EQuIP Rubric for Science

How can we communicate using objects that make sound?

Curriculum Developer: OpenSciEd

GRADE 1 | FEBRUARY 2025

nsta
National Science Teaching Association

Category I Rating

A	B	C	D	E	F
Explaining Phenomena/ Designing Solutions	Three Dimensions	Integrating the Three Dimensions	Unit Coherence	Multiple Science Domains	Math and ELA
EXTENSIVE	EXTENSIVE	EXTENSIVE	EXTENSIVE	EXTENSIVE	EXTENSIVE

Score Category I: 3

Category II Rating

A	B	C	D	E	F	G
Relevance and Authenticity	Student Ideas	Building Progressions	Scientific Accuracy	Differentiated Instruction	Teacher Support for Unit Coherence	Scaffolded Differentiation Over Time
EXTENSIVE	EXTENSIVE	EXTENSIVE	EXTENSIVE	EXTENSIVE	EXTENSIVE	ADEQUATE

Score Category II: 3

Category III Rating

A	B	C	D	E	F
Monitoring 3D Student Performance	Formative	Scoring Guidance	Unbiased Tasks/Items	Coherent Assessment System	Opportunity to Learn
EXTENSIVE	EXTENSIVE	EXTENSIVE	EXTENSIVE	EXTENSIVE	ADEQUATE

Score Category III: 3

UNIT 2

Sum Categories	**9**
Rating	**E**

Overall Summary Comments

This unit is designed for the *Next Generation Science Standards* (*NGSS*), including clear and compelling evidence of the following criteria:

- **Category I - *NGSS* 3-D Design**
  - **I.A Explaining Phenomena.** Students have opportunities to make sense of multiple phenomena through hands-on investigations that drive their learning about concepts related to sound. Students are positioned to see that their questions and wonderings are driving their learning. Teachers are provided with guidance to generate and leverage student questions and wonderings and co-construct lesson questions.
  - **I.D Unit Coherence.** Scientific concepts are integrated in service of students designing a solution to the problem of sending a message over the distance of their classroom.
- **Category II - Instructional Supports**
  - **II.A Relevance and Authenticity.** Students have opportunities to experience multiple phenomena through hands-on investigations that drive their learning about concepts related to sound. Teachers are provided with guidance for connecting instructions to students' homes and neighborhoods.
  - **II.B Student Ideas.** Teachers are provided with guidance to generate and leverage student questions and wonderings and to co-construct lesson questions in a way that positions very young students to see that their questions and wonderings are driving the learning.

The unit was reviewed to "provide constructive criterion-based feedback and suggestions for improvement to developers" (EQuIP Rubric for Lessons & Units: Science (Version 3.1). Reviewers recommend focusing on the following criteria during revisions:

- **Category II - Instructional Supports**
  - **II.G Scaffolded Differentiation Over Time.** Unit materials do not provide guidance to teachers for where and when to add and remove supports to move students toward independently knowing when to use and demonstrate proficiency with all elements of the intentionally developed SEPs. The materials could be strengthened with such guidance and with teacher supports to help all students explicitly build an understanding and proficiency in specific elements of the SEPs over the course of the unit.
- **Category III - Monitoring Student Progress**
  - **III.F Opportunity to Learn.** Consider adding increased clarity on how performances are iterative opportunities to demonstrate progress toward full proficiency over time.

Why are there two colors of text in this report?

Black text is used in this report to identify direct quotations or paraphrases of a lesson/unit (the evidence) and why/how this evidence indicates the criterion is being met (the reasoning). (EQuIP Rubric for Lessons & Units: Science (Version 3.1))

Black text is also used for evidence and reasoning that does not affect the rating of the criterion.

Purple text is used in this report to identify direct quotations or paraphrases of a lesson/unit (the evidence) and why/how this evidence indicates that the criterion is NOT being met (the reasoning). (EQuIP Rubric for Lessons & Units: Science (Version 3.1)) The exception to this is when a criterion is rated as "extensive." In those cases, purple is used as a visual cue to "*provide constructive criterion-based feedback and suggestions for improvement to developers*" (EQuIP Rubric for Lessons & Units: Science (Version 3.1)).

CATEGORY I
NGSS 3D Design

I.A. Explaining Phenomena / Designing Solutions

EXTENSIVE

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.

The reviewers found **extensive** evidence that making sense of phenomena and designing solutions to a problem drives student learning. Materials are organized so that students can figure out the central phenomenon: a clock tower makes and sends sound signals. Student questions and prior experiences related to the phenomenon or problem extensively motivate sensemaking and problem solving. When engineering is a learning focus, it is integrated with developing Disciplinary Core Ideas from physical science. Students' questions and wonderings drive the lesson sequence. Students are positioned, and teachers are guided to help them see that their wonderings and questions motivate sensemaking.

i. Student questions and prior experiences related to the phenomenon or problem motivate sense-making and/or problem-solving. The materials have a student-centered focus on phenomena or problems, and there is consistent student-driven learning over time. Students' own questions motivate student learning in each lesson and throughout the unit. There is a student-centered focus on phenomena or problems. Materials are organized so that students figure out the clocktower phenomenon, how and why it rings, and connect their understanding to the design of a device to communicate a good news message across the classroom.

- Lesson 1, Explore Section, Step 4: "Support students in generating questions. Consider supporting the class in articulating ideas they are uncertain about or ideas they will investigate further as questions by saying something like, "I notice that we have some different ideas about how bells make sound. Is that something we are wondering? How can I write that as a question we have?" (Lesson 1, Teacher Guide)
- Lesson 2, Navigate Section, Step 1: "Co-construct the lesson question. Build on students' questions about how objects make sound to suggest that we explore with the triangle to figure out more about how it makes sound. Together, co-construct a lesson question similar to, How does a triangle make sound? Revise the question on slide C to match the words used by your class and then display it." (Lesson 2, Teacher Guide)
- Lesson 3, Navigate Section, Step 7: "Discuss wonders and continued areas of uncertainty. Point out wonders (or groups of wonders) on the Notice and Wonder chart and/or in the Initial Class Model that reflect the other part of our lesson set question (how objects send sound signals). You may want to circle these or use another representation to draw attention to them. Use the prompts below to engage in a brief discussion about what we do not yet know." Prompts include: "What are we still wondering about sound signals or about how objects send sound/sound signals? What wonders did we have that are not yet figured out?" "What new questions do you want to add?" (Lesson 3, Teacher Guide)
- Lesson 4, Navigate Section, Step 1: "Co-construct the lesson question. Then use students' experiences and ideas to co-construct a lesson question. This might be similar to, How can we know sounds travel and are received? (refer to slide C). Be sure to edit the prepared lesson question to match your students' ideas and language. Emphasize to students how their question will guide our work in this lesson." (Lesson 4, Teacher Guide)

- Lesson 5, Synthesize Section, Step 2: "Review added ideas on the Gotta-Have-It Checklist. Review students' suggested representations that you have added to the Gotta-Have-It Checklist. Be sure to check with students to confirm their thinking has been captured and that you give them the opportunity to ask questions, seek clarification, and/or add any additional representations and words they may want to use in their models." (Lesson 5, Teacher Guide)
- Lesson 6, Synthesize Section, Step 3: "Add to Our Growing Ideas chart. Display Our Growing Ideas chart (refer to slide H). Remind students that we are using this chart to keep track of what we figure out across our science lessons. If you have not already, ensure that your version of the lesson question is written on Our Growing Ideas chart. The following is an example of how the Lesson 6 row of your class' Our Growing Ideas chart might look. Remember to use your own class artifacts, photos, and students' languages in the chart--this is only a sample." (Lesson 6, Teacher Guide)

Student questions and prior experiences related to sound and signals consistently create an explicit need, from the students' perspective, for the students to engage in learning throughout the materials.

- Lesson 2, Navigate Section, Step 1: Teacher guidance is provided to return to the Notice/Wonder chart and to remind students that they wanted to figure out how objects make sound and to use their questions to create a lesson question. "Build on students' questions about how objects make sound to suggest that we explore with the triangle to figure out more about how it makes sound. Together, co-construct a lesson question similar to, How does a triangle make sound?" (Lesson 2, Teacher Guide)
- Lesson 3, Synthesize Section, Step 6: "Reintroduce Our Growing Ideas chart. Display the class's Our Growing Ideas chart (refer to slide J). Remind students that we started this chart in our last lesson to keep a record of what we are figuring out about our lesson set question, How do objects make and send sound signals? This is a big question that we are answering through our investigations and science work in each lesson! Today, we will be able to add what we have figured out through our instruments investigation and our book. The following is an example of how your Lesson 3 row in Our Growing Ideas chart might look. If you have not already, ensure that your version of the lesson question is written on Our Growing Ideas chart. Remember to use your own class artifacts, photos, and students' languages in the chart--this is only a sample. (Lesson 3, Teacher Guide)
- Lesson 4, Navigate Section, Step 1: Planning an Investigation, students are asked to return to their previously designed investigations (triangle and instruments), students are asked, "Using our past investigation plans as guides, what decisions do we need to make about using an instrument? And "What decisions do we need to make about making and recording observations?" students then co-construct the "Sprinkles" investigation plan. (Lesson 4, Teacher Guide)
- Lesson 5, Synthesize Section, Step 2: "Motivate a Gotta-Have-It Checklist. Then, remind students that we decided to use what we have figured out so far to make new models that answer the question, "How does the clocktower make and send sound signals?" Suggest that we work together to make a Gotta-Have-It Checklist (refer to slide D) to help us as we develop those new models. Invite students to turn and talk about what "gotta have it" means to them, in order to affirm that this co-created Checklist will include the things we decide have to be included in our models." (Lesson 5, Teacher Guide)
- Lesson 6, Navigate Section, Step 1: Students return to their "Examples" chart that they created in Lesson 1 and return to in Lesson 5, when students are asked, "What questions did we have about the messages we send with sound signals?" (Lesson 6, Teacher Guide)

Teacher guidance is provided to co-construct the lesson question.

- Lesson 7, Navigate Section, Step 1: Students return to the sound signal ideas and wonders chart. The following teacher guidance is provided, "Then, use the following prompts to invite students to decide what we should do next by helping them connect to how they answered science questions earlier in this unit." (Lesson 7, Teacher Guide)
- Lesson 8, Navigate Section, Step 1: Students review their sound signal device "Ideas/Wonders" chart. The following teacher prompt is provided, "What questions did we have about how to build our sound signal devices?" (Lesson 8, Teacher Guide)
- Lesson 9, Navigate Section, Step 7: Decide Where to Go Next, students return to their sound signal device "Ideas/Wonders" chart. Students are asked, "What questions can we now answer based on what we figured out today? And What new questions do we have about how our sound signal devices?" (Lesson 9, Teacher Guide)

From the students' perspective, phenomena are connected logically and build on each other coherently. Students regularly return to the clocktower phenomenon as they build on what they learn about sound and signals.

