the rest of the class to give a nonverbal signal, such as a thumbs-up or thumbs-down, to indicate whether they agree" (TE, page 56). While this is peer feedback, it is not specific or explained, nor do students have the opportunity to respond.

- Lesson 9, Learn, Debrief Conceptual Checkpoint, Content Area Connection, English: "Consider offering reminders and feedback on speaking audibly and on expressing thoughts and ideas clearly (CCSS.ELA-Literacy.SL.K.6)" (TE, page 77). The likelihood of educators implementing this decreases when offered as an optional consideration.
- Lesson 10, Learn, Plan Tugboat Placement: "Have each student glue the second tugboat cutout on the map in their Science Logbooks (Lesson 10 Activity Guide). Have a few volunteers share their reasoning, and ask the rest of the class to use a nonverbal signal to show whether they think each approach would work" (TE, page 90). While this is peer feedback, it is not elaborated on, nor do students receiving the feedback have the opportunity to revise their work.
- Lesson 11, Learn, Investigate Direction: "After several minutes, ask students to pause the investigation and share their observations. As students share, have students from other groups use a nonverbal signal to indicate whether they had a similar experience" (TE, page 93). Indicating similar experiences is not constructive feedback to impact quality of student performance.
- Lesson 11, Learn, Investigate Direction: "After several minutes, ask students to pause the investigation and share their observations. As students share, have students from other groups use a nonverbal signal to indicate whether they had a similar experience…Allow groups to return to their map models for a few minutes to test new ideas or to explore strategies that students in other groups described" (TE, page 93).
- Lesson 12, Learn, Revisit Water Model: "As students share their ideas, have other students use a nonverbal signal to indicate whether they had a similar idea" (TE, page 97). Indicating similar experiences is not constructive feedback to impact quality of student performance.
- Lessons 21–23, Prepare, Materials, Preparation: "Score End-of-Module Assessment and write individual feedback" (TE, page 169).
- Lesson 22, Learn, Complete End-of-Module Assessment, Teacher Note: "To prepare for the next lesson, analyze students' responses to each item on the End-of-Module Assessment and score each item on the rubric. (See the rubric and sample responses in the End-of-Module Assessment section in the Teacher Edition.) Identify at least one assessment item to debrief with the class in the next lesson. Also select an exemplar student response for the item to show students, or display the sample student response to this item from the Teacher Edition. If selecting a student response, remember to remove identifying information and to select responses from diverse students over time. When providing individual feedback on the assessment, be sure to guide students to focus on specific areas of improvement to deepen their understanding of module concepts. Offer students who need remediation the opportunity to revisit portions of the module." (TE, page 176).
- Lesson 23, Learn, Debrief End-of-Module Assessment, Teacher Note: "Depending on students' familiarity with reflection and revision, consider these additional strategies for debriefing the assessment. Display a student-friendly version of the rubric's evidence description for the assessment item. Have students share evidence and questions about how the sample response meets rubric expectations. Display a sample response that does not meet expectations alongside the previously displayed sample response that does meet expectations. Have students compare the responses. Have students offer feedback on peers' responses or on their

own response to the assessment item. Have students revise their response to the assessment item, applying new ideas from the debrief conversation to show deeper understanding in their responses" (TE, page 178). Including as an option for consideration may leave this prompt overlooked, so students may only have the opportunity to look at *one* response and never revisit and revise their own response.

Suggestions for Improvement

- For an extensive rating, explicit and regular supports need to be provided to guide constructive feedback to students from both the educator and peers. Written educator feedback is only prompted for the end-of-module assessment as part of the rubric. Consider additional methods for students to regularly receive written and oral feedback from both the teacher and peers throughout the unit that focuses on performance with the targeted three dimensions.
- Consider adding regular opportunities for students to respond to and revise their thinking based on the feedback that they receive from both peers and teachers.

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

The reviewers found inadequate evidence that the materials identify and build on students' prior learning in all three dimensions because unit materials include descriptions of what students will do in later grade levels, but do not include information about prior proficiency students should have before this learning sequence. While it is recognized that Kindergarten units will naturally have reduced expectations for prior learning, there is no acknowledgment of what and when concepts and skills are completely new to students, and when they were introduced in the previous module.

The unit front matter includes brief descriptions of a continuum of learning in each of the three dimensions from this unit into the future. This description does not include details regarding prior learning from previous grade-level modules.

- TE, Module Overview, Building Knowledge and Skills Across Levels: "Throughout Kindergarten, students build knowledge and skills associated with the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts…" (TE, pages 8–9).

The title pages of the TE indicate that this is module two. The very last page of the TE indicates that the module is one among a total of four Kindergarten modules. However, there is no explanation of whether the modules should be taught in any certain order. If so, there is no explanation, and very limited evidence of what students should be coming to this module with from the previous module. The materials include references to learning that is anticipated in later levels. Related evidence includes, but is not limited to:

- Lesson 2, Land: "Remind students that in the previous module they developed an anchor model guide their learning about the weather at Mesa Verde" (TE, page 25).
- Lesson 4, Launch, Teacher Note: "Throughout this module, students may notice examples of movement that they struggle to explain by applying their knowledge of pushes and… Students will learn about these more abstract examples in later levels. In the meantime, support students' curiosity by offering age-appropriate explanations for their questions, and add their questions to the driving question board" (TE, page 34).
- Lesson 4, Learn, Sort Actions, Teacher Note: "Remind students that they found a pattern in the previous module when they observed how the temperature goes up and down throughout each day" (TE, page 40).
- Lesson 5, Learn, Create Anchor Chart, Teacher Note: "In later levels, students will learn more about how mass, friction, force, and acceleration relate" (TE, page 45).
- Lesson 7, Launch: "Consider reminding students of the relative scale they learned about in the previous module when they described temperature as warmer and cooler" (TE, page 57).
- Lesson 7, Learn, Investigate Pushes, Teacher Note: "In later levels, students will use the terms force and acceleration to describe similar interactions, and they will distinguish between acceleration, speed, and velocity" (TE, page 57).
- Lesson 8, Learn, Update Anchor Chart, Teacher Note: "In later levels, as students develop a deeper understanding of how force, mass, and friction relate, they will be able to explain these cases" (TE, page 67).

Suggestions for Improvement

- Consider explicitly stating the expected level of prior proficiency students should have with individual elements of all three dimensions for the core learning in the materials. It will be helpful to include an explanation of what three-dimensional elements students engaged with during the first module (Weather), as well as making it clear to educators when an element is completely new for students.
- Educator guidance for clarifying potential alternate conceptions is limited. The "Next Steps" section of the "Check for Understanding" charts advise teachers that students may have misconceptions, but it may be considered to add typical misconceptions that students may have and how teachers should address these.

- If students are expected to reach proficiency in the claimed NGSS PEs by the conclusion of the unit, consider being explicit with how the PEs are labeled. For example, consider using the language "addressed" or "students are expected to reach proficiency in the following NGSS PEs by the conclusion of the unit." Alternatively, if this unit is a smaller piece to a larger instructional sequence, and students are not expected to reach proficiency, make that clearer with language for educators and consider "Students are working toward…"

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 some issues with the accuracy of the science ideas and/or representations presented in the materials.

Related evidence includes:

- The New York Harbor map presented in Lesson 2 is slightly inaccurate, in that the proximity of Shooter's Island to the GCT New York terminal is made to look closer and the bend of the river is more significant, resulting in creating the sense of a more exaggerated turn than necessary.
- Lessons 4, Learn and 5, Launch Push and Pull T-chart: Although the sample chart shows objects in both columns, the lesson narrative implies that students must agree upon one column only, which is inaccurate because each object should be in both columns. Students should not have to be made to choose either/or.
- Lesson 13, Learn, Plan Stopping Investigation: Students are abruptly prompted without adequate reason to switch from using a model tugboat to push or pull the model cargo ship, as they had in previous lessons, to using their hand directly on the model cargo ship to propel it while investigating.
- Lessons 17–20, Engineering Design Challenge: Students are prompted, without reason or discussion, to switch from using a model tugboat a flat surface to using a car with wheels rolling down a ramp to represent the tugboat. This abrupt change in representation may present as too abstract for young learners and create confusion.
- Lesson 15, Launch: This activity (TE, pages 119–120) presents significant potential for the development of misconceptions among students. When students are prompted to perceive how their partner's hand feels like it is "pushing back" against theirs, the partner is very likely going to actively push back, or actively pull away. This is not accurate to the interaction

between a tugboat and cargo ship. Although the mass of the cargo ship is technically exerting force against the tugboat, a cargo ship will not be actively fighting against the force of the tugboat. In fact, in many cases, the cargo ship will be assisting forward momentum with its engine.

The premise of the Engineering Design Challenge is contrived and disregards the function of boats. For example:

- Lesson 17, Launch: "Ask students to imagine that the tugboat in the photograph is returning to its dock after a day of moving cargo ships through the harbor and that the tugboat captain needs to get back to the dock fast. Tell students that because the captain cannot slow down, the tugboat will bump into the dock" (TE, page 139). Students are not given an accurate reason for why the captain cannot slow down.
- Lesson 17, Launch, Teacher Note: "To encourage student engagement, consider telling the class to imagine that the tugboat captain is hurrying back to the dock for a specific reason. For example, the captain could be rushing to get to a birthday party or to bring a sick crew member back to shore" (TE, page 139). Regardless of what the captain is rushing for, they can use the boat's motor to slow down the boat to dock quickly and safely.
- Lesson 17, Learn, Think About Tugboat Docking: "Remind students that the tugboat needs to stop close to the dock so that people can get on and off the boat safely but that the captain is also in a hurry and cannot slow down. Tell students that the class needs to figure out a way to change how the dock pushes on the tugboat without changing how fast the tugboat is moving when it bumps into the dock" (TE, page 142).