- Lesson 1, Explore Section, Step 3: "Make observations of the clocktower. Play The Clocktower Rings Again video and show the bells inside the clocktower, both available again on slide G, encouraging students to watch and listen carefully, so that afterward we can share the details we noticed and ask questions about them." (Lesson 1, Teacher Guide) In this lesson, students are introduced to the anchoring clocktower phenomenon.
- Lesson 2, Explore Section, Step 5: "Carry out our planned investigation. In a way that works for your classroom, organize students into pairs and distribute materials so that each pair has a triangle and striker and each student has a Triangle Investigation Observations handout and writing utensil." (Lesson 2, Teacher Guide) Students use the triangle to make sense of the relationship between the movement of a triangle and the production of sound.
- Lesson 3, Explore Section, Step 3: "Review the Instrument Investigation Plan. As needed (particularly if your class is starting a new science session), invite students to turn and talk with a partner to review their Instruments Investigation Plan (refer to slide F). Students will use each instrument and make observations by looking and feeling for what is happening with the rubberband of the box guitar, the beads inside the shaker, and the metal disks on the sides of the tambourine. They should make observations when there is sound and when there is not." "Compare recorded observations with a partner. Once students have completed moving through the stations (making observations for each instrument), invite them to find a different classmate and compare their recorded observations on their Instruments Investigation Observations handouts. If time permits, encourage students with different recorded observations to return to a station to retest the instrument/s and try to come to agreement." (Lesson 3, Teacher Guide) Students use a variety of instruments to make sense of vibrations and their relationship to sound.
- Lesson 5, Synthesize Section, Step 2: "Confirm with students what we have now figured out related to our Lesson Set Question (posted at the top of Our Growing Ideas chart), How do objects make and send sound signals? We have figured out how objects - like the instruments we investigated - make sounds when they vibrate. And we know that sounds are sent, or travel, because we can hear (receive) sounds made somewhere else. Sometimes, we can see or feel vibrations caused by those sounds." (Lesson 5, Teacher Guide)
- Lesson 7, Explore Section, Step 3: "Discuss instrument parts and sound. After they have spent a few minutes revisiting familiar instruments, gather students' attention as a class to discuss what students have observed and how their gathering more information may have helped generate new ideas for our sound signal devices. As students share their ideas during this discussion, encourage them to hold up, point to, and/or manipulate the instrument they revisited." (Lesson 7, Teacher Guide)

ii. The focus of the unit is to support students in making sense of phenomena and/or designing solutions to problems.

- Lesson 1, Explore Section, Step 4: "Broadening Access: Students' opportunity to explore handbells intentionally precedes the co-creation of an initial class model. This sequence activates or supplies background knowledge by providing all students opportunities to engage with and make observations of a sound (ringing) and the object making it (handbell) as well as providing time to think, draw, and write. These activities position every member of the classroom community with experiences and ideas to share related to the anchoring phenomenon." (Lesson 1, Teacher Guide)
- Lesson 2, Explore Section, Step 2: "Connect to our experiences making sound with instruments. Remind students that we are trying to figure out how a triangle makes sound and suggest that they have already shared and listened to many ways that students have made sounds using other instruments and objects. Display slide D and invite students to think quietly about and/or mime or gesture one or two ways they may want to to try using the triangle to make sound." (Lesson 2, Teacher Guide)
- Lesson 3, Explore Section, Step 2: "Revisit the Triangle Investigation Plan. Remind students that in our last lesson, we planned an investigation that would help us make observations to answer our question, How does a triangle make sound? This time, we want to answer the question, How do other objects make sound? Display the class' Triangle Investigation Plan from Lesson 2 (refer to slide D) and invite students to briefly turn and talk about how we investigated with the triangle during the last lesson. This turn-and-talk and referencing the Triangle Investigation Plan (with its two columns for using the instrument and making/recording observations) supports all students in recalling experiences that can contribute to this lesson's decision-making. How did we use the triangle? How did we make and record our observations? (Lesson 3, Teacher Guide)
- Lesson 6, Explore Section, Step 2: "Practice identifying a sound signal message. Remind students we are wondering what messages people communicate using sound signals and suggest we start by exploring the message the clocktower sends. Hold up the clocktower card from the Sound Signal Device Cards set (refer to slide C) and use the following prompts to practice the steps students will be completing with a partner." Prompts include: "What sound signal does the clocktower make?" "What message (information) does this sound signal send? In other words, what does the sound mean?" "What other objects can you think of that may use a sound signal to send a message about time?" (Lesson 6, Teacher Guide)
- Lesson 8, Explore Section, Step 3: "Gather materials and begin building in pairs. As partnerships are ready, have them use their *Materials Menu* handout to gather their materials and begin building in their work zone using their drawn designs. If additional wait-time or staggering is needed, consider having students show and/or tell about their drawn designs to another pair before gathering materials." (Lesson 8, Teacher Guide)

iii. When engineering is a learning focus, it is integrated with developing disciplinary core ideas from physical science, life, and/or earth and space sciences.

- Lesson 6, Explore Section, Step 5: "Connect to our classroom. Remind students that when we read the Local School Celebrates National Engineering Week newspaper article, we found out that an engineering problem is something that people want to improve in the world around them. Support students in connecting information from that article to their own classroom by engaging in a brief discussion to identify our engineering problem, define it clearly, and begin to consider how we can use engineering to solve it." (Lesson 6, Teacher Guide)
- Lesson 7, Explore Section, Step 4: "Introduce the Sound Signal Device Design handout. Display the Sound Signal Device Design handout (refer to slide H), reading the directions for Part A ("Draw your design in the box. Include your materials. Use lines, arrows, and labels to explain how your device will make and send a sound signal.") and explaining to students that they can use this to draw and write a design to show their ideas for a sound signal device.

If needed, remind students that a design is a plan showing how something will be made or built. Connect with information in the Meet the Engineer: Matias Dermond book by reminding students that - just like Matias' design - their designs should represent what the sound signal device will look like, the materials/parts it will be made of, and how it will work. Ensure students have access to the Device Gotta-Have-It Checklist while working; you may also want to display their Ideas and Wonders chart." (Lesson 7, Teacher Guide)

- Lesson 8, Explore Section, Step 3: "Revise drawn designs. As groups finish building, remind them that, in engineering, it is common to have our designs change once we start building. Invite students to compare their built design to their drawn design on their Sound Signal Device Design handouts (Part B. Engineering Partnership Design). Using a different color or kind of writing utensil, invite engineering partnerships to revise their drawn designs to represent their built design. This might be through circling what is the same; putting x's over what they did not include in their built design; and/or drawing and labeling any new parts or materials in their built design. Encourage students to use this opportunity to reflect on how they likely improved on their design as they were building it!" (Lesson 8, Teacher Guide)
- Lesson 9, Explore Section, Step 3: "Revisit planning and carrying out investigations. Using the information about Matias and his team as a connection, explain how engineers, like scientists, also carry out investigations. Engineers investigate to answer questions about how well their designs work and to learn in what ways their designs work as planned and in what ways they do not. Ask students to recall how they have investigated objects that make sounds in previous lessons (Lesson Set 1) by displaying slide D and using the following prompts. The purpose of this discussion is to support students in using their experiences investigating instruments to guide them in making a plan to test their built sound signal devices." (Lesson 9, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

I.B. Three Dimensions

(All 3 dimensions must be rated at least "adequate" to mark "adequate" overall)

EXTENSIVE

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.*

The reviewers found **extensive** evidence that the materials give students opportunities to build an understanding of grade-appropriate elements of the three dimensions because students regularly engage in elements of all three dimensions to make sense of the anchoring or lesson-level phenomenon. Teacher materials, such as the Unit Overview and the 1.2 Wave Sounds SEP-DCI-CCC-ELA-Math-Matrix, provide explicit descriptions regarding the elements that are intentionally developed and those that are practiced or used. The unit centers on students using targeted elements of all three dimensions that are clearly identified and addressed throughout the unit to explain the ringing of clock towers and how sound can be generated and used to communicate information across the classroom.

Rating for Criterion: SEP **EXTENSIVE**

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

Students engage with six SEPs throughout the unit. The SEPs Developing and Using Models, Planning and Carrying Out Investigations, Asking Questions and Defining Problems, Analyzing and Interpreting Data, Constructing Explanations and Designing Solutions, and Obtaining, Evaluating, and Communicating Information are claimed. Three of these SEPs—Developing and Using Models, Planning and Carrying Out Investigations, and Constructing Explanations and Designing Solutions—are identified as intentionally developed. Students use the SEP elements listed as key learning objectives in service of making sense of the phenomena of ringing clock towers and designing a device that will communicate news across the classroom. The reviewers found **extensive** evidence that the materials provide opportunities to develop and use specific elements of the SEPs.

MOD: Developing and Using Models

Claimed Element: MOD-P3: Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). Claimed in Lessons 1 and 5. Evidence was found in claimed lessons. Examples include:

- Lesson 1, Synthesize Section, Step 5: "Display slide M and the blank Initial Class Model with the question at the top, "How does the clocktower make and send sound signals?" Remind students that - when we make our model - we will use words and pictures to explain our beginning ideas about this question. Assure students that we have not yet figured out how everything works! This initial model will help us put together our different ideas and identify what we are not yet sure about. Also assure students that it is expected that we will not all agree on everything. We will try to figure out parts we do agree on and parts we are unsure." "Use the suggested prompts further below to elicit students' initial ideas, surface agreement and disagreement, and add ideas and uncertainty to the Initial Class Model. The suggested prompts are organized into three sections (the clocktower; making sound; sending sound signals)." (Lesson 1, Teacher Guide)
- Lesson 5, Synthesize Section, Step 3: "Introduce the Sound Signal Model handout. Display slide E and review with students how the Sound Signal Model handout provides an opportunity for each of us to explain the question from our Initial Class Model, "How does the clocktower make and send sound signals?" Show students the spaces (box and lines) for both drawing and writing their ideas and review the first direction, "Use the boxes and lines to draw and write a model showing how the clocktower makes and sends sound signals" together. Additionally, point out the second direction, "Circle which investigations helped you draw or write your ideas." and demonstrate how students can indicate what evidence supports their ideas by circling the image/s of the investigations they completed across Lessons 2-4." (Lesson 5, Teacher Guide)

Claimed Element: MOD-P4: Develop a simple model based on evidence to represent a proposed object or tool. Claimed in Lessons 7 and 8. Evidence was found in claimed lessons. Examples include:

- Lesson 7, Explore Section, Step 4: "Plan a Design, students use the Sound Signal Device Design handout to generate a model of their device that will "make and send a sound signal". Students continue to revise and design this device collaboratively in step 5. " "Display the Sound Signal Device Design handout (refer to slide H), reading the directions for Part A ("Draw your design in the box. Include your materials. Use lines, arrows, and labels to explain how your device will make and send a sound signal.") and explaining to students that they can use this to draw and write a design to show their ideas for a sound signal device. If needed, remind students that a design is a plan showing how

something will be made or built. Connect with information in the Meet the Engineer: Matias Dermond book by reminding students that - just like Matias' design - their designs should represent what the sound signal device will look like, the materials/parts it will be made of, and how it will work." (Lesson 7, Teacher Guide)

- Lesson 8, Explore Section, Step 3: "Review the Device Gotta-Have-It-Checklist. Ensure students are with their engineering partners, ideally in their work zone. As a class, briefly review the Device Gotta-Have-It Checklist (refer to slide D) to remind ourselves of the engineering problem we are trying to solve and what our devices need to have or be able to do." "Provide directions for using the Materials Menu. Show students a blank Materials Menu handout (refer to slide F) and demonstrate how to circle each material that they will need to build their sound signal devices based on their drawn designs." "Suggest to students that there are two steps they should complete before gathering their materials from the classroom materials center. First, invite them to turn and talk with their engineering partners to reacquaint themselves with their drawn Engineering Partnership Designs (Part B. on their Sound Signal Device Design handouts) by discussing what their build design will look like; what materials they will use; and how they think it will work. Second, they should circle the materials together using one copy of the Materials Menu handout. Then they will be ready to gather their materials!" (Lesson 8, Teacher Guide)

INV: Planning and Carrying Out Investigations

Claimed Element: INV-P2. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. Claimed in Lessons 2, 3 and 4. Evidence was found in all claimed lessons. Examples include:

- Lesson 2, Explore Section, Step 4: "Collaboratively plan our triangle investigation. Use the following prompts to facilitate a Think, Pair, Share discussion to have students begin to collaboratively plan their investigation of how the triangle makes sound (refer to slide F). Record students' decisions on the prepared but blank Triangle Investigation Plan on the board, a digital space, or other public space in the classroom for students to refer to as they carry out their investigation. Consider adding sketches or other visual prompts to accompany students' ideas and/or inviting students to add these throughout the discussion. The following is an example of how your Triangle Investigation Plan might look after this discussion. Remember to use your own class ideas, drawings, and students' languages in the chart." (Lesson 2, Teacher Guide)
- Lesson 4, Synthesize Section, Step 6: " Remind students that our goal in a Building Understandings Discussion is to consider how the data we gathered in our investigation helps us make a claim that answers our scientific question, How can we know sounds travel and are received? In this discussion the goal is for students to articulate that their observations (hear, see, feel) provide evidence that sounds travel and are received. Once multiple students have shared and responded to one another's ideas, add a synthesis of the class' ideas to the column titled, 'What did we figure out?'" "Continue the discussion about students' evidence. Remind students that in science, we always use evidence to support our claims. Evidence is the observations, data, or information that helps answer the science question. Point to each claim that students made and ask students what evidence we have that supports that claim." (Lesson 4, Teacher Guide)

Claimed Element: INV-P4: Make observations (firsthand or from media) to collect data that can be used to make comparisons. Claimed in Lessons 2, 3 and 4. Evidence was found in all claimed lessons. Examples include:

- Lesson 2, Explore Section, Step 2: "Discuss our explorations with the triangle. Engage students in a short discussion using the following prompts to share the variety of strategies they used to play and explore with the triangles and their varied observations. The discussion should not lead to consensus on how the triangle makes sound or answer the lesson question. Instead, its purpose is to elevate differences and allow students to grapple with the challenges of trying to compare observations when they varied in their exploration strategies as well as what they paid attention to when making observations." Prompts include: "What did you notice about the triangle?" (Lesson 2, Teacher Guide)

- Lesson 3, Explore Section, Step 2: "Next, invite students to decide how we should use the instruments to make sound and record decisions using words and drawings on the "Use the Instrument" side of your class' Instruments Investigation Plan." "Turn and talk about recording observations. Ask students what they should do with their observations (or what they should do after they make observations). If students do not suggest recording observations, point out that section of the Triangle Investigation Plan from Lesson 2. Ask students for their ideas to record their observations so that we can use and compare them, reminding them that they will be recording observations of 3 instruments, while in the last investigation, they recorded observations of just 1 instrument (the triangle)." (Lesson 3, Teacher Guide)
- Lesson 4, Explore Section, Step 2: "Co-construct a blank class data table. Tell students that in this investigation - now that we have had practice recording observations using our senses of sight and touch - we can record our data right onto a class data table instead of recording it on a handout first." "Facilitate a turn-and-talk discussion to co-create the Sprinkles Investigation data table. Use the following prompts to engage students in a discussion, using the Instruments Investigation data table from Lesson 3 as a guide for co-creating the Sprinkles Investigation data table. For each question, invite students to first turn and talk to a partner, then discuss as a whole class, before recording decisions on the co-constructed data table. Note that your class may discuss these ideas in any order." (Lesson 4, Teacher Guide)
- Lesson 9, Explore Section, Step 4: Test a Design, students work in groups to complete their Testing our Sound Signal Device handout. Students are instructed that all members will make observations during the testing process. (Lesson 9, Teacher Guide)

Claimed Element: INV-P5: Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. Claimed in Lesson 9. Evidence was found in the lesson. Examples include:

- Lesson 9, Explore Section, Step 4: "Review the testing plan. As needed (particularly if your class is starting a new science session), invite students to turn and talk with a partner to review their plans to test their designs, referring to the Device Gotta-Have-It Checklist (continue to refer to slide E). Introduce the Testing our Sound Signal Device handout. Then display slide F and use it (or a paper copy) to show students the Testing our Sound Signal Device handout. Support students in noticing how their ideas for what to observe and how to test are captured in this handout! Continue to connect how the parts of the handout coordinate with our Device Gotta-Have-It Checklist." "Show students how Part A coordinates with our checklist item about making sound by providing an opportunity to test if our device makes sound and providing a place to record our observations using our senses. Show students how they can circle if they hear the sound and if they see or feel vibrations, as well as a place to write the part of their device that moves or vibrates." "Show students how Part B coordinates with our checklist item about sound traveling across the classroom. Show students how to circle a thumbs up or a thumbs down to show whether they can hear the device close by and/or across the classroom. Briefly decide with students where in the classroom would count as "nearby" the device (ex: standing next to it) and where would count as "across the classroom." Point out the boxes on the handout where students can draw and write their observations as they test their devices." and "Remind students how we are gathering data to help us know how well our sound signal devices work to solve the engineering problem of needing a way to communicate a good news message across the classroom." (Lesson 9, Teacher Guide)

AQDP: Asking Questions and Defining Problems

Claimed Element: AQDP-P3. Define a simple problem that can be solved through the development of a new or improved object or tool. Claimed in Lessons 6. Evidence was found in the claimed lesson, examples include:

- Lesson 6, Explore Section, Step 5: "Use students' questions to co-construct a Lesson Set 2 Question similar to, How can we make sound signal devices to communicate a good news message across our classroom? (refer to slide J). Suggest to students how exciting it is that - as we answer this question - we will be able to use ideas we have already figured out in this unit about how devices make and send sound signals!" (Lesson 6, Teacher Guide)

DATA: Analyzing and Interpreting Data

Claimed Element: DATA-P1. Record information (observations, thoughts, and ideas). Claimed in Lessons 1, 2, and 3. Evidence was found in claimed lessons, examples include:

- Lesson 1, Explore Section, Step 4: Play and Explore, students investigate handbells and complete the Bell Sound Observations and Sounds worksheet. As they do so, they are engaging with the claimed element. "Explore using handbells to make sound. Arrange students into groups with one handbell per group and distribute materials so that each student has a Bell Sound Observations and Ideas handout and a writing utensil." "Share a notice. Before transitioning to the next whole class discussion, invite students to show their Bell Sound Observations and Ideas handouts to a partner and share one noticing that they drew or wrote." (Lesson 1, Teacher Guide)
- Lesson 2, Explore Section, Step 5: Carry Out and Investigation, students investigate with the triangle and record their observations on the Triangle Investigation Observations handout. "Introduce the Triangle Investigation Observations handout. Show students a blank Triangle Investigation Observations handout (refer to slide G) and help them notice how their decisions about what observations to make (hearing, feeling, seeing), when to make them (when the triangle is not making sound and when it is making sound), and how to record them (writing, drawing) are all represented. As you overview the Triangle Investigation Observations handout with students, reference the Triangle Investigation Plan to reaffirm how their decisions shaped what they will do next." (Lesson 2, Teacher Guide)
- Lesson 3, Explore Section, Step 3: Students investigate with a series of different instruments and record their observations on the Instruments Investigation Observations handout. "Students will use each instrument and make observations by looking and feeling for what is happening with the rubberband of the box guitar, the beads inside the shaker, and the metal disks on the sides of the tambourine. They should make observations when there is sound and when there is not." "Support students in noticing how their ideas for what to observe and how to record observations are captured in this handout! Ensure students notice the two columns to record observations when the instrument is making sounds ("Hear sound") and when it is not making sounds ("Do not hear sound"). Ensure students know how to circle the observations they make (seeing movement or feeling movement) for each instrument when it is making sound and when it is not making sound." "Once students have completed moving through the stations (making observations for each instrument), invite them to find a different classmate and compare their recorded observations on their Instruments Investigation Observations handouts." (Lesson 3, Teacher Guide)

Claimed Element: DATA-P2: Use and share pictures, drawings, and/or writings of observations. Claimed in Lesson 2. Evidence was found in all claimed lessons. Examples include:

- Lesson 2, Explore Section, Step 4: "Continue the discussion about making observations. Once students have agreed on how to use the triangle to make sound, continue the Think, Pair, Share discussion to plan how to make observations. Record students' decisions under the prepared heading "Make and Record Observations" on the Triangle Investigation Plan." and "Continue the discussion about recording our observations. Continue the Think, Pair, Share discussion to have students collaboratively plan how to record their observations during their investigation. Add these ideas to the Triangle Investigation Plan under the heading "Make and Record Observations." (Lesson 2, Teacher Guide)

Claimed Element: DATA-P3: Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. Claimed in Lesson 2, 3, 4, and 6. Evidence was found in all claimed lessons. Examples include:

- Lesson 2, Explore Section, Step 6: "Gather students in shared meeting space and recall that we found out how to make and record observations from the Scientists Make and Record Observations book. Remind students that the first graders shared the observations they recorded to help them answer their scientific question. Have students briefly turn and talk about how we can use the observations we recorded to try and answer our lesson question, How does a triangle make sound? (refer to slide H). Look and listen for ideas to share and compare our observations, like the first graders in the book, to figure out how the triangle makes sound." (Lesson 2, Teacher Guide)
- Lesson 3, Explore Section, Step 4: Teacher guidance is provided to create a class data table where all of the student observations are shared and tallied. Students share their data and then engage in a classroom discussion about their data and cause/effect relationships. As they do so, they are engaging with the claimed SEP, but they are focusing more on relationships than patterns. "Support students in noticing that our Instruments Investigation data table shows us a pattern; a pattern is something that happens over and over again. Point out to students that our data show, over and over again, there was evidence of the instrument moving when we heard a sound. Invite students to turn and talk with a partner about this idea. For every instrument, what do you notice about our data in the "Hear sound" columns? Invite a few students to share their noticing out loud and/or by coming up to the Instruments Investigation data table to point to all of the tally marks in the "Hear sound" columns. Ensure students are supported in noticing the visual representation of tally marks shows us a pattern in our data; when we see the same thing over and over we can call it a pattern in our data. You may choose to repeat this question and experience using the "Do not hear sound" columns, as well, to show the absence of tally marks is also a pattern in our data." (Lesson 3, Teacher Guide)
- Lesson 4, Explore Section, Step 4: Students engage in a class discussion about their observations during the Sprinkles investigation. As a part of that discussion, students are asked, "What do you notice about our data in the "make sound" columns? "What do you notice about our data in the "Do not make sound" columns?", What did we observe when the drum was not making sounds?, and "What pattern is there in our data? (A pattern is something that happens over and over.)" As they respond to these prompts, they are engaging with the claimed element. "Engage students in a whole class discussion making sense of class data. Have investigation materials available (drum with drumstick, prepared tube) to support students in describing experiences and observations. You and your students may decide to count the data in each of the categories in the data table. This may be helpful if students need extra support analyzing the data to make sense of patterns." Prompts include: What pattern is there in our data?" "Confirm the pattern in students' observations. Confirm with students we observed movement/vibration when we made sounds with the drum. Across all of our observations, there is a pattern of seeing and feeling movement or vibration in the tube when there was sound from the drum, but not when there was no sound from the drum." (Lesson 4, Teacher Guide)