The use of colors and/or numbers for varied purposes (e.g., classifying, describing, measuring, ranking, labeling) has the potential of leading to misunderstanding and confusion. Related evidence includes, but is not limited to:

- Lesson 7, Learn, Compare Results, Teacher Note: "To further distinguish between the stronger and weaker push and pull cutouts, classes may elect to use a color-coding or shading system. For example, students may color the smaller hands on the weaker cutouts a light shade of blue and the larger hands on the stronger cutouts a dark shade of blue" (TE, page 60).
- Lesson 17, Learn, Demonstrate Testing Procedures: "Then remind students that they need a way to check how well their cushions work. Show students the measurement paper (Lesson 17 Resource E). Have them consider how they could use the color zones on the paper to note how far back the tugboat bounces after each bump" (TE, page 145).
- Lesson 19, Learn, Improve Dock Cushions, Teacher Note: As students begin to use numbers to test cushions, "In the next lesson, students share their final dock cushions with the class. Between lessons, store each group's cushion in a place that is out of the way. Consider labeling each cushion with a sticky note with students' names or assigning groups a number with which to label their cushion" (TE, page 160).
- Lesson 20, Learn, Analyze Data: When comparing cushions, "On a flat surface that all students can see, start a line plot by placing 11 sticky notes in a row and labeling them 1–11. Tell students that they are going to sort their cushions. Explain to students that on one end they will place the

cushions that helped the tugboat stop closest to the dock, and on the other end they will place the cushions that pushed the tugboat farthest away from the dock" (TE, page 163).

Suggestions for Improvement

- It is recommended that the accuracy of problem that drives the Engineering Design Challenge is improved. While boats do not have breaks, they can slow down using the motor in reverse. It is contrived and inaccurate to assume that a captain would need to rush back to the dock for a birthday party or sick crew member without being able to slow down at all.
- Kindergarten students new to measuring distance are provided with a color-coded measurement paper with color zones under rulers. Since they are using the color-coded papers to measure and each color (red, yellow, green) has a range of number equivalents, it may be confusing when students are asked to use colors and numbers in contexts that are not for measuring. Consider using alternate ranking and sorting labeling systems.

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 educators to support differentiated instruction because suggestions are highlighted for addressing the needs of a variety of learners. However, because the unit is significantly dependent on speaking and listening in English, there are insufficient differentiation strategies for students who have difficulty with auditory processing and who are emerging multilingual learners. There is also limited guidance for educators to provide adaptations if students begin a lesson with significantly higher or lower levels of proficiency in the targeted three-dimensional learning goals.

Throughout the learning materials, developers have explicitly called out opportunities for what they have identified as differentiation. This helps educators anticipate student needs and provides ideas for how to respond. Related evidence includes, but is not limited to:

- Lesson 1, Learn, Read Aloud Tugboat, Differentiation: "To support English learners during this discussion, consider sharing the following sentence frame: Before, I thought ___. Now I know ___. Model using this sentence frame so that students hear how they can use it to discuss how their thinking about tugboats has changed" (TE, page 17).
- Lesson 2, Learn, Model Tugboats in New York Harbor, Differentiation: "Kindergarten students may need help staying focused as they model how the tugboat moves the cargo ship through the harbor. To keep students engaged while they are not actively moving the tugboat, ask them to observe how the students in their group move the cargo ship and to try to come up with a new way to move the ship" (TE, page 23).
- Lesson 3, Learn, Develop Essential Question, Differentiation: "Kindergarten students may need help articulating their questions. Remind students to use question words such as how, why, and what to form questions. Consider displaying these question words and encouraging students to use the words as they share" (TE, page 27).
- Lesson 6, Learn, Introduce Water Model, Differentiation: "To support students with visual impairments, consider introducing the water model to one group of students at a time."
- Lesson 8, Learn, Update Anchor Chart, Differentiation: "To support student understanding, consider rereading the previous bullet point after posting this new learning. Adding a drawing beside each bullet point may also be helpful. For example, consider drawing stronger and weaker push symbols next to illustrations of balls moving faster and slower, as shown in the Lesson 7 Activity Guide" (TE, page 66).
- Lesson 9, Learn, Conceptual Checkpoint A, Differentiation: "If students struggle to dictate a question, remind them of the question words shared in Lesson 3. Suggest that students use words such as who, how, and which to start their questions. If students are capable of writing, encourage them to write their question in the Conceptual Checkpoint. Supervise to ensure that they capture their question accurately" (TE, page 75).
- Lesson 10, Learn, Plan Tugboat Placement, Differentiation: "If students need more support and would benefit from interacting with the wooden block cargo ships directly, consider providing groups with map models" (TE, page 90).
- Lesson 12, Learn, Revisit Water Model, Differentiation: "To help students organize their thinking, consider providing a sentence frame such as the following: My idea was to__. It (worked/did not work)" (TE, page 97).
- Lesson 13, Launch, Differentiation: "To support English learners, consider modeling a few sample responses by using the following sentence frame: I noticed ___, and it made me wonder___" (TE, page 107).
- Lesson 16, Learn, Conceptual Checkpoint Part A, Differentiation: "If students have trouble identifying the ball's path, reread the scenario slowly, and have students use a finger to trace where they think the ball moves" (TE, page 128).
- Lesson 17, Learn, Set Up Problem and Solution Chart, Differentiation: "If students would benefit from additional support, discuss other examples of cushions to help students

understand how cushions can make pushes feel weaker. Ask students whether they have ever worn helmets or safety pads when bicycling, skating, or riding a skateboard. Help students understand that when they bump into an object, these cushions protect them by making the push from the object feel weaker" (TE, page 144).

- Lesson 17, Learn, Demonstrate Testing Procedure, Differentiation: "Students with color vision deficiencies, commonly known as color blindness, may need support during this activity. Point out that the green zone is at the top of the sheet, the yellow zone is in the middle, and the red zone is at the bottom. For resources to help students with color vision deficiencies, see this page on the National Science Teaching Association website: http:/phdsci.link/1512" (TE, page 145).
- Lesson 18, Learn, Imagine Dock Cushions, Differentiation: "Later in this lesson, groups will post sticky notes with their results on a class results chart. To support students with color vision deficiencies, consider designating a shape for each of the three colors. For example, students can draw green circles, yellow triangles, and red squares on their sticky notes" (TE, page 149).
- Lesson 18, Learn, Plan Dock Cushions, Differentiation: "Students who need support articulating their ideas and coming to a consensus may find these sentence frames helpful: I think we should use because__. What if we try__. I agree because__. I disagree because__" (TE, page 152).
- Lesson 19, Learn, Test Dock Cushions: "To help students count boxes on the measurement paper and compare their results, consider providing tools and manipulatives, such as number lines, counting bears, linking cubes, or 10-frames. To support students who are not yet writing their numbers, write the numbers 1–11 within each empty square on the Science Logbook page, and have students circle their results instead" (TE, page 158).
- Lesson 20, Learn, Analyze Data, Differentiation: "To help students recognize the connection between the results they are analyzing and the experience of testing their cushions, consider color-coding the sticky notes or numbers to match the color zones on the Dock Cushion Testing Station measurement paper" (TE, page 163).
- Lesson 21, Launch, Differentiation: "Before using the Link Up routine with key terms, consider having students practice with familiar words such as ball, toy car, throw, and roll. Highlight connections between these familiar words to help students understand the different ways terms can be related" (TE, page 170).
- Lesson 22, Learn, Complete End-of-Module Assessment, Differentiation: "Students with visual processing difficulties may benefit from watching both clips in this assessment at a slower playback speed" (TE, page 176).

Throughout the learning materials, developers have explicitly called out opportunities for what they have identified as extensions. However, these opportunities are presented as "if time allows" extension of instruction for *all* students, and they do not seem to be explicitly intended to address the needs of students with high interest or those that have demonstrated proficiency with the learning targets. These specific callouts include:

- Lesson 5, Launch, Extension: "Consider preparing an additional toy stroller icon card. If time allows, choose a second student example that involves whichever action (push or pull) is not

already on the chart, and repeat this exercise with the second card. If students suggest examples of only pushes or only pulls, encourage them to consider whether they could also move the toy stroller with the other action" (TE, page 42).

- Lesson 6, Learn, Update Anchor Model, Extension: "If time allows, supervise students as they take turns experimenting with the water model" (TE, page 49).
- Lesson 11, Learn, Investigate Direction, Extension: "Students can carry out the investigation with additional obstacles in the harbor, such as boats made of clay" (TE, page 93).
- Lesson 14, Learn, Investigate Slowing Down and Stopping, Extension: "If students' plans did not successfully slow and stop the cargo ship, consider having students glue a new tugboat cutout and a new push or pull cutout on the page to reflect what did work in the investigation. Students can color their new cutouts to distinguish them from their original set" (TE, page 116).
- Lesson 14, Learn, Investigate Slowing Down and Stopping, Extension: "Students can also add drawings, symbols, or words to the column in their Science Logbooks (Lesson 13 Activity Guide). Some students may want to show the direction of their tugboat's push or pull" (TE, page 116).
- Lesson 19, Learn, Test Dock Cushions, Teacher Note: "If students successfully stopped the tugboat in the green zone in all three tests with the first version of their cushion, challenge students to stop the tugboat even closer to the dock" (TE, page 159).
- Lesson 20, Learn, Analyze Data, Extension: "If multiple classrooms participate in the Engineering Challenge, consider sharing and comparing data across classes" (TE, page 163).
- Lesson 23, Land, Extension: "Offer opportunities for students to explore these questions, such as through shared research, collaborative investigation, or optional homework" (TE, page 180).
- Lesson 23, Land, Optional Homework: "With their family's permission and supervision, students set up one of the carnival games from the End-of-Module Assessment or create their own carnival games. Students share with a family member or a friend how pushes or pulls cause objects to move in each game" (TE, page 180).

"English Language Development" sections are included in Lessons 1, 4, 7, 10, and 23. Information included in these sections includes guidance for supporting emerging multilingual learners. It is understood that these supports could benefit both young learners whose first language is English, as well as emerging multilingual learners. However, the multiple language connections are limited to Spanish. Additionally, there are no explicit supports for students who are nonverbal. Related evidence includes, but is not limited to:

- Lesson 1, Launch, English Language Development: "Students will encounter the term object throughout the module. Providing the Spanish cognate objeto may be useful. To reinforce the idea that an object is anything students can see or touch, consider generating a list of classroom objects" (TE, page 17).
- Lesson 1, Launch, English Language Development (sidebar call-out): "Students will encounter the terms dock, port, and cargo throughout the module. When each term appears in the text, point to the corresponding illustration. Explain that a dock is a place where ships can park that sticks out into the water. Tell students that a port is a place where ships go to pick up and drop

off cargo and people. Cargo can refer to food, supplies, and other products. Providing the Spanish cognates for port (puerto) and cargo (carga) may also be useful" (TE, page 17).

- Lesson 4, Learn, Sort Actions: "In this module, students will see and hear the terms push and pull used as both nouns and verbs. Introduce both terms explicitly by using strategies such as the following: Provide student-friendly examples of pushes and pulls, such as pushing a friend on a swing or pulling a balloon on a string. Invite students to think of other examples of pushing and pulling" (TE, page 38).
- Learn, Learn, Sort Actions (sidebar call-out): "Students will encounter the terms predict and prediction throughout the module. Providing the Spanish cognates for predict (predecir) and prediction (predicción) may be helpful. Explain that a prediction is what we think might happen. To further illustrate the meaning of these terms, consider having students predict what the weather will be like later in the day" (TE, page 40).
- Lesson 7, Learn, Investigate Pushes: "Students will encounter the terms investigate and investigation throughout the module. Providing the Spanish cognates for investigate (investigar) and investigation (investigación) may be helpful" (TE, page 57).
- Lesson 10, Launch: "Introduce the term direction explicitly. Providing the Spanish cognate dirección may be useful. Explain that people use the word direction in different ways. For example, students may follow a direction that tells them what to do. Point out that when talking about movement, people often use direction to mean the path along which objects, such as tugboats and cargo ships, move" (TE, page 85).
- Lesson 23, Learn, Reflect on CCC in Module Learning: "To help English learners and other students who may need support in connecting causes with their effects, consider providing a sentence frame such as the following: A (cause) made the object (effect)" (TE, page 179).

Suggestions for Improvement

- It is recommended that the materials provide a wider range of specific individualized and customized learning strategies to ensure that all students can engage with all learning tasks and assessments, as well as all targeted learning goals in a progressing manner over the course of the learning sequence. This is especially important for students who have difficulty with auditory processing and limited spoken English since so much of the unit is dependent on verbal presentation and verbal response. Additionally, supports for students with disabilities (e.g., students with fine motor difficulties) could be included, as well as targeted extensions for students who are found to have already met proficiency in any of the three dimensions being addressed throughout the unit.
- Consider offering options for a variety of modalities for expression, especially for those students that are proficient with fine motor skills (e.g., writing, drawing).
- To avoid having to address a variety of languages, it is recommended that guidance is added to remind educators to collaborate with school support staff to meet the needs of a variety of learners, and not just students whose first language is Spanish.

II.F. TEACHER SUPPORT FOR UNIT COHERENCE

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

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

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

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

The reviewers found extensive evidence that the materials support educators in facilitating coherent student learning experiences over time because a variety of educator tools and guidance is provided to explain the intended scope and sequence of the unit.

Related evidence includes, but is not limited to:

- The Module Overview, Introduction (TE, pages 1–2) provides a narrative description of the flow of the unit, including the main ideas of each of the two unit "Concepts" — Starting Movement and Changing Movement — as well as the engineering challenge lesson set and the summative lessons.
- The Module Map (TE, pages 3–5) organizes the lessons into "Concepts." Within each of the two unit "Concepts" the lessons are organized into "Science Topics." The phenomenon question and a statement of student learning is outlined for each individual lesson.
- Each "Science Topic" lesson set begins with a "Prepare" section that summarizes the three-dimensional learning in the set. While the information addresses how the lessons within the set are linked, it is not explained how student learning in the lesson set relates to the previous and/or subsequent lessons. Related evidence includes, but is not limited to:
  - Lessons 4–6 Making Objects Start to Move, Prepare: "In this lesson set, students explore what causes objects to move, and they develop an understanding that when an object starts moving, it does so because of a push or a pull (PS2.A). In Lesson 4, students use a set of toys to explore ways to start movement. Students find that they can sort their actions into two categories: pushes and pulls. In Lesson 5, students identify pushes and pulls in other contexts and record their observations of those actions (SEP.4). By testing their thinking in a variety of situations, students recognize the pattern that pushes and pulls cause objects to move (CC.1). Lesson 6 introduces students to a water model that helps them make sense of their learning in the context of the anchor phenomenon" (TE, page 31).
  - Lesson 7–8 Pushes and Pull Strength, Prepare: "In Lessons 7 and 8, students explore how stronger and weaker pushes and pulls can affect an object's movement (PS2.A) to

build on their knowledge of how tugboats help move cargo ships. In Lesson 7, students plan and carry out an investigation (SEP.3) to determine that a stronger push makes an object move faster, and a weaker push makes an object move slower (CC.3). In Lesson 8, students revisit the water model to explore how pushes and pulls of different strengths affect the movement of an object in water. Students then use their new understanding to update the anchor model" (TE, page 53).

- Appendix B, Module Storyline: The storyline includes a unit overview of the unit; anchor phenomenon, essential question, conceptual overview, and PEs followed by concept lesson sets which include focus question, phenomenon question, phenomenon, three-dimensional integration, knowledge statements and learning summaries (TE, pages 257–270).

Suggestions for Improvement

One strategy to help educators link student engagement across lessons is a structure for cultivating and curating student questions that will be answered in subsequent lessons. Therefore, the improvements suggested for Criterion I.D Unit Coherence would also support this criterion. Consider including explicit educator guidance to help students see coherent connections between all lessons and activities that recruit their questions and progressing understanding.

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 educators in helping students engage in the practices as needed and gradually adjust supports over time because there is obvious reduction of support by the educator over time with a few SEP elements. However, with a total of 12 SEP elements claimed as learning targets at the unit and/or lesson level, students are not supposed to become increasingly more independent with nearly SEP learning targets.

Scaffolds are provided for students to become increasingly independent in the **Planning and Carrying Out Investigations** SEP element: *With guidance, plan and conduct an investigation in collaboration with peers:*

- Lesson 7, Learn, Investigate Pushes, Spotlight on Science and Engineering Practices: "This investigation is the first one that students conduct collaboratively (SEP.3). During the investigation, guide students to focus on the steps they must follow to succeed. Subsequent

lessons in this module give students the opportunity to provide increasing input when planning and conducting investigations" (TE, page 58).

- Lesson 10, Learn, Create Direction Investigation Plan, Spotlight on Science and Engineering Practices: "Throughout this module, students create investigation plans (SEP.3) with increasing independence. In this lesson set, students work with the teacher to plan the steps of the investigation. In their groups, students decide where to place each tugboat and how each tugboat will push or pull on the cargo ship to turn it" (TE, page 86).
- Lesson 13, Learn, Plan Stopping Investigation, Spotlight on Science and Engineering Practices: "In this lesson set, students continue to develop their investigation planning skills (SEP.3). To provide additional guidance, ask questions such as the following: What question are we trying to answer? How can we use the map model to help us answer the question? What steps should we include in our plan?" (TE, page 110).

Scaffolds are provided for students to become increasingly independent in the **Using Mathematics and Computational Thinking** SEP element: *Use counting and numbers to identify and describe patterns in the natural and designed world(s)*. Scaffolds are reduced between Lesson 17 and Lesson 19. Related evidence includes:

- Lesson 17, Learn, Demonstrate Testing Procedure: "Have them consider how they could use the color zones on the paper to note how far back the tugboat bounces after each bump. Slide the measurement paper into its position under the rulers. Then invite two volunteers to help demonstrate how to use the measurement paper to describe how far the tugboat bounces after hitting the dock" (TE, pages 145–146).
- Lesson 18, Learn, Imagine Dock Cushions: Strips of measurement paper with green, yellow, and red zones are placed under rulers. Students use color zones to measure and analyze group data. "Remind students that if the tugboat stops close to the dock, its front will be in the green zone; if it stops a little farther away from the dock, its front will be in the yellow zone; and if it stops far away from the dock, its front will be in the red zone" (TE, page 149).
- Lesson 18, Learn, Imagine Dock Cushions: Students use measurement to analyze results "analyze the results with students to designate a single color zone for each material. Start by pointing to the first material on the results chart. Ask the class to look at the results and to decide on the color zone for this material: green, yellow, or red. If students need support, work with them to count how many green sticky notes, yellow sticky notes, and red sticky notes are in the column. Then suggest selecting the most frequent result from all three or six tests. After the class has determined the color zone for each material, mark a sticky note with that color, and attach the sticky note to the illustration of the material" (TE, page 151).
- Lesson 18, Learn, Imagine Dock Cushions: Students are encouraged to think about how they could compare cushions that cause a tugboat to stop in the same color zone and the need for numbers. "If the tugboat stopped in the same color zone with two different materials, how do we know which material worked better?...Highlight the importance of measuring with numbers to compare the distance the tugboats bounce back, and tell students that they will use a new measuring paper when they test their cushions" (TE, page 152).