- Lesson 5, Synthesize Section, Step 3: Develop a model, using the Sound Signal Model handout, students develop a model to explain how the clocktower makes and sends sound messages. Guidance is provided to "Encourage students to refer to the class Gotta-Have-It Checklist, Our Growing Ideas chart, the Initial Class Model, and the Word Wall as resources while they individually develop their models....to support students in using evidence from their investigations to inform their models." (Lesson 5, Teacher Guide)
- Lesson 6, Explore Section, Step 2: "Prepare to share and discuss about the messages. Ensure Our Examples chart is available for you/students to record the category labels (types of message) for referencing later. During the following discussion, students should notice that, although sound signals are used to communicate specific messages, these can be organized in different ways/into different categories. Additionally, students may notice that people sometimes use a sound signal device (ex: whistle) to send more than one type of message. The primary purpose of this discussion is to support students in noticing patterns (categories) in the Sound Signal Device Cards (data) so that they can use these patterns (the different types of messages that people use sound signal devices to send) later." "Facilitate a discussion about the messages. Use the prompts below to engage in a class discussion in which students share the categories (labels) they organized cards into and the sound signal devices they put in each category. Invite a pair to share a category, and then invite other pairs to raise their hands to show that they, too, had the same (or similar) category. As students share, record a list of categories (ex: attention/warning, good news, "I'm here," time) by adding students' labels and/or drawings (or inviting students to do so) to Our Examples chart. Additionally, you may choose to use the class set of Sound Signal Device Cards to represent students' groupings on the whiteboard or a class chart." "Pause to notice patterns. Notice with students how - over and over - we raised our hands to indicate that we, too, organized sound signal devices onto a placemat that all sent a message like "I'm here!" That suggests we found a pattern in the data. Remind students that a pattern is something that happens over and over again. When scientists have many data - like all the different Sound Signal Device Cards - they can organize that data into categories or groups. These categories are one way to see what happens over and over again; they show us patterns in the data." (Lesson 6, Teacher Guide)

Claimed Element: DATA-P5: Analyze data from tests of an object or tool to determine if it works as intended.
Claimed in Lesson 9. Evidence was found in the claimed lesson. Examples include:

- Lesson 9, Explore Section, Step 5: "Analyze and Interpret Data, students engage in a class discussion, using their observations from the Testing our Sound Signal Device handouts, to determine how well their designs worked. Our Growing Ideas chart, the Initial Class Model, and the Word Wall as resources while they individually develop their models....to support students in using evidence from their investigations to inform their models." "Revisit the Device Gotta-Have-It checklist. Ensure students can view the Device Gotta-Have-It Checklist (refer to slide H) and invite students to turn and talk with a partner about how their Testing our Sound Signal Device handouts represent the "gotta-have-its" - the things we decided our sound signal devices had to have or be able to do. Invite a few students to share ideas out loud, which should include having a part that moves/vibrates to make sound and sending its sound signal across the classroom (and may include an additional class-specific gotta-have-it)." "Prepare to use our evidence. Suggest that now we can use Matias and his team as an example for how we can make sense of our own data! Have students point to their completed Testing our Sound Signal Device handouts to show where they recorded evidence about their sound signal device making sound by having a part or parts that move or vibrate (Part A). Then have them point to show where they recorded evidence about their sound signal device sending a sound signal that traveled across the classroom (Part B)." "Turn-and-talk with engineering partners. Invite students to turn and talk with their engineering partner, using their completed Testing our Sound Signal Device handouts as evidence for how well their sound signal devices worked." (Lesson 9, Teacher Guide)

CED: Constructing Explanations and Designing Solutions

Claimed Element: CEDS-P2: Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. Claimed in Lesson 7 and 8. Evidence was found in claimed lessons. Examples include:

- Lesson 7, Explore Section, Step 3: "Use students' suggestions for gathering information using objects that make sound to connect the class to familiar instruments from Lesson Set 1 and briefly point out the instruments (handbell, triangle with striker, box guitar, shaker, tambourine, drum with drumstick). Explain that students will work in pairs focusing on the parts of the instrument and how those parts help it make sound. This information can help us plan how our own sound signal devices can make sound! Pair students together and invite each pair to pick an instrument and spend a few minutes examining it and discussing, using the following prompts (refer to slide D)" (Lesson 7, Teacher Guide)
- Lesson 8, Explore Section, Step 3: Students return to their collaborative "Engineering Partnership Design." Students then complete the "Materials Menu" to gather their materials and begin building their sound signal device. As students build, continue to support them in using their drawn designs and the Device Gotta-Have-It Checklist as a guide (refer to slide G). While partnerships build their sound signal devices, engage pairs in discussions using the prompts below." Prompts include: What parts/materials does your sound signal device have?" "Which parts/materials are you using in your device to make and send a sound signal? How does it work?" (Lesson 8, Teacher Guide)

Claimed Element: CEDS-P3: Generate and/or compare multiple solutions to a problem. Claimed in Lesson 7, 8, 9, and 10. Evidence was found in all claimed lessons. Examples include:

- Lesson 7, Synthesize Section, Step 5: Students work collaboratively with a partner to discuss their individual designs and then to generate an "Engineering Partnership Design" "Organize students into the engineering partnerships they will keep through Lesson 10. Discuss with students that when engineers work together, it involves agreeing and disagreeing with one another to help their designs get better. Explain that students will be making one sound signal device so they will need to decide what they should include from each of their individual designs that will work well to solve the problem of wanting to communicate good news across the classroom. Give students directions for meeting with their engineering partners (refer to directions on slide I): 1. Look at our Device Gotta-Have-It Checklist. 2. Each share our current drawn designs. 3. Decide what parts of each design to include and circle those parts. 4. Draw the engineering partnership's sound signal device design." (Lesson 7, Teacher Guide)
- Lesson 8, Explore Section, Step 3: Students return to their collaborative "Engineering Partnership Design". Students generated this collaborative design in Lesson 7. "Partway through this Explore, gather students' attention and invite them to pause their building and to review their drawn designs. Invite students to briefly talk with their engineering partner about how their built design is and is not like their drawn designs. If possible, invite students to share some of their experiences to explain how and why their built design is the same as or different from their drawn designs. Alternatively, you may have students raise their hands to show one experience (same) and the other (different). Use this opportunity to assure students that in engineering, we use our plans to prepare and get started, and we also sometimes need to make changes as we work. That is OK!" "Revise drawn designs. As groups finish building, remind them that, in engineering, it is common to have our designs change once we start building. Invite students to compare their built design to their drawn design on their Sound Signal Device Design handouts (Part B. Engineering Partnership Design). Using a different color or kind of writing utensil, invite engineering partnerships to revise their drawn designs to represent their built design. This might be through circling what is the same; putting x's over what they did not include in their built design; and/or drawing and labeling any new parts or materials in their built design. Encourage students to use this opportunity to reflect on how they likely improved on their design as they were building it!" (Lesson 8, Teacher Guide)

- Lesson 9, Explore Section, Step 5: Analyze and Interpret Data, "Support students in noticing how their ideas for what to observe and how to test are captured in this handout! Continue to connect how the parts of the handout coordinate with our Device Gotta-Have-It Checklist." "Show students how Part A coordinates with our checklist item about making sound by providing an opportunity to test if our device makes sound and providing a place to record our observations using our senses. Show students how they can circle if they hear the sound and if they see or feel vibrations, as well as a place to write the part of their device that moves or vibrates. Show students how Part B coordinates with our checklist item about sound traveling across the classroom." "Remind students how we are gathering data to help us know how well our sound signal devices work to solve the engineering problem of needing a way to communicate a good news message across the classroom." (Lesson 9, Teacher Guide)
- Lesson 10, Synthesize Section, Step 5: "Continue the discussion about solutions. Now suggest to students that we focus on the part of the question related to sound signal devices that communicate a good news message across the classroom. During this discussion, encourage students to refer to their Device Gotta-Have-It Checklist (refer to slide H). Invite engineering partnerships to talk with each other first, then invite a few students to share ideas as a class. Welcome students in pointing to and using their built sound signal devices as resources during this discussion." Prompts include: "Let's compare our sound signal devices! What is something that makes all of our devices the same?" "What is different about the parts of our devices?" "All our devices are solutions. How do they all work to solve our engineering problem?" (Lesson 10, Teacher Guide)

INFO: Obtaining, Evaluating, and Communicating Information

Claimed Element: **INFO-P1. Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).** Claimed in Lessons 1, 3, and 4. Evidence was found in all claimed lessons. Examples include:

- Lesson 1, Connect Section, Step 2: Students listen to the book, What's that Sound. Students then respond to a series of discussion prompts about the book. As they do so, they are obtaining scientific evidence about the natural and designed world. "Read the What's That Sound? book and make connections. As you read the book and play the audio files, provide opportunities for students to make guesses in response to the page-based questions: "What's that sound?" and "Why is that ...?" Cue students to use the audio and the images in the book as they answer each question. Additionally, after each example, use the prompts below to encourage students to make connections to other experiences they have had." (Lesson 1, Teacher Guide) This is an example of students engaged in a portion of the claimed element, Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).
- Lesson 2, Connect Section, Step 3: Students listen to the book, "Scientists Make and Record Observations." Students then respond to a series of discussion prompts about key ideas within the reading. As they do so, they are obtaining scientific and/or technical evidence that movement is required for sound to occur. (Lesson 2, Teacher Guide) This is an example of students engaged in a portion of the claimed element, Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).
- Lesson 3, Connect Section, Step 5: Students respond to a series of discussion prompts about key ideas within the reading. As they do so, they are obtaining scientific and/or technical evidence that movement is required for sound to occur. "Introduce the Make Some Noise! book (refer to slide I) by pointing to and reading the title aloud. Remind students that we are using this book to further help us address our lesson question, How do other objects make sound? since our investigations so far have only provided evidence of instruments making sound." (Lesson 3, Teacher Guide)) This is an example of students engaged in a portion of the claimed element, read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).

- Lesson 4, Connect Section, Step 5: Read a Book; students are read the "Feeling Vibrations in the Community" book. Students then respond to a series of discussion prompts about key ideas within the reading. As they do so, they are obtaining scientific and/or technical evidence that movement is required for sound to occur. Consequently, they are engaging in the following portion of the claimed element, Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s). Remind students that we are using this book to gather more examples of what happens when sounds are received by connecting to other people's experiences and observations." "Reconfirm cause-and-effect relationships. Reread the introductory question on page 1 of the Make Some Noise! book, "Did you know that vibrations are related to sound?" and invite students to turn and talk about how vibrations and sound are related." (Lesson 4, Teacher Guide)

Claimed Element: **INFO-P4. 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.** Claimed in Lesson 10. Evidence was found in all claimed lessons. Examples include:

- Lesson 10, Synthesize Section, Step 5: "To close the unit, invite students to communicate good news across the classroom by making a signal using their sound signal devices! You could do this by inviting engineering partnerships to move all around the room and have students make their signal one partnership at a time or even all together for a cacophony of sound signals! You may also want to invite students' suggestions for how to use some or all of the sound signal devices in the classroom for times when there is good news available to share." (Lesson 10, Teacher Guide)

Criterion-Based Suggestions for Improvement

- When students are engaged in a portion of an element, ensure the portion that is used/not used is clearly identified. (INFO-P1)

Rating for Criterion: DCI — EXTENSIVE

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

The reviewers found **extensive** evidence that the materials provide opportunities to develop and use identified elements of the DCIs. Students have opportunities to develop and use specific elements of the DCIs listed as key learning objectives in service of making sense of the phenomena of ringing clock towers and designing a device that will communicate news across the classroom.