- Lesson 19, Launch: "Show students the lined measurement paper (Lesson 19 Resource). Point out that the boxes match up with the numbers, and count the rows from 1 to 11 with the class. Emphasize that boxes 1, 2, and 3 are in the green zone; boxes 4, 5, 6, and 7 are in the yellow zone; and boxes 8, 9, 10, and 11 are in the red zone. Tell students that when the tugboat stops twice in the same color zone, they can use the boxes to figure out which time the tugboat stopped closer to the dock. Gather students around the testing station, and invite two volunteers to help demonstrate how to measure the distance that the tugboat bounces without a dock cushion. Follow the testing station procedure (Lesson 17 Resource F). Then demonstrate how to measure the distance from the dock to the front of the tugboat by counting the number of boxes in front of the tugboat, including the box that the front of the tugboat is in" (TE, page 156).
- Lesson 19, Learn, Test Dock Cushions: "…and one student counts the number of boxes between the cushion and the front of the tugboat (including the box that the front of the tugboat is in) and announces the number for the group to record… Then point out the three empty boxes in the same row, under Bounce. Explain to students that they will write a number in each box to show how far the tugboat bounces in each of their three tests… Remind students to record in their Science Logbooks (Lesson 18 Activity Guide) how far the tugboat bounces after each test" (TE, pages 157–158).

Suggestions for Improvement

Consider providing explicit guidance for where and when to add and remove supports to move students towards independence in all claimed SEP element targets, with attention to the individual needs of all learners. It is recommended that educator-provided scaffolding for the use of all targeted SEP learning goals undergoes a clear transition over the course of the unit.

Pushes and Pulls

EQuIP RUBRIC FOR SCIENCE EVALUATION

OVERALL CATEGORY II SCORE: 2	
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/or design solutions because there are several instances that are intended to produce artifacts that require students to use grade-appropriate elements of the three dimensions, but it is inconsistently necessary for students to use the elements together during these performances. The more regular opportunities for integrated three-dimensional student performance in service of sense-making are mostly dependent on verbal contributions from a potentially limited number of students.

Related evidence includes, but is not limited to:

- Lesson 5, Learn, Draw Pushes and Pulls, Check for Understanding: "Students record their observations of how the object started moving, identify the action as either a push or a pull, and orally demonstrate an understanding of what caused the object to move. Evidence: The observations that students recorded (SEP.4) include both the object and the push or pull that made the object start to move (PS2.A)…Evidence: Students correctly identify the cause of the movement as either a push or a pull (CC.2)" (TE, page 44).
- Lesson 8, Learn, Revisit Water Model, Check for Understanding: "Students compare the effects of stronger and weaker pushes on the model cargo ship. Evidence: Students use their observations of the water model demonstration to compare the effects of stronger and weaker pushes on an object's movement (SEP.3). Students identify that stronger (CC.3) pushes cause the model cargo ship to move more quickly, whereas weaker pushes cause it to move more slowly (PS2.A)" (TE, page 65). While this is labeled as an opportunity to monitor progress toward three-dimensional goals, it is based on a classroom discussion. Consequently, there is no evidence that a direct, observable artifact would be available from all students.
- The Lesson 9, Conceptual Checkpoint: This engages students in a three-question assessment, "Tell students they will use what they know about pushes and pulls and cause and effect to explore the Phenomenon Question How can a push or a pull help in a skateboard race?" (TE, page 74). Students are asked, "Will a push or pull cause each rider to move toward the finish line? Which picture shows the effect of a push? And what question about strength can you ask to figure out which team was faster?" (TE, pages 75–76).
- Lesson 9, Learn, Conceptual Checkpoint Part B, Conceptual Checkpoint: "The Conceptual Checkpoint assesses student understanding of the Concept 1 Focus Question: What causes objects to start moving? Elements Assessed: SEP.1: Ask questions based on observations to find

more information about the natural and/or designed world(s). PS2.A: Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. PS3.C: A bigger push or pull makes things speed up or slow down more quickly. CC.2: Events have causes that generate observable patterns.CC.3: Relative scales allow objects and events to be compared and described (e.g., bigger and smaller, hotter and colder, faster and slower). Evidence…Next Steps…" (TE, page 76). Although this is labeled as an opportunity for monitoring learning targets in all three dimensions, this three-question artifact requires only the use of one or two elements at a time. Students are not using all three dimensions together in service of sense-making.

- Lesson 11, Learn, Record Observations: "Bring the class back together, and distribute two small tugboat cutouts (Lesson 10 Resource B) to each student. Explain to students that they will glue the tugboat cutouts into their Science Logbooks (Lesson 11 Activity Guide) to record their investigation results. Draw students' attention to the position of the cargo ship on the map. Tell students to glue their two tugboat cutouts on the map to show where their group placed the tugboats to push or pull the cargo ship at that location. After students have glued their tugboat cutouts, distribute two small push cutouts and two small pull cutouts (Lesson 10 Resource B) to each student. Have students determine whether each of their tugboats used a push or a pull. Then guide students to glue a push cutout or a pull cutout next to each tugboat cutout on the map" (TE, page 94). In this activity, students integrate the following three dimensions:
  - DCI: *Pushes and pulls can have different ~~strengths and~~ directions.*
  - SEP: *Distinguish between a model and the actual object, process, and/or events the model represents.* While students are using a two-dimensional model in this assessment opportunity, there is no evidence that students are prompted or supported to explicitly distinguish between the model and the actual objects.
  - CCC: *Simple tests can be designed to gather evidence to support or refute student ideas about causes.*
- Lesson 12, Learn, Revisit Water Model, Check for Understanding: "Students describe how pushes and pulls cause the model cargo ship to change direction, and they consider whether real tugboats turn cargo ships by using pushes and pulls in the same way. Evidence: Students describe a sideways push or pull from the second model tugboat as the cause of the change in direction for the model cargo ship (PS2.A, CC.2)…Evidence: Students recognize that testing their ideas with the water model can help them consider how real tugboats use pushes and pulls to turn cargo ships (SEP.2, PS2.A)" (TE, page 98). While this is labeled as an opportunity to monitor progress toward three-dimensional goals, it is based on a classroom discussion and guidance is not provided for the teacher to monitor all students' responses. Consequently, there is no evidence that a direct, observable artifact would be available from all students.
- Lesson 16, Learn, Conceptual Checkpoint Part B, Conceptual Checkpoint: "The Conceptual Checkpoint assesses student understanding of the Concept 2 Focus Question: What causes moving objects to change direction or stop? SEP.3: Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. PS2.A: 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 it. PS2.B: When objects

touch or collide, they push on one another and can change motion. CC.2: Events have causes that generate observable patterns. Evidence…Next Steps…" (TE, page 130). Although this is labeled as an opportunity for monitoring learning targets in all three dimensions, this six-question artifact requires only the use of one or two elements at a time. Students are not using all three dimensions together in service of sense-making.

- Lesson 18, Learn, Plan Dock Cushions, Check for Understanding: "Students draw their plans for using the materials the class tested to make their dock cushions. Then students predict how their cushions will affect the movement of the model tugboat. Evidence: Students draw a cushion they plan to build to stop the tugboat closer to the dock. Students select materials for their design to solve this specific problem (SEP.6, ETS1.B)…Evidence: Students glue their tugboat cutout closer to the dock than the model tugboat stopped during the demonstration without a cushion. By predicting that the tugboat will stop closer to the dock, students exhibit an awareness that their cushion should cause the tugboat to bounce back less than it would without their cushion present (CC.2)" (TE, page 154).
- End-of-Module Assessment Map: "For teacher reference, this alignment map lists the NGSS elements assessed by each item in the End-of-Module Assessment" (TE, page 192)
- Engineering Design Challenge Alignment Map: "For teacher reference, this alignment map lists the NGSS elements assessed in each stage of the engineering design process during the Engineering Challenge" (TE, page 232)
- Appendix B, Module Storyline, Concept 1, Lesson 9, Spotlight on Three-Dimensional Integration: "Students use their understanding that pushes and pulls can make objects start to move and can change the speed of the objects (PS2.A) to analyze cause and effect (CC.2) in a skateboard race, and they ask a question (SEP.1) that could help them determine which team won the race" (TE, page 263).
- Appendix B, Module Storyline, Concept 2, Lessons 13–15, Spotlight on Three-Dimensional Integration: "Students plan and carry out an investigation (SEP.3) to determine how tugboats can use pushes and pulls to cause (CC.2) cargo ships to slow down and stop (PS2.A)" (TE, page 266).
- Appendix B, Module Storyline, Application of Concepts, Lessons 21–23, Spotlight on Three-Dimensional Integration: "Students use their understanding of how pushes and pulls can change an object's movement (PS2.A) to communicate information (SEP.8) about the causes of movement (CC.2) in carnival games" (TE, page 270).

Suggestions for Improvement

- Consider providing routine, direct, and observable evidence collected from all students that requires them to use the targeted three-dimensional elements together in service of sense-making.
- Consider proportionally matching assessments with the claimed learning goals or prioritizing and identifying key learning targets to which assessment opportunities are aligned. For example, some SEP elements are more regularly emphasized throughout the learning sequence, while others may be aligned with only one assessment event. An explanation of this may be helpful for educators if the focus on certain elements is intentional.

III.B. FORMATIVE

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

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

The reviewers found adequate evidence that the materials embed formative assessment processes throughout that evaluate student learning and inform instruction because materials explicitly call out opportunities for formative assessment throughout the unit that are aligned to one or more learning targets. Some formative assessment opportunities provide guidance on next steps based on students' responses. However, the materials do not highlight multiple formative assessments per lesson targeted to three-dimensional goals and most moments that are labeled as or intuitively assumed to be formative assessment are verbal opportunities which do not ensure collection of evidence from all students.