PS4.A-P1 Wave Properties

Claimed Element: **PS4.A-P1 Sound can make matter vibrate, and vibrating matter can make sound.** Claimed in Lessons 1, 2, 3, 4, and 5. Evidence was found in all claimed lessons. Examples include:

- Lesson 1, Connect Section, Step 4: Students conduct an investigation using handbells and complete the Bell Sound Observations and Ideas worksheet. Students then have a class discussion where they add to their "Notice/Wonder" chart. As they do so, they are engaging with the claimed DCI. (Teacher Guide, Lesson 1)

- Lesson 2, Explore Section, Step 6: Making Sense of Data, students engage in a class discussion to share observations that they collected during the triangle investigation. Students are asked, "What did you observe when the triangle was making sound?" and "What happened when the triangle stopped making the sound?" (Lesson 2, Teacher Guide) As they respond, they are engaging with the claimed DCI.
- Lesson 3, Explore Section, Step 3: "Review the Instrument Investigation plan. As needed (particularly if your class is starting a new science session), invite students to turn and talk with a partner to review their Instruments Investigation Plan (refer to slide F). Students will use each instrument and make observations by looking and feeling for what is happening with the rubberband of the box guitar, the beads inside the shaker, and the metal disks on the sides of the tambourine. They should make observations when there is sound and when there is not." "Ensure students notice the two columns to record observations when the instrument is making sounds ("Hear sound") and when it is not making sounds ("Do not hear sound"). Ensure students know how to circle the observations they make (seeing movement or feeling movement) for each instrument when it is making sound and when it is not making sound." (Lesson 3, Teacher Guide)
- Lesson 3, Connect Section, Step 5: Literacy Supports, "Students are introduced to the science term "vibration" on page 4 of the Make Some Noise! book, defined as "small, fast movements back and forth." Encourage students to connect this science term to observations they have made during their investigations. Additionally, encourage students to make connections to feeling vibrations in their everyday lives." (Lesson 3, Teacher Guide)
- Lesson 4, Synthesize Section, Step 6: "Continue the discussion about students' evidence. Remind students that in science we always use evidence to support our claims. Reiterate that evidence is the observations, data, or information that helps answer the scientific question. In this lesson, we have data from our investigation that we recorded on our Instruments Investigation data table, as well as information we gathered from reading the Make Some Noise! book. As students share ideas, continue to support them in responding to and building off of one another while adding ideas and images to the column titled, 'How did we figure it out?' " Prompts include: "What did we do that helped us figure that out? What evidence do we have to support a claim that vibrations cause sound?" (Lesson 4, Teacher Guide)
- Lesson 5, Connect Section, Step 5: "Discuss how the object makes and sends sound. Using 1-2 examples, invite students to discuss how the object makes and sends sound, reminding students that this is our Lesson Set Question: How do objects make and send sound signals?!. The purpose of this discussion is to help students apply what they have figured out about the patterns of vibrations causing sound and sound causing vibrations to other objects that make sound. Therefore, it is okay if students are unfamiliar with the sound-making mechanism of an object (ex: a whistle, a timer on a computer or phone). Student responses that indicate that they can apply what they have figured out about the patterns will include "something vibrates to make sounds" and "sounds travel and we can hear and sometimes even see/feel vibrations caused by them")." Prompts include: "What causes (this object) to make sound?" (Lesson 5, Teacher Guide)

PS4.C Information Technologies and Instrumentation

Claimed Element: **PS4.C-P1 People use a variety of devices to communicate (send and receive information) over long distances** Claimed in Lessons 1, 5, 6, 7, 8, 9, and 10. Evidence was found in all claimed lessons. Examples include:

- Lesson 1, Connect Section, Step 1: "Connect to communication. Remind students that just earlier we described different experiences with sounds that meant different things. Share an example, such as "(student) shared that the sound they heard meant that school is starting." Introduce how this suggests that people use these sounds to communicate or share information." "Share initial ideas about what is being communicated. Invite students to share ideas about what they think people are communicating through the sound of the clocktower. Consider

having students use hand signals to show agreement (e.g., "Thumbs up if you agree."). This will provide a way for all students to participate in this discussion while also providing an experience that students can relate to later in this Connect, when the word "signal" is introduced. At this point, all ideas are welcome; it is not necessary that students surface the "right" ideas (the sound is used to get people's attention and tell people the time)." (Lesson 1, Teacher Guide)

- Lesson 1, Connect Section Step 2: Read a Book, students listen to the book, "What's that sound?" and its accompanying digital files of sounds. Students then share experiences with what is being communicated by that sound. As they do so, they are engaging with the claimed DCI. However, they have previously been told by the teacher that sounds are used to communicate and they are not actually figuring out this science idea but are instead confirming what they have been told. (Lesson 1, Teacher Guide)
- Lesson 5, Connect Section Step 5: "Prepare to add to Our Examples chart. Ensure students can see Our Examples chart (refer to slide H) and suggest that we can add objects and their sound signals that we have identified from our in- and out-of-school communities and explain how they make and send their sound signals" "Group students into pairs and ensure each pair has several (2-4) sticky notes and writing utensils. Provide students an opportunity to share and discuss examples they may have from their out-of-school community and/or to find objects that make and send sound signals in the classroom. As student pairs finish adding an object to a sticky note, have them place their example on Our Examples chart." (Lesson 5, Teacher Guide)
- Lesson 6, Explore Section, Step 2: Students organize sound signal cards by the messages that they intend to send. "Invite students to consider what categories we noticed over and over again in our cards (data). Then, use the following prompts to engage students in a discussion related to the patterns in their data." Prompts include: "What patterns do you notice? What are the different messages that people use sound signals to send?" (Lesson 6, Teacher Guide)
- Lesson 7, Explore Section, Step 3: "Develop our Device Gotta-Have-It Checklist. Invite students to turn and talk about what our sound signal devices need to have and be able to do in order to solve our problem of needing a way to share good news messages across our classroom. As they do this, use their ideas and language to write the class' engineering problem onto the prepared, but blank, Device Gotta-Have-It Checklist." "Point out that the Device Gotta-Have-It Checklist will help us as we plan and make our sound signal devices so we can solve our engineering problem of needing a way to communicate good news messages across the class." (Lesson 7, Teacher Guide)
- Lesson 8, Synthesize Section, Step 4: "Take a gallery tour. Use students' suggestions about looking at different examples of built designs to invite students to take a gallery tour, or offer this suggestion if it does not arise from students. In a way that works well for your class, have students briefly travel around the classroom to view their classmates' sound signal devices. Encourage them to notice parts and ways of putting parts together that may be the same or different from their built designs." (Lesson 8, Teacher Guide)
- Lesson 9, Explore Section, Step 5: Analyze and Interpret Data, students engage in a class discussion, using their observations from the Testing our Sound Signal Device handouts, to determine how well their designs worked. Prepare to discuss using evidence from tests. Gather students in a Scientists Circle, inviting students to sit with their engineering partners. Students should have their built sound signal devices and their Testing our Sound Signal Device handouts with them. The purpose of this whole-group discussion is to support students in making sense of and using recorded observations on their Testing our Sound Signal Device handouts as evidence about how well their devices worked." "Revisit the Device Gotta-Have-It checklist. Ensure students can view the Device Gotta-Have-It Checklist (refer to slide H) and invite students to turn and talk with a partner about how their Testing our Sound Signal Device handouts represent the "gotta-have-its" - the things we decided our sound signal devices had to have or be able to do. Invite a few students to share ideas out loud, which should include having a part that moves/vibrates to make sound and sending its sound signal across the classroom (and may include an additional class-specific gotta-have-it)." (Lesson 9, Teacher Guide)

- Lesson 10, Connect Section, Step 4: Share with our classroom community, use their Device Communication Plan handouts to support students as they share their sound signal devices with the class. "Provide an opportunity for students to tour and view all of the class devices. Students will also have their built devices in the final Synthesize, providing an opportunity for comparison during the Consensus Discussion. In a way that works well for your class, gather students' completed Testing our Sound Signal Device handouts from Lesson 9 and their completed Device Communication Plan handouts." (Lesson 10, Teacher Guide)

ETS1.A-P1 Defining Engineering Problems

Claimed Element: **ETS1.A-P1 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.** Claimed in Lessons 6 and 7. Evidence was found in all claimed lessons. Examples include:

- Lesson 6, Explore Section, Step 5: Students are engaging in a classroom discussion about how they can better communicate good news in the classroom. Teacher prompts such as, "How do you think we could use engineering to communicate good news better?" and "How would using a sound signal device help us communicate good news in our classroom better than what we do right now?" "Connect to our classroom. Remind students that when we read the Local School Celebrates National Engineering Week newspaper article, we found out that an engineering problem is something that people want to improve in the world around them. Support students in connecting information from that article to their own classroom by engaging in a brief discussion to identify our engineering problem, define it clearly, and begin to consider how we can use engineering to solve it." "Define our engineering problem. Summarize and restate this discussion using students' suggestions and ideas to define the engineering problem as needing a way to communicate good news across the classroom. The language of your class' engineering problem should reflect students' ideas and goals, so it may be something like, "we don't have a fun way to communicate good news messages across the classroom and we want one so we share good news more often" or "we don't have a quick way of sharing good news to all of our tables and we want to do that to include every classmate." (Lesson 6, Teacher Guide)
- Lesson 7, Synthesize Section, Step 5: "Organize students into the engineering partnerships they will keep through Lesson 10. Discuss with students that when engineers work together, it involves agreeing and disagreeing with one another to help their designs get better. Explain that students will be making one sound signal device so they will need to decide what they should include from each of their individual designs that will work well to solve the problem of wanting to communicate good news across the classroom. Give students directions for meeting with their engineering partners (refer to directions on slide I)" (Lesson 7, Teacher Guide)

ETS1.A-P2 Defining Engineering Problems

Claimed Element: **ETS1.A-P2 Asking questions, making observations, and gathering information are helpful in thinking about problems.** Claimed in Lessons 6 and 7. Evidence was found in all claimed lessons. Examples include:

- Lesson 6, Explore Section, Step 5: "Define our engineering problem. Summarize and restate this discussion using students' suggestions and ideas to define the engineering problem as needing a way to communicate good news across the classroom. The language of your class' engineering problem should reflect students' ideas and goals, so it may be something like, "we don't have a fun way to communicate good news messages across the classroom and we want one so we share good news more often" or "we don't have a quick way of sharing good news to all of our tables and we want to do that to include every classmate." (Lesson 6, Teacher Guide)

- Lesson 7, Navigate Section, Step 7: "Lead a discussion sharing ideas. Ensure students can view the Ideas and Wonders chart (refer to slide K) and engage in a brief discussion to review students' wonders. Invite students to identify what questions they can now answer. In a way that works for your class, mark these (e.g., with a check, underline in a specific color, etc.) Elicit students' continued questions about what they can do next with their sound signal device designs and other questions related to engineers and engineering." (Lesson 7, Teacher Guide)

ETS1.A-P3 Defining Engineering Problems

Claimed Element: **ETS1.A-P3 Before beginning to design a solution, it is important to clearly understand the problem.** Claimed in Lessons 6 and 7. Evidence was found in all claimed lessons. Examples include:

- Lesson 6, Explore Section, Step 5: Students are engaging in a classroom discussion about how they can better communicate good news in the classroom. Teacher prompts such as, "How do you think we could use engineering to communicate good news better?" and "How would using a sound signal device help us communicate good news in our classroom better than what we do right now?" "Confirm with students how a new sound signal device could help us communicate good news with our classmates across our classroom! Then, have students briefly turn and talk using the following prompt to generate questions that will inform co-constructing the Lesson Set 2 Question." Prompts include: "What questions do you have about making a device to help us send a good news message across our classroom?" (Lesson 6, Teacher Guide)
- Lesson 7, Connect Section, Step 2: Students are read the book, "Meet the Engineer: Matias Dermond", which tells them how engineers solve problems. On page 4, students are asked, "What problem are we trying to solve?". Students then return to page 3, where they are asked, "Have we defined our engineering problem? What did we figure out?" "Engage students in an interactive read-aloud. Read pages 1-7, pausing to ask the following questions to connect students' own experiences and the problem of needing a way to communicate good news across the classroom to the information in the book. As you read, use the headings of each section of the Meet the Engineer: Matias Dermond book to help students figure out what we have already done and what we could do next." Prompts include: "What problem did Matias and the team of engineers want to solve?" "What problem are we trying to solve?" "How are these problems similar?" (Lesson 7, Teacher Guide)

ETS1.B-P1 Developing Possible Solutions

Claimed Element: **ETS1.B-P1 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. Claimed in Lessons 7, 8, and 10. Evidence was found in all claimed lessons. Examples include:

- Lesson 7, Explore Section, Step 4: Plan a Design, students use the Sound Signal Device Design handout to generate a model of their device that will "make and send a sound signal". Students continue to revise and design this device collaboratively in step 5. "Draw and write ideas. Encourage students to draw, write, and use labels and other representations (lines, arrows) to explain their ideas. While students draw and write their designs, circulate and use the following prompts to support students in expressing their ideas in their design. If needed, support students in drawing their ideas clearly by demonstrating how the materials can be drawn using familiar two-dimensional lines and shapes; for example, a three-dimensional rubberband can be drawn as a circle or oval." (Lesson 7, Teacher Guide)
- Lesson 8, Explore Section, Step 3, Build a Design, students return to their collaborative "Engineering Partnership Design" models. Students have previously generated these designs individually and then worked collaboratively to generate a combined design. "Invite students to compare their built design to their drawn design on their Sound Signal Device Design handouts (Part B. Engineering Partnership Design). Using a different color or kind of writing

utensil, invite engineering partnerships to revise their drawn designs to represent their built design. This might be through circling what is the same; putting x's over what they did not include in their built design; and/or drawing and labeling any new parts or materials in their built design. Encourage students to use this opportunity to reflect on how they likely improved on their design as they were building it!" (Lesson 8, Teacher Guide)

- Lesson 10, Connect Section, Step 4: Students display their sound signal devices and use their Device Communication Plan handouts to explain how their design works. "Provide an opportunity for students to tour and view all of the class devices. Students will also have their built devices in the final Synthesize, providing an opportunity for comparison during the Consensus Discussion. In a way that works well for your class, gather students' completed Testing our Sound Signal Device handouts from Lesson 9 and their completed Device Communication Plan handouts."(Lesson 10, Teacher Guide)

ETS1.C-P1 Optimizing the Design Solution

Claimed Element: **ETS1.C-P1 Because there is always more than one possible solution to a problem, it is useful to compare and test designs.** Claimed in Lessons 9 and 10. Evidence was found in all claimed lessons. Examples include:

- Lesson 9, Explore Section, Step 3: "Revisit planning and carrying out investigations. Using the information about Matias and his team as a connection, explain how engineers, like scientists, also carry out investigations. Engineers investigate to answer questions about how well their designs work and to learn in what ways their designs work as planned and in what ways they do not. Ask students to recall how they have investigated objects that make sounds in previous lessons (Lesson Set 1) by displaying slide D and using the following prompts. The purpose of this discussion is to support students in using their experiences investigating instruments to guide them in making a plan to test their built sound signal devices." (Lesson 9, Teacher Guide)
- Lesson 10, Connect Section, Step 4: Students display their sound signal devices and use their Device Communication Plan handouts to explain how their design works. (Lesson 10, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

Rating for Criterion: CCC **EXTENSIVE**

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

The reviewers found **extensive** evidence that the materials provide opportunities to develop and use specific elements of the CCCs. In the Unit Front Matter, Cause and Effect (elements P1 and P2) and Structure and Function (element P1) are identified as intentionally developed. Materials require students to use grade-level CCC elements CE-P2—Simple tests can be designed to gather evidence to support or refute student ideas about causes; CE-P1—Events have causes that generate observable patterns; and SF-P1—The shape and stability of structures of natural and designed objects are related to their function(s). However, the materials do not support students to fully engage with the entire CCC element CE-P1. Student thinking is primarily focused on the cause-and-effect portion without consistently addressing the patterns portion of CE-P1—Events have causes that generate observable patterns.

CE: Cause and Effect

Claimed Element: **CE-P1: Events have causes that generate observable patterns.** Claimed in Lessons 1, 3, 4, 5, 7, 8, and 10. Evidence was found in all claimed lessons. Examples include:

- Lesson 1, Explore Section, Step 4: "Prepare to explore with handbells. Tell students that you have enough handbells that each small group will be able to explore making sounds with one. Remind students that our lesson set question is How do objects make and send sound signals? Ask students what they think they should pay attention to as they explore the handbells that will help them answer that question. Anticipate that students will suggest touching the bell, looking at the bell, holding the bell, shaking/moving the bell, trying to make the bell ring or bong, etc." (Lesson 1, Teacher Guide) As students do so, they focus on what causes the bells to make sound rather than identifying that these causes generate patterns that they can use to support their thinking. Consequently, they are engaging with the following K-2 element of Cause and Effect, Simple tests can be designed to gather evidence to support or refute student ideas about causes.
- Lesson 3, Explore Section, Step 4: "Support students in noticing patterns. Support students in noticing that our Instruments Investigation data table shows us a pattern; a pattern is something that happens over and over again. Point out to students that our data show, over and over again, there was evidence of the instrument moving when we heard a sound. Invite students to turn and talk with a partner about this idea." "Ensure students are supported in noticing the visual representation of tally marks shows us a pattern in our data; when we see the same thing over and over we can call it a pattern in our data. You may choose to repeat this question and experience using the "Do not hear sound" columns, as well, to show the absence of tally marks is also a pattern in our data."(Lesson 3, Teacher Guide).
- Lesson 4, Explore Section, Step 4: "Confirm the pattern in students' observations. Confirm with students we observed movement/vibration when we made sounds with the drum. Across all of our observations, there is a pattern of seeing and feeling movement or vibration in the tube when there was sound from the drum, but not when there was no sound from the drum." (Lesson 4, Teacher Guide)
- Lesson 5, Connect Section, Step 5: "Using 1-2 examples, invite students to discuss how the object makes and sends sound, reminding students that this is our Lesson Set Question: How do objects make and send sound signals?" The purpose of this discussion is to help students apply what they have figured out about the patterns of vibrations causing sound and sound causing vibrations to other objects that make sound." "Student responses that indicate that they can apply what they have figured out about the patterns will include "something vibrates to make sounds" and "sounds travel and we can hear and sometimes even see/feel vibrations caused by them." (Lesson 5, Teacher Guide)
- Lesson 7, Explore Section, Step 3: Gather More Information, students revisit the instruments they previously investigated. Students are told to make observations to answer the following prompts, " What parts do you notice? How do they help the instrument make sound? What ideas does this give you about how to make a sound signal device?" "Revisit instruments. Use students' suggestions for gathering information using objects that make sound to connect the class to familiar instruments from Lesson Set 1 and briefly point out the instruments (handbell, triangle with striker, box guitar, shaker, tambourine, drum with drumstick). Explain that students will work in pairs focusing on the parts of the instrument and how those parts help it make sound. This information can help us plan how our own sound signal devices can make sound! Pair students together and invite each pair to pick an instrument and spend a few minutes examining it and discussing, using the following prompts (refer to slide D)" (Lesson 7, Teacher Guide). As they do so, they are implicitly engaging with the claimed CCC. Students are not prompted to use patterns to support their sensemaking.
- Lesson 8, Synthesize Section, Step 4: "Take a gallery tour. Use students' suggestions about looking at different examples of built designs to invite students to take a gallery tour, or offer this suggestion if it does not arise from students. In a way that works well for your class, have students briefly travel around the classroom to view their

classmates' sound signal devices. Encourage them to notice parts and ways of putting parts together that may be the same or different from their built designs." (Lesson 8, Teacher Guide). While students are prompted to notice similarities and differences in their designs, they are not prompted to recognize that all of the successful sound signal devices have causes that have generated patterns that they can then use to support their sensemaking.

- Lesson 10, Synthesize Section, Step 5: "Continue the discussion about solutions. Now suggest to students that we focus on the part of the question related to sound signal devices that communicate a good news message across the classroom. During this discussion, encourage students to refer to their Device Gotta-Have-It Checklist (refer to slide H). Invite engineering partnerships to talk with each other first, then invite a few students to share ideas as a class. Welcome students in pointing to and using their built sound signal devices as resources during this discussion." Prompts include: "Let's compare our sound signal devices! What is something that makes all of our devices the same?" (Lesson 10, Teacher Guide) While students are prompted to notice similarities and differences in their designs, they are not prompted to recognize that all of the successful sound signal devices have causes that have generated patterns that they can then use to support their sensemaking.

CE: Cause and Effect

Claimed Element: CE-P2: Simple tests can be designed to gather evidence to support or refute student ideas about causes. Claimed in Lessons 2, 3, 5, 9, and 10. Evidence was found in all claimed lessons. Examples include:

- Lesson 2, Synthesize Section, Step 7: "Connect students' claim to cause-and-effect. Summarize for students that their claim and evidence suggest they have figured out what causes a triangle to make sound. A cause explains why something happens. And the effect explains what happened. Use the following prompts to briefly connect students' claim and evidence to a triangle-specific cause-and-effect relationship." Prompts include: "How does the triangle make sound? What are we saying causes its sound?" "What was the effect when the triangle stopped moving?" (Lesson 2, Teacher Guide)
- Lesson 3, Explore Section, Step 3: "Introduce the Instruments Investigation Observations handout. Display slide G and use it (or a paper copy) to show students the Instruments Investigation Observations handout. Support students in noticing how their ideas for what to observe and how to record observations are captured in this handout! Ensure students notice the two columns to record observations when the instrument is making sounds ("Hear sound") and when it is not making sounds ("Do not hear sound"). Ensure students know how to circle the observations they make (seeing movement or feeling movement) for each instrument when it is making sound and when it is not making sound." (Lesson 3, Teacher Guide)
- Lesson 5, Connect Section, Step 5: "Using 1-2 examples, invite students to discuss how the object makes and sends sound, reminding students that this is our Lesson Set Question: How do objects make and send sound signals?!. The purpose of this discussion is to help students apply what they have figured out about the Student responses that indicate that they can apply what they have figured out about the patterns will include "something vibrates to make sounds" and "sounds travel and we can hear and sometimes even see/feel vibrations caused by them")." Prompts include: "What causes (this object) to make sound?" (Lesson 5, Teacher Guide)
- Lesson 9, Explore Section, Step 4: "Test sound signal devices. Organize engineering partnerships together into groups of 4 to test each partnership's sound signal devices, making sure each team has their built device from Lesson 8. Ensure each student has their own Testing our Sound Signal Device handout and writing utensil to record their observations. Circulate and use questions like the ones below to support students in using their observations as evidence to determine if their device works as planned.." Questions include: "Does your device make sound?" "What is your evidence?" "Does your device send a signal across the classroom? What is your evidence?"(Lesson 9, Teacher Guide)