There is nothing explicitly labeled as formative assessment in the learning materials, but "Check For Understanding" in-line and sidebar call-outs highlight moments for evaluating progress. Some, but not all these moments are framed as "if, then" scenarios to provide instructional next steps. Most opportunities for educators to be collecting real-time evidence through formative instruction require them to listen for that evidence. While verbal expression is valid and appropriate at the Kindergarten level with students still developing fine motor and writing skills, there is no guidance for the educator to ensure that evidence is being collected from all or most students, and the momentum of the lesson is not driven by a limited number of students' oral contributions. Related evidence includes, but is not limited to:

- Lesson 1, Learn, Read Aloud Tugboat, Check for Understanding: "This task is a pre-assessment. Use students' responses to gauge their prior and developing knowledge of how pushes and pulls can cause objects to move as well as how observations can reveal patterns. Evidence: After observing multiple instances of the tugboat moving ships, students recognize a pattern (CC.1): The tugboat always uses a push or a pull to move another vessel (PS2.A). Next Steps: At this point, students do not need to fully understand how pushes and pulls can change an object's movement, and they do not need to independently identify the pattern. Make note of students who express misconceptions, and check in with those students again at the end of Concept 1" (TE, page 18). There is no assurance that educators will be collecting evidence from all students because this task requires verbal response.
- Lesson 2, Land, Check for Understanding: "Students explored the similarities and differences between models and the phenomena they represent (SEP.2) in the previous module. Look for evidence that students understand how the harbor map anchor model is similar to the phenomenon and how the model is different from the phenomenon. If students need support to identify similarities and differences between the model and the phenomenon, consider

providing examples. Then invite students to share their own examples of similarities and differences" (TE, page 25). There is no assurance that educators will be collecting evidence from all students because this task requires verbal response.

- Lesson 3, Learn, Build DQB: "As students share their questions, listen for evidence that they connect their questions to their observations. Evidence: Students use what they have noticed to ask questions (SEP.1) about how tugboats help move cargo ships through a harbor (PS2.A). Next Steps: If students share questions that are unrelated to the anchor phenomenon, ask them first to share something they noticed. If necessary, guide students to make observations that could lead to a meaningful question about how tugboats move cargo ships through a harbor. Then help students use a question word, such as how, why, or what, to frame their question" (TE, page 29). It is not clear if educators should hear this from one or many students. Listening for verbal contributions would not guarantee that every student has reached desired understanding.
- Lesson 4, Learn, Sort Actions, Check for Understanding: "Listen for students to recognize that a push or a pull always started each toy's movement (CC.1). In the discussion in this lesson's Land, students will use this pattern as evidence of a cause and effect relationship" (TE, page 39). There is no assurance that educators will be collecting evidence from all students because this task requires verbal response with no guidance on how to elicit and make record of a response from most students.
- Lesson 5, Learn, Draw Pushes and Pulls, Check for Understanding: "Students record their observations of how the object started moving, identify the action as either a push or a pull, and orally demonstrate an understanding of what caused the object to move. Evidence: The observations that students recorded (SEP.4) include both the object and the push or pull that made the object start to move (PS2.A). Next Steps: If students do not represent both the object and the push or pull, repeat the action, and encourage students to draw the object and a hand pushing or pulling the object. Evidence: Students correctly identify the cause of the movement as either a push or a pull (CC.2). Next Steps: If students select the incorrect action, refer to the push and pull chart from the previous lesson. Ask students to think about which group of actions this one is more similar to: the actions in the Push column or those in the Pull column" (TE, page 44).
- Lesson 6, learn, Introduce Water Model, Check for Understanding: "Listen for students to identify that the tugboat can use a push or a pull to cause the cargo ship to start moving (CC.2)" (TE, page 49). It is not clear if educators should hear this from one or many students. Listening for verbal contributions would not guarantee that every student has reached the desired understanding. Additionally, no direction is given for if educators do not hear this.
- Lesson 7, Learn, Compare Results, Check for Understanding: "Listen for students to make connections between push strength and the movement of the ball. Encourage students to explain that pushing the ball caused it to start moving (PS2.A, CC.2) and that stronger and weaker pushes (CC.3) resulted in the ball moving at different speeds (PS3.C)" (TE, page 61). It is not clear if educators should hear this from one or many students. Listening for understanding in verbal contributions from a few does not indicate understanding by all. Additionally, no direction is given for if educators do not hear this.

- Lesson 8, Learn, Revisit Water Model, Check for Understanding: "Students compare the effects of stronger and weaker pushes on the model cargo ship. Evidence: Students use their observations of the water model demonstration to compare the effects of stronger and weaker pushes on an object's movement (SEP.3). Students identify that stronger (CC.3) pushes cause the model cargo ship to move more quickly, whereas weaker pushes cause it to move more slowly (PS2.A). Next Steps: If students have difficulty supporting their claims with appropriate evidence, prompt them to share what they noticed during the water model demonstration. If students do not make the connection between push strength and the model cargo ship's speed, consider individually coaching them to test their own pushes with the water model" (TE, page 65). There is no assurance that educators will be collecting evidence from all students because this task requires verbal response with no guidance on how to elicit and make record of a response from most students.
- Lesson 10, Learn, Plan Tugboat Placement, Check for Understanding: "Listen for evidence that students are collaborating with their peers (SEP.3) and using what they have learned to determine where they should push or pull the cargo ship to move it in the correct direction (PS2.A). As necessary, prompt students to consider how pushes and pulls on different parts of the cargo ship would affect the ship's movement" (TE, page 90).
- Lesson 11, Learn, Investigate Direction, Check for Understanding: "Listen for evidence that students used their knowledge of pushes and pulls to make their cargo ship change direction. Also listen for student responses that mention the cause of the cargo ship's movement and the effects of the tugboats' pushes and pulls (CC.2). While circulating, encourage students to describe the actions that move the cargo ship. Provide students with a sentence frame such as the following: The tugboat is ___(pushing/pulling) the cargo ship to make the cargo ship___" (TE, page 93). It is not clear if educators should hear this from one or many students. Listening for understanding in verbal contributions from a few does not indicate understanding by all.
- Lesson 12, Learn, Revisit Water Model, Check for Understanding: "Students describe how pushes and pulls cause the model cargo ship to change direction, and they consider whether real tugboats turn cargo ships by using pushes and pulls in the same way. Evidence: Students describe a sideways push or pull from the second model tugboat as the cause of the change in direction for the model cargo ship (PS2.A, CC.2). Next Steps: If students need support to explain how a push or pull caused a change in direction, ask follow-up questions such as these: What happened after the second tugboat pushed the cargo ship? What do you think would happen if the second tugboat did not push the cargo ship? Evidence: Students recognize that testing their ideas with the water model can help them consider how real tugboats use pushes and pulls to turn cargo ships (SEP.2, PS2.A). Next Steps: If students easily recognize that the water model helps them understand how real tugboats could turn cargo ships, challenge them to consider the limitations of the water model" (TE, page 98). There is no assurance that educators will be collecting evidence from all students because this task requires verbal response.
- Lesson 13, Learn, Explore Difference Between Models, Check for Understanding: "Listen for students' use of comparative language when they describe the difference in how the cargo ships move on water and on the map (CC.3). For example, students may describe one cargo ship as moving faster or slower, or they may notice that one ship moves farther or for a longer

period of time than the other ship" (TE, page 109). It is not clear if educators should hear this from one or many students. Listening for understanding in verbal contributions from a few does not indicate understanding by all. Additionally, no direction is given for the case in which educators do not hear this.

- Lesson 14, Learn, Make Predictions with Water Model, Check for Understanding: "Listen for students to support their predictions with prior events or experiences (SEP.3). If students do not mention personal experiences, prompt them with questions such as these: What have you noticed before that can help you make a prediction? Have you ever used a push or a pull to stop something from moving?" (TE, page 116). There is no assurance that educators will be collecting evidence from all students because this task requires verbal response with no guidance on how to elicit and make record of a response from most students.
- Lesson 15, Learn, Update Anchor Chart, Check for Understanding: "Students use their knowledge of pushes and pulls to explain how to slow down and stop an object. Evidence: Students explain that pushing on the Hall's car can make it slow down and stop (PS2.A). Next Steps: If students struggle to explain what caused the Hall's car to stop, have them push the car forward. Then perform a clear pushing action to slow down and stop the car. Ask students whether a push or a pull stopped the car. Evidence: Students notice the following pattern: When their classmates push on the front of the moving Hall's car, the car slows down and stops. Students identify these pushes as causes of the car's change in movement (CC.2). Next Steps: If students have difficulty explaining what causes the Hall's car to slow down and stop, point out similarities in how students are stopping the car. Ask students to act out how they would stop the car, and help them identify their pushing or catching action as the cause of the car stopping" (TE, page 122). There is no assurance that educators will be collecting evidence from all students because this task is formatted as whole group discussion with a limited number of student volunteers to demonstrate.
- Lesson 17, Learn, Demonstrate Testing Procedure, Check for Understanding: "Listen for evidence that students recognize the similarities in how the two model tugboats move after bumping into the dock (SEP.3) and that students identify a pattern: The dock pushing on the tugboats causes the tugboats' movement to change (CC.1, PS2.B). If students do not recognize this pattern, repeat the demonstrations, and ask students to notice similarities between the two. To monitor student progress, use the Engineering Challenge rubric (Lesson 17 Resource A)" (TE, page 145). There is no assurance that educators will be collecting evidence from all students because this task requires verbal response with no guidance on how to elicit and make record of a response from most students.
- Lesson 18, Learn, Imagine Dock Cushions, Check for Understanding: "Call out the materials that students tested, one by one. Ask students to give a thumbs-up if they think the material will make a good cushion, a thumbs-down if they think the material will make a bad cushion, and a thumbs-to-the-side if they are unsure or if they think the cushion will be somewhere in the middle. For each material, ask one or two students to share their reasoning with the class" (TE, page 152). No direction is given for next steps if student responses signal misconception(s).
- Lesson 18, Learn, Imagine Dock Cushions, Check for Understanding: "Listen for responses that mention how well each material might work to solve the problem (SEP.3) by causing the

tugboat to travel a shorter distance after the bump (CC.2, PS2.B)" (TE, page 152). It is not clear if educators should hear this from one or many students. Listening for understanding in verbal contributions from a few does not indicate understanding by all. Additionally, no direction is given for the case in which educators do not hear this.