- Lesson 10, Synthesize Section, Step 3: "Introduce the Device Communication Plan handout. Display slide F and use it (or a paper copy) to show students the Device Communication Plan handout. Review directions with students, showing them where to draw and write to explain how your device works. Tell students how drawing and writing our ideas about what we want to share helps us prepare to present to our classmates. Then support students in noticing how their ideas for what to share and how to share it are captured on the back of the handout! Briefly review this information, continuing to connect how the parts of the handout coordinate with our Device Gotta-Have-It Checklist. Finally, show students the last column so that partnerships can decide who is going to share about each "gotta-have-it." Remind students how communicating information about our designs is an important part of engineering, and one way to work well together as a partnership is to decide who will be responsible for different tasks." "Complete Device Communication Plan handouts. As students draw, write, and otherwise prepare for their presentations, engage in individual conversations with the purpose of supporting students in using what they have figured out about engineering sound signal devices to prepare to communicate with their classmates. Consider using questions like the ones below." Prompts include: "What would you or your partner like to share about the part/s of your device that make sound? How will you do that?" (Lesson 10, Teacher Guide

SF: Structure and Function

Claimed Element: **SF-P1: The shape and stability of structures of natural and designed objects are related to their function(s).** Claimed in Lessons 1, 4, 7, 8, 9, and 10. Evidence was found in all claimed lessons. Examples include:

- Lesson 1, Explore Section, Step 4: "An important lens for making sense of designed objects is considering how their structure is related to their function. Through this discussion comparing the bells in the clocktower to handbells used in the classroom, students have their first opportunity to consider this relationship (without naming it)." (Lesson 1, Teacher Guide)
- Lesson 4, Explore Section, Step 2: "Show students a prepared tube and invite students to comment on how it is like our ears. How is this prepared tube like our ears? Invite a few students to share with the whole class. Students may notice the tube's curved, o- or c-shape, particularly as they observe while gesturing (cupping a hand around the back of their ear in a c-shape, as described in the Navigate). Students' hands in this c-shape are likely to be very similar to the curved circular opening of the tube. Students may also connect the ear hole or canal to the tube's shape." (Lesson 4, Teacher Guide)
- Lesson 7 Explore Section, Step 3: "Revisit instruments. Use students' suggestions for gathering information using objects that make sound to connect the class to familiar instruments from Lesson Set 1 and briefly point out the instruments (handbell, triangle with striker, box guitar, shaker, tambourine, drum with drumstick). Explain that students will work in pairs focusing on the parts of the instrument and how those parts help it make sound. This information can help us plan how our own sound signal devices can make sound! Pair students together and invite each pair to pick an instrument and spend a few minutes examining it and discussing, using the following prompts (refer to slide D)" Prompts include: "What parts do you notice? How do they help the instrument make sound?" "What ideas does this give you about how to make a sound signal device?" (Lesson 7, Teacher Guide)
- Lesson 8, Explore Section, Step 3: "Support partnerships in building. As students build, continue to support them in using their drawn designs and the Device Gotta-Have-It Checklist as a guide (refer to slide G). While partnerships build their sound signal devices, engage pairs in discussions using the prompts below." Prompts include: "What parts/materials does your sound signal device have?" "Which parts/materials are you using in your device to make and send a sound signal? How does it work?" "Are there parts/materials in your build device that have a purpose besides making sound?" (Lesson 8, Teacher Guide)

- Lesson 9, Explore Section, Step 4: "Test sound signal devices. Organize engineering partnerships together into groups of 4 to test each partnership's sound signal devices, making sure each team has their built device from Lesson 8. Ensure each student has their own Testing our Sound Signal Device handout and writing utensil to record their observations. Circulate and use questions like the ones below to support students in using their observations as evidence to determine if their device works as planned.." Questions include: "Does your device make sound?" "What is your evidence?" "What part/material is making sound? How does that work?" (Lesson 9, Teacher Guide)
- Lesson 10, Synthesize Section, Step 3: "Students have now been using structure and function as a lens for making sense of engineering their sound signal devices across multiple lessons. Students should be able to explain how their devices work, including how well they solve the engineering problem, by considering how materials and parts function together. Students may do this by pointing to or manipulating their built designs, through drawing, labeling, and writing, and/or by using oral language." (Lesson 10, Teacher Guide)

Students have opportunities to use two CCCs simultaneously during sensemaking, for example:

- **PAT-P1:** In addition to CE, PAT-P1 was also used in sensemaking in Lessons 3 and 4.
  - Lesson 3, Matrix, "Students observe the cause-and-effect pattern of movement (vibrations) causing sound as they analyze data from their instruments investigation. Using these observations and additional information in their Make Some Noise! text, students use this pattern to describe how all sounds are caused by vibrating objects/materials."
  - Lesson 4, Matrix, "Students identify patterns across observations when they analyze the Sprinkles Investigation Data Table. These patterns are used as evidence to support claims about what happens when sounds are received (we hear them and we sometimes see or feel something moving)."

Criterion-Based Suggestions for Improvement

- Consider having teachers use explicit CCC language when working with their students so that students (and teachers) are aware that they are applying the CCC to deepen their understanding of the core ideas, and that CCCs can be used in other sensemaking contexts.
- Consider clarifying when students are expected to apply the entire CCC element or a portion of the element. For example, considering the CCC **CE-P1—Events have causes that generate observable patterns**, when is the focus on events having causes? And when are students expected to extend that understanding to patterns?

I.C. Integrating the Three Dimensions

EXTENSIVE

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

The reviewers found **extensive** evidence that student sensemaking of phenomena and designing solutions requires student performances that integrate elements of the SEPs, CCCs, and DCIs. In the unit, students are expected to explain phenomena and design a solution to a problem, which requires them to use grade-appropriate elements of the three dimensions simultaneously. The three dimensions are not used in isolation. In most activities in the unit, students integrate the elements in service of figuring out the relationship between vibrations and sound and when applying their understanding to the design of a device that can be used to share good news across the classroom.

Student learning is integrated. Throughout the unit, students engage in three-dimensional tasks to help explain phenomena.

- Lesson 1, Synthesize Section, Step 5: Handout Bell Sound Observations and Ideas, "In the box below, use drawings and words to show how you think a bell makes sound." Students integrate the use of the elements when they use their observations and ideas to co-create an initial model in a class discussion in the three dimensions: **CE-P1 Events have causes that generate observable patterns, 1-PS4.A1 PS4.A Wave Properties: Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1),** and **MOD-P3 Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).**
- Lesson 2, Explore Section, Steps 4, 5, and 6: Students go through the steps of collaboratively planning an investigation, making and recording observations, carrying out an investigation to explore the triangle as an instrument and how it makes sound, and making sense of the data from the investigation. **CE-P2 Simple tests can be designed to gather evidence to support or refute student ideas about causes, DCI 1-PS4.A1 PS4.A Wave Properties: Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1),** and **INV-P2 Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.**
- Lesson 3, Explore Section, Steps 2, 3, and 4: Students go through the steps of collaboratively planning an investigation to answer the question 'How do other objects make sound?' making and recording observations, carrying out an investigation, and making sense of the data from the investigation. (Lesson 3, Teacher Guide) **CE: 2.P2 Simple tests can be designed to gather evidence to support or refute student ideas about causes, DCI 1-PS4.A1 PS4.A Wave Properties: Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1),** and **INV-P2 Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.**
- Lesson 4, Explore Section, Step 4: Make Sense of Data: students engage in a class discussion about their observations during the Sprinkles investigation. As a part of that discussion, students are asked, "What do you notice about our data in the "make sound" columns?, "What do you notice about our data in the "Do not make sound" columns?", What did we observe when the drum was not making sounds?, and "What pattern is there in our data? (A pattern is *something that happens over and over*.)" As they respond to these prompts, they are engaging with the claimed elements. **CE:P1 Cause and Effect: Events have causes that generate observable patterns. DCI PS4.A. Wave Properties: Sound can make matter vibrate, and vibrating matter can make sound** and **(DATA-P3) Analyzing and Using Data: Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.**

- Lesson 5, Synthesize Section, Steps 3 and 4: Use the Sound Signal Model handout and patterns from cause and effect relationships to develop a model to answer the question 'How does a clocktower make and send sound signals?' participate in a consensus discussion, and co-construct a class consensus model making sense of the data from the investigation. (Lesson 5, Teacher Guide) **CE-P1 Events have causes that generate observable patterns, DCI PS4.A1 PS4.A Wave Properties: Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1),** and **MOD-P3 Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).**
- Lesson 6, Explore Section, Step 5: Lead students in defining the engineering problem and co-creating the lesson set question using patterns to address *How can we make sound signals devices to communicate a good news message across our classroom?* participate in a consensus discussion, and co-construct a class consensus model making sense of the data from the investigation to ask questions about using engineering. (Lesson 6, TE p. 32-36) **PAT-P1 Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence., DCI PS4.C Information Technologies and Instrumentation: People use a variety of devices to communicate (send and receive information) over long distances.,** and **AQDP-P1 Ask questions based on observations to find more information about the natural and/or designed world(s).**
- Lesson 7, Explore Section, Step 4: Students use materials and their understanding of how the materials will make music to plan building their device to communicate over a classroom. (Lesson 7, Teacher Guide) **SF-P1 The shape and stability of structures of natural and designed objects are related to their function(s), DCI PS4.C Information Technologies and Instrumentation: People use a variety of devices to communicate (send and receive information) over long distances and ETS1.B-P1 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,** and **CEDS-P2 Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.**
- Lesson 9, Explore Section, Step 4: Students plan an investigation to test their designs to determine if their signal instruments make a sound signal to communicate a message across the classroom. They receive peer feedback about the design and have time to work on redesigning their device based on the feedback. **SF-P1 The shape and stability of structures of natural and designed objects are related to their function(s), DCI PS4.C Information Technologies and Instrumentation: People use a variety of devices to communicate (send and receive information) over long distances,** and **INV: 3.P5 Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal.**

Integration to support student sense-making over time

- Lesson 8, Explore Section, Step 3: Students apply what they learned about how engineers use their plans to work together to build their signal instrument inspired by their plans from Lesson 7 using the Materials Menu handout. (Lesson 8, Teacher Guide) **SF-P1 The shape and stability of structures of natural and designed objects are related to their function(s). PS4.C Information Technologies and Instrumentation: People use a variety of devices to communicate (send and receive information) over long distances and ETS1.B-P1 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. (1-PS4-4) CEDS-P2 Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.**

- In Lesson 10, Synthesize Section, Step 5: Students apply what they learned about how engineers use their plans to work together to build their signal instrument inspired by their plans from Lesson 7 using the Materials Menu handout, observations and discussions about designs/tests/revision to address How can we make sound signals devices to communicate a good news message across our classroom? Using the Device Communication Plan and the Testing our Sound Signal Device handouts. (Lesson 10, Teacher Guide) **SF-P1 The shape and stability of structures of natural and designed objects are related to their function(s). PS4.C Information Technologies and Instrumentation: People use a variety of devices to communicate (send and receive information) over long distances. and ETS1.B-P1 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.(1-PS4-4),** and **INFO-P4 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.**

Criterion-Based Suggestions for Improvement: N/A

I.D. Unit Coherence

EXTENSIVE

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.

The reviewers found **extensive** evidence that the lessons fit together coherently to target a set of performance expectations because the lessons help students develop toward proficiency in a targeted set of performance expectations.

- 1-PS4-1—Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.
- 1-PS4-4—Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.
- K-2-ETS1-1—Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- K-2-ETS1-2—Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
- K-2-ETS1-3—Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

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.