- Lesson 18, Learn, Plan Dock Cushions, Check for Understanding: "Students draw their plans for using the materials the class tested to make their dock cushions. Then students predict how their cushions will affect the movement of the model tugboat. Evidence: Students draw a cushion they plan to build to stop the tugboat closer to the dock. Students select materials for their design to solve this specific problem (SEP.6, ETS1.B). Next Steps: If students select only materials that did not test well, allow them to move forward with testing, but encourage them to use the class results chart to inform their material selections during the Improve stage in Lesson 19. If students draw a material the class did not test, coach them to think about the testing the class did in the Imagine stage, and help them select materials that tested well. Evidence: Students glue their tugboat cutout closer to the dock than the model tugboat stopped during the demonstration without a cushion. By predicting that the tugboat will stop closer to the dock, students exhibit an awareness that their cushion should cause the tugboat to bounce back less than it would without their cushion present (CC.2). Next Steps: If possible, follow up with students about their predictions. Ask students to explain why they think their cushion will help solve the problem. Consider using the following sentence frame to support their thinking: I predict that our tugboat will stop___ (far from/close to/ very close to) the dock. The reason I think so is that___" (TE, page 154).
- Lesson 19, Learn, Test Dock Cushions, Check for Understanding: "Make sure that students accurately count and use numbers to observe and record how far the model tugboat bounces from the dock (SEP.5). Students should describe the effects of their cushion (CC.2) and recognize that their cushion can change how far the tugboat bounces from the dock (PS2.B)" (TE, page 158). No instructional next steps are provided for if students are unable to meet these expectations, which may be likely during this time within the grade level.
- Lesson 19, Learn, Improve Dock Cushions, Check for Understanding: "Listen for explanations that include students' rationale for making specific changes to solve the tugboat's problem (SEP.3). Students should only make adjustments that they think will help the tugboat stop closer to the dock (CC.2, PS2.B). If students have trouble identifying ways they might improve their cushion, ask them the following questions to prompt them to focus on solving the problem: How can you make the tugboat stop closer to the dock? Which materials do you think will work best? Consider referring students to the results chart from Lesson 18 to help them identify the materials that are likely to improve their cushion the most" (TE, page 159).
- Lesson 20, Learn, Analyze Data, Check for Understanding: "Listen for responses that mention numerical patterns in the data (CC.1, SEP.5). Students should recognize that the data show how each cushion changed the movement of the tugboat (PS2.B), and students should use the data to explain which cushions best solved the problem (ETS1.A)" (TE, page 164). It is not clear if educators should hear this from one or many students. Listening for understanding in verbal contributions from a few does not indicate understanding by all. Additionally, no instructional next steps are given for the case in which educators do not hear desired responses.

- Lesson 21, Learn, Engage in Socratic Seminar, Check for Understanding: "As students engage in the Socratic Seminar, note how they provide details about scientific ideas and practices (SEP.8). To monitor student participation and the flow of the conversation, consider writing each student's name around the edge of a sheet of paper before the lesson and drawing lines between speakers during the conversation" (TE, page 171). A representation of who has contributed verbally and/or who has held a verbal exchange is not indicative of the students' three-dimensional understanding.
- Lesson 23, Learn, Reflect on CCCs in Module Learning, Check for Understanding: "Listen for students to connect the concept that events have causes that can help people identify patterns (CC.2) with other aspects of their learning throughout the module, including the phenomena they explored, the investigations they conducted, the practices they applied, and the scientific ideas they developed" (TE, page 179). It is not clear if educators should hear this from one or many students. Listening for understanding in verbal contributions from a few does not indicate understanding by all. Additionally, no instructional next steps are given for the case in which educators do not hear desired responses.

Suggestions for Improvement

- To earn an extensive rating, formative assessment would need to be explicitly called out and accompanied by educator guidance for all key learning experiences that target three-dimensional goals. This likely means providing multiple explicit formative assessments per lesson, including instructional next steps for a variety of student responses.
- If educators are expected to listen for evidence of understanding, include guidance for how educators can collect that evidence from the majority, or all students so that a lesson does not progress because the "correct" understanding was heard from just one or a few students.
- Consider including opportunities for students to self-assess. Lesson 21 includes an opportunity for students to reflect upon how they learned. This type of reflection focused on self-assessment of learning throughout the learning materials would provide students with opportunities to formatively assess their own learning.

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 aligned rubrics and scoring guidelines that help the educator interpret student performance for all three dimensions because next steps are suggested for moments labeled as checks of three-dimensional understanding, answer keys are provided for three major assessment opportunities, along with two rubrics that are aligned to learning targets in the three dimensions. However, the rubrics do not provide indicators for multiple levels of proficiency and the answer keys do not provide targeted instructional next steps for incorrect responses, limiting the quantity and quality of information available to enable provisions for ongoing targeted feedback to individual students.

There are "Check for Understanding" call-outs (also listed as evidence above in Criterion III.D) that are in-line with the lesson text that provide the connection between an assessment task and the three-dimensional learning targets. While these call-out boxes do not highlight the connection to learning experiences students would have had earlier in the sequence, they do provide instructional next steps to support adaptation, differentiation, or extension. The call-outs do not indicate that educators would be prompted or guided in how to provide targeted and constructive feedback to individual students for their own reflection and response.

- Lesson 3, Learn, Build DQB: "As students share their questions, listen for evidence that they connect their questions to their observations. Evidence: Students use what they have noticed to ask questions (SEP.1) about how tugboats help move cargo ships through a harbor (PS2.A). Next Steps: If students share questions that are unrelated to the anchor phenomenon, ask them first to share something they noticed. If necessary, guide students to make observations that could lead to a meaningful question about how tugboats move cargo ships through a harbor. Then help students use a question word, such as how, why, or what, to frame their question" (TE, page 29).
- Lesson 5, Learn, Draw Pushes and Pulls, Check for Understanding: "Students record their observations of how the object started moving, identify the action as either a push or a pull, and orally demonstrate an understanding of what caused the object to move. Evidence: The observations that students recorded (SEP.4) include both the object and the push or pull that made the object start to move (PS2.A). Next Steps: If students do not represent both the object and the push or pull, repeat the action, and encourage students to draw the object and a hand pushing or pulling the object. Evidence: Students correctly identify the cause of the movement

as either a push or a pull (CC.2). Next Steps: If students select the incorrect action, refer to the push and pull chart from the previous lesson. Ask students to think about which group of actions this one is more similar to: the actions in the Push column or those in the Pull column" (TE, page 44).

- Lesson 8, Learn, Revisit Water Model, Check for Understanding: "Students compare the effects of stronger and weaker pushes on the model cargo ship. Evidence: Students use their observations of the water model demonstration to compare the effects of stronger and weaker pushes on an object's movement (SEP.3). Students identify that stronger (CC.3) pushes cause the model cargo ship to move more quickly, whereas weaker pushes cause it to move more slowly (PS2.A). Next Steps: If students have difficulty supporting their claims with appropriate evidence, prompt them to share what they noticed during the water model demonstration. If students do not make the connection between push strength and the model cargo ship's speed, consider individually coaching them to test their own pushes with the water model" (TE, page 64).
- Lesson 12, Learn, Revisit Water Model, Check for Understanding: "Students describe how pushes and pulls cause the model cargo ship to change direction, and they consider whether real tugboats turn cargo ships by using pushes and pulls in the same way. Evidence: Students describe a sideways push or pull from the second model tugboat as the cause of the change in direction for the model cargo ship (PS2.A, CC.2). Next Steps: If students need support to explain how a push or pull caused a change in direction, ask follow-up questions such as these: What happened after the second tugboat pushed the cargo ship? What do you think would happen if the second tugboat did not push the cargo ship? Evidence: Students recognize that testing their ideas with the water model can help them consider how real tugboats use pushes and pulls to turn cargo ships (SEP.2, PS2.A). Next Steps: If students easily recognize that the water model helps them understand how real tugboats could turn cargo ships, challenge them to consider the limitations of the water model" (TE, page 98).
- Lesson 15, Learn, Update Anchor Chart, Check for Understanding: "Students use their knowledge of pushes and pulls to explain how to slow down and stop an object. Evidence: Students explain that pushing on the Hall's car can make it slow down and stop (PS2.A). Next Steps: If students struggle to explain what caused the Hall's car to stop, have them push the car forward. Then perform a clear pushing action to slow down and stop the car. Ask students whether a push or a pull stopped the car. Evidence: Students notice the following pattern: When their classmates push on the front of the moving Hall's car, the car slows down and stops. Students identify these pushes as causes of the car's change in movement (CC.2). Next Steps: If students have difficulty explaining what causes the Hall's car to slow down and stop, point out similarities in how students are stopping the car. Ask students to act out how they would stop the car, and help them identify their pushing or catching action as the cause of the car stopping" (TE, page 122).
- Lesson 18, Learn, Plan Dock Cushions, Check for Understanding: "Students draw their plans for using the materials the class tested to make their dock cushions. Then students predict how their cushions will affect the movement of the model tugboat. Evidence: Students draw a cushion they plan to build to stop the tugboat closer to the dock. Students select materials for

their design to solve this specific problem (SEP.6, ETS1.B). Next Steps: If students select only materials that did not test well, allow them to move forward with testing, but encourage them to use the class results chart to inform their material selections during the Improve stage in Lesson 19. If students draw a material the class did not test, coach them to think about the testing the class did in the Imagine stage, and help them select materials that tested well. Evidence: Students glue their tugboat cutout closer to the dock than the model tugboat stopped during the demonstration without a cushion. By predicting that the tugboat will stop closer to the dock, students exhibit an awareness that their cushion should cause the tugboat to bounce back less than it would without their cushion present (CC.2). Next Steps: If possible, follow up with students about their predictions. Ask students to explain why they think their cushion will help solve the problem. Consider using the following sentence frame to support their thinking: I predict that our tugboat will stop___ (far from/close to/ very close to) the dock. The reason I think so is that___" (TE, page 154).

The module includes two rubrics that are aligned to three-dimensional learning goals. However, the rubrics are not available in a student-facing format, and they only include descriptors for the "Meets Expectations" column, so educators may be unclear about what to look/listen for at the other levels of proficiency. Related evidence includes:

- Lesson 17, Launch, Teacher Note: "Review the Engineering Challenge rubric (Lesson 17 Resource A) before beginning Lessons 17 through 20. Use the rubric to assess students throughout the Engineering Challenge by looking and listening for evidence of engagement as students participate in each stage of the engineering design process. The Checks for Understanding in each lesson identify points at which to gather evidence" (TE, page 139).
- Lesson 17, Learn, Demonstrate Testing Procedure, Check for Understanding: "To monitor student progress, use the Engineering Challenge rubric (Lesson 17 Resource A)" (TE, page 145).
- Lesson 17, Resource A, Engineering Challenge Rubric: (TE, pages 229–231)
- Lesson 22, Learn, Complete End-of-Module Assessment, Teacher Note: "To prepare for the next lesson, analyze students' responses to each item on the End-of-Module Assessment and score each item on the rubric. (See the rubric and sample responses in the End-of-Module Assessment section in the Teacher Edition)" (TE, page 176).
- End-of-Module Assessment Rubric: "Score each student's End-of-Module Assessment. The rubric describes evidence of student work that meets expectations. Use the blank spaces as needed to record evidence of student work that exceeds or falls below expectations" (TE, page 190).

A variety of sample student verbal responses are offered consistently throughout the materials when discourse is referenced. Additionally, educators are sometimes guided with which responses to confirm or highlight. Related evidence includes but is not limited to:

- Lesson 4, Launch: "Highlight student responses that describe different ways to move the toys" (TE, page 35).
- Lesson 10, Learn, Create Direction Investigation Plan: "If students suggested adding a second tugboat, confirm that using two tugboats would help" (TE, page 89).

- Lesson 13, Learn, Explore Difference between Models: "Highlight student responses about the water model cargo ship moving farther, more easily, more quickly, or for a longer time than the map model cargo ship" (TE, page 109).
- Lesson 15, Learn, Explore Collisions with Water Model: "Ask students to Think–Pair–Share about what they noticed, and highlight responses that mention the cargo ship bouncing back after hitting the side of the bin" (TE, page 121).

The module does include answer keys for the two Conceptual Checkpoints (Lesson 9 and Lesson 16), as well as the end-of-module assessment.

Suggestions for Improvement

- To earn an extensive rating for this criterion, explicit guidance needs to be provided for educators to interpret student progress and for students to interpret their own progress in relation to both the instructional materials (e.g., the activity) as well as the targeted standards, elements, parts of elements, and learning performances.
- Scoring guidance, whether in the form of aligned rubrics or samples of exemplar student responses, would ideally provide guidance for how to interpret a range of student performance along all the dimensions as well as their integration and use in sense-making. Consider providing teachers with examples of student work that would show progress toward the target learning goals.
- Consider providing student-friendly versions of the two provided rubrics, as well as completing the educator rubrics so indicators at all proficiency levels are provided.
- Consider providing rubrics relate to all elements claimed at the unit and lesson level. Increasing the number of rubrics provided to educators throughout the learning sequence may be helpful with interpreting key moments of three-dimensional student performance so that all claims are formally represented.

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

The reviewers found adequate evidence that the materials assess student proficiency using accessible and unbiased methods, vocabulary, representations, and examples because vocabulary and text volume in student assessments are grade-level appropriate and text in tasks is always accompanied by other methods (e.g., read aloud) of communicating the expectations for student performance. Some variation in modalities used by students is incorporated over the course of the unit, but students are not regularly provided a choice of what modality to use when responding within individual tasks and most tasks are presented and responded to in spoken English, limiting who may be able to access them.

Some scaffolds are provided to make sure students have the background and/or support they need to be successful with some tasks. Related evidence includes, but is not limited to:

- Lesson 2, Learn, Develop Anchor Model: Students are asked to explain ways a tugboat can move a cargo ship. “Invite students to use a set of wooden blocks on the map to demonstrate as they explain their ideas” (TE, page 23).
- The questions presented during the Conceptual Checkpoints of Lessons 9 and 16, as well as during the End-of-Module Assessment are presented in written text, as well as read aloud by the educator.
- Lesson 21, Learn, Engage in Socratic Seminar: “Have students discuss their answers to the Essential Question with their group. Allow students to respond to one another directly, with minimal teacher facilitation. Students should remind one another of conversation norms, ask for evidence, and pose questions to extend the conversation” (TE, page 171). With no guidance on when this module falls within the Kindergarten experience, and what students should be expected to know/do, it is inappropriate to communicate to an educator that their Kindergarten students will be able to function in independent small groups to hold an on-topic and/or productive discussion, even with the provided Teacher Note scaffolds (below).
- Lesson 21: As students engage in a Socratic seminar discussion to share their current understanding of the Essential Question, “How do tugboats move cargo ships through a harbor?” teachers are provided with the suggestion to use talking chips, “After a student shares, the student places the chip in the middle of the circle. After every student shares and all chips are in the circle, students retrieve the chips and start the process again” (TE, page 171).

- Lesson 22, Launch: Prior to completing the end-of-module assessment focus on pushes and pulls moving objects in carnival games, "ask students to show with a nonverbal signal whether they have ever played a game at a carnival, fair, or amusement park. Ask one or two volunteers to share what they know about carnival games. Then show the class the videos of children playing carnival games (http://phdsci.link/1593 and http://phdsci.link/1594). Engage students in a discussion about the videos. What are the children in each video doing? Are the children using pulls to play either game? Are they using pushes?" (TE, page 174).

"English Language Development" call-outs are included throughout the learning sequence (see Criterion II.E Differentiated Instruction) and a few of the highlighted moments are included during student performance evaluation opportunities when academic and/or topic vocabulary may be anticipated as unfamiliar or difficult. Related evidence includes:

- Lesson 4, Learn, Sort Actions: "In this module, students will see and hear the terms push and pull used as both nouns and verbs. Introduce both terms explicitly by using strategies such as the following: Provide student-friendly examples of pushes and pulls, such as pushing a friend on a swing or pulling a balloon on a string. Invite students to think of other examples of pushing and pulling" (TE, page 38).
- Lesson 7, Learn, Investigate Pushes: "To reinforce the steps of the investigation and to make the plan as accessible as possible, consider adding a sketch next to each instruction" (TE, page 57).
- Lesson 23, Learn, Reflect on CCCs in Module Learning: "To help English learners and other students who may need support in connecting causes with their effects, consider providing a sentence frame such as the following: A (cause) made the object (effect)" (TE, page 179).

Suggestions for Improvement

- Consider providing variety in the modalities expected for student responses (e.g., cut-and-glue, gesture, verbal, written, drawn, use of assistive technology) for most or all individual performance tasks.
- It is recommended that additional formats for presenting information, questions, and tasks are included throughout the learning sequence. Consider additional ways of presenting information in combination with spoken English (e.g., verbal, written, picture support, gestures).

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 because materials include assessments that connect to most learning goals and require students to apply grade-appropriate elements of the three dimensions to make sense of phenomena or solve problems. However, the assessment of the three dimensions does not proportionally match up with all claims, and the assessment rationale is not explicitly described for all three dimensions, including how the different types of assessment work together to provide feedback to educators to inform instruction and students to inform learning throughout the materials.

There is only one pre-assessment opportunity explicitly highlighted. This opportunity only claims to assess one CCC element and one DCI element. The unit materials do not include explicit pre-assessment opportunities for any of the other claimed three-dimensional learning goals, nor do materials describe connections to student learning in prior units from the same school year.

- Lesson 1, Learn, Read Aloud Tugboat, Check for Understanding: "This task is a pre-assessment. Use students' responses to gauge their prior and developing knowledge of how pushes and pulls can cause objects to move as well as how observations can reveal patterns. Evidence: After observing multiple instances of the tugboat moving ships, students recognize a pattern (CC.1): The tugboat always uses a push or a pull to move another vessel (PS2.A). Next Steps: At this point, students do not need to fully understand how pushes and pulls can change an object's movement, and they do not need to independently identify the pattern. Make note of students who express misconceptions, and check in with those students again at the end of Concept 1" (TE, page 18).

Formative assessment (see evidence in Criterion III.B) opportunities are assumed to be labeled as "Check for Understanding."

No tasks are specifically identified by developers as "summative" assessments, but it can be assumed that the two Conceptual Checkpoints (Lessons 9 and 16) and the "End-of-Module Assessment" are equivalent.

No self-assessment opportunities are explicitly called out and structured in the unit materials, but students are occasionally prompted to make general reflections. Related evidence includes, but is not limited to:

- Lesson 9, Land: "Ask students to reflect on what they have learned so far. What causes objects to start moving?" (TE, page 79).
- Lesson 12, Learn, Revisit Water Model: "After several pairs test their ideas for turning the cargo ship, ask students to reflect on whether their ideas were successful" (TE, page 97).
- Lesson 14, Learn, Investigate Slowing Down and Stopping: "As students share their responses, ask them to reflect on the plans they recorded in their Science Logbooks (Lesson 13 Activity Guide). Did your plan work?" (TE, page 116).
- Lesson 21, Land: "Restate a few responses from the Socratic Seminar that show evidence of students' learning. Ask students to reflect silently on how their knowledge has grown since the beginning of the module" (TE, page 172).

Suggestions for Improvement

- It is recommended that materials show evidence that, when considered altogether, the variety of assessment opportunities over the course of the materials provide both the educator *and students* with feedback about the degree to which the intended three-dimensional learning targets were accomplished. Consider providing guidance about how the different assessments work together to measure key and/or targeted learning in the unit. Educator guidance could be enhanced to include an explanation of the purpose and rationale for how and why student learning is measured across the materials.
- Because of the discrepancies between the elements claimed as learning targets at the unit level, elements claimed at the Concept lesson set level, and those elements identified in the two rubrics (see evidence and suggestions for improvement in this report under Criterion I.B Three Dimensions), it is unclear what the intended key learning targets are and how students should be expected to progress toward them throughout the unit. Consider aligning the unit-level, lesson-level, and assessment-level elements of the three-dimensional learning goals.
- Consider including opportunities for pre-assessments that are designed to evaluate students' prior knowledge in all three dimensions of the learning targets.
- Consider including opportunities for self-assessment of performance on an individual student level.

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

The reviewers found inadequate 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 some iterative opportunities to demonstrate they have progressed toward select targeted learning goals, but feedback loops are very limited and there is a discrepancy in the claimed SEP learning targets and the opportunities students have to engage with them through performances that demonstrate their progress.

Explicit evidence of prompted feedback is limited to the end of the module and the lessons do not indicate time for students to respond to the feedback so students are unable to construct new learning and improve performance in preparation for any future assessment opportunities. Related evidence is limited to:

- Lesson 22, Learn, Complete End-of-Module Assessment, Teacher Note: "When providing individual feedback on the assessment, be sure to guide students to focus on specific areas of improvement to deepen their understanding of module concepts. Offer students who need remediation the opportunity to revisit portions of the module" (TE, page 176). Time is not provided for students to make revisions or construct new learning based on feedback.
- Lesson 23, Learn, Debrief End-of-Module Assessment, Teacher Note: "Have students offer feedback on peers' responses or on their own response to the assessment item" (TE, page 178). Time is not provided for students to make revisions or construct new learning based on feedback.

The CCC elements of the unit are claimed and addressed in several lessons allowing students iterative experiences with them. Related evidence includes, but is not limited:

- In the following instances, students are tasked with demonstrating understanding of the CCC element: *Events have causes that generate observable patterns.*
    - Lesson 5, Learn, Draw Pushes and Pulls, Check for Understanding: "Tell students that they will now record what they just observed. Ask students to draw their observations in their Science Logbooks (Lesson 5 Activity Guide). Then use the following questions to elicit ideas about the relationship between a push or a pull and an object's movement. What caused the _to start moving? How can you show in your drawing how I made the _ move? Did you observe a push, or did you observe a pull? How do you know? When

students finish drawing the action they observed, have them identify the action as either a push or a pull by circling the correct symbol and word in their Science Logbooks (Lesson 5 Activity Guide)" (TE, page 44). While some whole group instructional next steps are offered, there is no feedback loop prompted at this time, in that educators are not guided to provide to students individual and specific feedback for the purposes of improving performance with the learning target(s).

- Lesson 9, Learn, Conceptual Checkpoint A and B: In this three-question assessment task, educators are prompted to, "Tell students they will use what they know about pushes and pulls and cause and effect to explore the Phenomenon Question How can a push or a pull help in a skateboard race?" Students answer the questions, "Will a push or a pull cause each rider to move toward the finish line? Which picture shows the effect of a push? And What question about strength can you ask to figure out which team was faster?" (TE, page 76).
- Lesson 13, Plan Stopping Investigation: "Distribute one small tugboat cutout, one small push cutout, and one small pull cutout (Lesson 10 Resource B) to each student. Instruct students to glue a tugboat cutout in the second column to show where they will place the tugboat. Then tell students to glue either a push cutout or a pull cutout next to the tugboat cutout to show how they plan to use the tugboat to stop the cargo ship" (TE, page 111). There is no feedback loop prompted at this time, in that educators are not guided to provide to students individual and specific feedback for the purposes of improving performance with the learning target(s).

Out of the 12 claimed SEP elements eight elements are addressed in only two to three lessons each. This reduces the opportunity for students to repeatedly engage with these elements through performances and demonstrate their growth in proficiency over time. This is particularly concerning for the four elements that are claimed as learning targets at both the unit and Science Topic lesson set level.

Asking Questions and Defining Problems

- *Ask questions based on observations to find more information about ~~natural and/or~~ designed world(s).*
  - The element is claimed as a unit level SEP element in the front matter (TE, page 6), but there is a disproportionate number of opportunities given to students to ask new questions throughout the learning sequence, in comparison to the total number of lessons. This presents a significant missed opportunity as it reduces the amount of time students are purposefully engaged with the element. In Lesson 3, students are presented through scaffolded instruction (i.e., modeled sentence starter) how to ask a question about the tugboat moving a cargo ship (TE, page 27), but in the subsequent lessons (i.e., 9–10, 13, and 23) students are simply prompted to ask new questions without a feedback loop for improving performance with this element.

Planning and Carrying Out Investigations

- *Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons.*
    - This element is claimed as a unit level SEP element in the front matter (TE, page 6), but it is explicitly addressed only in Lessons 7–8 and Lessons 19–20, significantly reducing the time students engage with the element and opportunity for performance improvement. Although in these lessons some students will have the opportunity to verbally respond to educator question prompts that elicit comparison using observation and/or measurement, evidence will likely not be gathered from all students. Additionally, in both lesson sets there is no guidance to support the educator in providing targeted feedback from which students can improve their performance related specifically to this element.

Analyzing and Interpreting Data

- *Record information (observations~~, thoughts, and ideas)~~.*
    - The element is claimed as a unit level SEP element in front matter (TE, page 6), but it is claimed as only addressed in Lessons 4–6. However, students do record quantitative observations (i.e., single digit numbers) in Lessons 18–19. Because of the grade level it is appropriate that the expectation to record is limited, but there is no evidence to support that educators are supported in giving student feedback about their recordings for students to make improvements related to this learning target.

Using Mathematics and Computational Thinking

- *Use counting and numbers to identify and describe patterns in the ~~natural and~~ designed world(s).*
    - The element is claimed as unit level SEP element in front matter (TE, page 6), but it is explicitly addressed only in Lessons 19 and 20. While counting the boxes is modeled for students at first and teachers are prompted to help students if needed, there is no evidence to support that all students will be counting, so there may be no opportunity for some or many students to practice and advance with this SEP element. Although there are two "Check for Understanding" educator notes (TE, pages 145 and 164) that mention that students should identify a pattern, there is no evidence to support that educators prompt or support students to make connections between their quantitative data and patterns.

Similarly, two (i.e., **ETS1.A**, **ETS1.B**) of the six claimed DCI elements are only addressed in four of the total 23 lessons. This reduces the opportunity for iterative engagement by students. However, it is recognized that the ETS DCI elements are K–2 grade-band goals so the opportunity for students to progress in relation to these learning goals will be extended over several grade levels. The other four DCI elements are extensively addressed throughout the learning sequence and presented within a variety of contexts to support student understanding. Related evidence includes, but is not limited to:

- In the following instances, students are tasked with demonstrating an understanding of **PS2.A**: *Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.*
    - Lesson 5, Learn, Draw Pushes and Pulls, Check for Understanding: "Tell students that they will now record what they just observed. Ask students to draw their observations in their Science Logbooks (Lesson 5 Activity Guide). Then use the following questions to elicit ideas about the relationship between a push or a pull and an object's movement. What caused the _to start moving? How can you show in your drawing how I made the _ move? Did you observe a push, or did you observe a pull? How do you know? When students finish drawing the action they observed, have them identify the action as either a push or a pull by circling the correct symbol and word in their Science Logbooks (Lesson 5 Activity Guide)" (TE, page 44). While some whole group instructional next steps are offered, there is no feedback loop prompted at this time, in that educators are not guided to provide to students individual and specific feedback for the purposes of improving performance with the learning target(s).
    - Lesson 9, Learn, Conceptual Checkpoint A and B: In this three-question assessment task, educators are prompted to, "Tell students they will use what they know about pushes and pulls and cause and effect to explore the Phenomenon Question How can a push or a pull help in a skateboard race?" Students answer the questions, "Will a push or a pull cause each rider to move toward the finish line? Which picture shows the effect of a push? And what question about strength can you ask to figure out which team was faster?" (TE, page 76).
    - Lesson 11, Learn, Record Observations: "Tell students to glue their two tugboat cutouts on the map to show where their group placed the tugboats to push or pull the cargo ship at that location. After students have glued their tugboat cutouts, distribute two small push cutouts and two small pull cutouts (Lesson 10 Resource B) to each student. Have students determine whether each of their tugboats used a push or a pull. Then guide students to glue a push cutout or a pull cutout next to each tugboat cutout on the map" (TE, page 94). There is no feedback loop prompted at this time, in that educators are not guided to provide to students individual and specific feedback for the purposes of improving performance with the learning target(s).
    - Lesson 13, Plan Stopping Investigation: "Distribute one small tugboat cutout, one small push cutout, and one small pull cutout (Lesson 10 Resource B) to each student. Instruct students to glue a tugboat cutout in the second column to show where they will place the tugboat. Then tell students to glue either a push cutout or a pull cutout next to the tugboat cutout to show how they plan to use the tugboat to stop the cargo ship" (TE, page 111). There is no feedback loop prompted at this time, in that educators are not guided to provide to students individual and specific feedback for the purposes of improving performance with the learning target(s).

Suggestions for Improvement

Consider ensuring that educator and student materials consistently include clear and iterative opportunities for *all* key learning goals such that students can: 1) demonstrate their integration of the three dimensions through assessment, and 2) receive oral and written feedback and a chance to apply the feedback to improve their performance in each key targeted dimension. To move towards an extensive rating for this criterion for key, claimed learning in the unit in each of the three dimensions, there are multiple student performances that provide students with iterative opportunities to demonstrate their growth in proficiency over time. This includes feedback loops in which students receive both written and oral feedback from the educator and peers that focuses on improving student performance for all key, claimed learning in each of the three dimensions and provides students the opportunity to use feedback to construct new learning and improve their performance in preparation for the next assessment opportunity.

OVERALL CATEGORY III SCORE: 2	
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

Pushes and Pulls

EQuIP RUBRIC FOR SCIENCE EVALUATION

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