- Elementary Teacher Handbook: "The Navigate component directly supports coherence for students from lesson to lesson. This component generally happens at the beginning and end of each lesson and provides opportunities for the class to take stock of where they are in finding answers to their questions, remind themselves what they figured out last time, and decide where they want to go next. Often this navigation will come naturally from questions generated by students, but occasionally the teacher will "problematize" an idea or investigation result by asking a salient question or pushing the class to consider other situations or new directions. What are the potential outcomes of this component? During the Navigate component, students ask questions, define problems, and make predictions. The class builds their sense of shared purpose, sees progress toward answering their questions, and takes ownership of their science work." (Elementary Teacher Handbook)
- Lesson 1, Navigate Section, Step 6: Students return to their notice and wonder chart, along with the initial consensus model. Students are guided to turn "areas of uncertainty" into questions and record those on the chart. Students then respond to the following prompts, "How do you think we could figure out how an object makes sound?" and "We explored using handbells today; what are some other objects we could explore with? Why would you like to try that?" "Brainstorm ideas for what to explore next. Using the prompts below, engage students in a brief discussion generating ideas about how to pursue answers to our questions about how objects make sound. Invite students to turn and talk with a partner and then share ideas with the class. (Lesson 1, Teacher Guide)
- Students routinely return to their Notice/Wonder chart that is created in Lesson 1. Lessons 2, 3, and 4 begin with students returning to the Notice/Wonder chart to remind them of what questions they still have and to co-construct a lesson question to drive the learning. For example:
  - Lesson 3, Synthesize Section, Step 6: "Summarize for students that we have figured out part of our big lesson set question and remind students that - in Lesson 1 - we made an initial class model with our ideas about how objects make and send sound signals. We noted things that we weren't sure about and combined those with questions on our class Notice and Wonder chart. Suggest that now that we have figured out part of our lesson set question, we can return to our Notice and Wonder chart and identify wonders that we have not yet figured out." (Lesson 3, Teacher Guide)
  - Lesson 4, Navigate Section, Step 1: "Recall where we left off. Remind students that we ended our last science lesson celebrating what we had figured out about how objects make sound, while also realizing we still have questions about what happens to sounds after they are made, how sounds/sound signals are sent, and how we hear them. You may want to point to these questions on the Notice and Wonder chart, possibly circled or otherwise marked (refer to slide A) or read questions from pre-selected stickies." (Lesson 4 Teacher Guide)
- Lesson 8, Navigate Section, Step 6: "Identify answered "wonders." Ensure students can view the class Ideas and Wonders chart (refer to slide K). Suggest to students that we have completed a lot of engineering together so far and can probably answer many of our wonders! With students' input, add a check or other "we did this!" symbol to the questions on the wonders side of the chart that we have now addressed." (Lesson 8, Teacher Guide)
- Students routinely return to their Growing Ideas Chart, created in Lesson 2, to keep track of what they have figured out in each lesson. Students return and update the Growing Ideas Chart in Lessons 3, 4, 6, 7, 8, and 9.
  - Lesson 4, Navigate Section, Step 7: Revisit Our Initial Model. Students are asked to "think about what we now know that we didn't when we were first exploring sound signals." (Lesson 4, Teacher Guide)
  - Lesson 5, Navigate Section, Step 1: "Recall initial ideas. Display the Initial Class Model from Lesson 1 (refer to slide A), which may be connected to the class Notice and Wonder chart, reminding students how we

briefly discussed this model at the end of our last lesson. Also, remind students that a model explains how something looks, how it works, or how it happens and that this model shows our initial ideas explaining how the clocktower makes and sends sound signals. (Lesson 5, Teacher Guide)

  - Lesson 6, Navigate Section, Step 6: Create Our Ideas/Wonders chart, students "co-create our Ideas and Wonders chart by adding our initial ideas and questions about making sound signal devices and use the chart where to go next." (Lesson 6, Teacher Guide)

- Students routinely return to the Idea/Wonder chart to remind them of what questions they still have and to co-construct the lesson question to drive learning. Lessons 8, 9, and 10 begin with students returning to the Ideas/Wonders chart.

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

The lessons help students develop toward proficiency in a targeted set of performance expectations. Five target Performance Expectations are identified. The lessons work toward the following claimed Performance Expectations:

- 1-PS4-1 Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.
- 1-PS4-4 Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.
- K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- K-2-ETS1-2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
- K-2-ETS1-3 Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
- Materials and Preparation sections include Three-dimensional Learning Goal(s) charts. The charts consist of four columns: "Using the lens of" "Students will" "To make sense of" and "Lesson learning goal" columns. For example:
  - Lesson 2, Materials and Preparation:
    - Using the lens of: "Cause and Effect"
    - Students will: "Plan and carry out investigations"
    - To make sense of: "How objects, like a triangle, move/shake (vibrate) to make sounds
    - Lesson learning goal: **Plan and conduct an investigation to gather evidence** about how a **triangle makes sound**. (Lesson 2, Teacher Guide)
  - Lesson 6, Materials and Preparation:
    - Using the lens of: "Patterns"
    - Students will: "Ask questions and define problems"
    - To make sense of: "How sound signal devices can be useful for communicating over distances"
    - Lesson learning goal: **Use patterns** in how **people use** sound signal **devices to communicate** to **define a simple problem** about **communicating** good news **across the classroom**. (Lesson 6, Teacher Guide)

- Lesson 4, Explore Section, Step 2: "Revisit the Triangle or Instrument Investigation Plans. Remind students that in our last two lessons, we planned investigations that would help us make observations to answer our questions about how different objects make sound. Ensure the class' Triangle Investigation Plan from Lesson 2 and/or the Instruments Investigation Plan from Lesson 3 (refer to slide D) are on display and invite students to turn and talk with a partner to reconnect with investigations as plans scientists use to help them answer their question and figure out what to do next and to consider how we have used investigations in the last two lessons to help us answer our questions." Targeted performance expectation: **Plan and conduct an investigation to gather evidence** that **sounds** travel and **can cause materials to vibrate** (**effect**) when **sounds are received**. (Lesson 4, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

I.E. Multiple Science Domains

EXTENSIVE

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.

The reviewers found **extensive** evidence that links are made across the science domains when appropriate because in this unit, only one science domain (physical science) is necessary to explain phenomena or design solutions. Physical science elements are used in conjunction with ETS elements as students design solutions.

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

The following DCI elements from the physical science domain can explain the clocktower phenomenon:

- How the clocktower makes sound: **PS4.A-P1: Sound can make matter vibrate, and vibrating matter can make sound**
- Why the clocktower was designed: **PS4.C-P1: People use a variety of devices to communicate (send and receive information) over long distances.**

PS4.C, ETS1.A were used together to explain phenomena.

- Lesson 6, SEP-DCI-CCC-ELA-Math Matrix, "In PS4.C, students categorize devices and identify a need to communicate good news. ETS1.A-P1 helps them see this as an engineering problem and connect it to device design. In ETS1.A-P2, they observe and categorize devices, recognizing gaps in communication methods. ETS1.A-P3 emphasizes understanding the problem through discussions, considering factors like frequency, before designing a solution.

PS4.C, ETS1.A, ETS1.B were used together to explain phenomena.

- Lesson 7, SEP-DCI-CCC-ELA-Math Matrix, "PS4.C introduces them to a communication device for the DeafBlind community, inspiring their own designs. ETS1.A-P2 encourages observations of familiar instruments to understand structure-function relationships for their designs. ETS1.A-P3 highlights the importance of clearly defining the engineering problem, leading to a "Device Gotta-Have-It Checklist." ETS1.B guides students in using sketches to communicate their design ideas, which they refine with a partner.

PS4.C, ETS1.B were used together to explain phenomena.

- Lesson 8, SEP-DCI-CCC-ELA-Math Matrix, "Students figure out that they can use materials to build a variety of devices that are intended to communicate across the distance of their classroom. ETS1.B: Students figure out that their designs can be conveyed by using their drawn designs from Lesson 7 to construct their built designs in this lesson using selected materials and tools. These representations of their sound signal devices are useful in communicating ideas about their solution."

PS4.C, ETS1.C were used together to explain phenomena.

- Lesson 9, SEP-DCI-CCC-ELA-Math Matrix, "Students figure out that people use different devices to communicate over distances as they test their and other students' sound signal devices to recognize how these are a type of technological devices that can be used to communicate across various distances in the classroom. ETS1.C: Students figure out that it is useful to test designs when they use their sound signal devices and gather evidence about how well it makes and sends a sound signal across the classroom. They use this evidence and feedback from peers to consider ideas for revisions. In the next lesson, they will also compare different partnerships' solutions to further understand how there is always more than one possible solution to an engineering problem."

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

Figuring how the clocktower bell rings and designing a device to send information across the classroom can be fully addressed using the physical science domain.

Criterion-Based Suggestions for Improvement: N/A

I.F. Math and ELA

EXTENSIVE

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.

The reviewers found **extensive** evidence that the materials provide grade-appropriate connections to the Common Core State Standards in Mathematics and/or English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects because the materials explicitly state the mathematics and ELA standards that are used in the unit and support students to see the connections among content areas.

ELA Reading: Information Text

The following ELA Reading: Informational Text standards were claimed to be "explicitly used and named in the lesson with specific support for teachers. (1.2 Waves Sound SEP-DCI-CCC-ELA-Math Matrix)

CCSS-ELA-LITERACY.RI.1.5 Know and use various text features (e.g., headings, tables of contents, glossaries, electronic menus, icons) to locate key facts or information in a text. Claimed to be explicitly used in Lessons 7, 8, and 9.

- Lesson 7, Connect Section, Step 2: "Engage students in an interactive read-aloud. Read pages 1-7, pausing to ask the following questions to connect students' own experiences and the problem of needing a way to communicate good news across the classroom to the information in the book. As you read, use the headings of each section of the Meet the Engineer: Matias Dermond book to help students figure out what we have already done and what we could do next." (Lesson 7, Teacher Guide)
- Lesson 8, Connect Section, Step 2: Literacy Supports, "As students use the table of contents to figure out which portion of the text aligns with their current engineering work, they are gaining additional knowledge about the ways that science text features are written to support their sensemaking. They are also learning how to use text features to quickly locate information in the text and support their understanding of what was read." (Lesson 8, Teacher Guide)
- Lesson 9, Connect Section, Step 2: Literacy Supports, "Note that the word test has multiple meanings and it can be used as a noun or a verb. You might consider explaining this with examples like: "A test can be a thing, like taking a spelling test. Or a test can be an action you do, like how we are going to test our designs." Support students in recognizing that two words that are spelled and said the same way can have different uses and meanings (i.e., homonyms)" (Lesson 9, Teacher Guide)

CCSS-ELA-LITERACY.RI.1.7 Use the illustrations and details in a text to describe its key ideas. Claimed to be explicitly used in Lessons 1 and 9.

- Lesson 1, Connect, Step 2, "Read the What's That Sound? book and make connections. As you read the book and play the audio files, provide opportunities for students to make guesses in response to the page-based questions: "What's that sound?" and "Why is that...?" Cue students to use the audio and the images in the book as they answer each question. Additionally, after each example, use the prompts below to encourage students to make connections to other experiences they have had. Recognize that not all students may have experienced or be familiar with some of the sounds in this text. Reading the text with these interactive questions supports both students who have had experiences and those for which the example will be novel. (Lesson 1, Teacher Guide)
- Lesson 9, Connect Section, Step 2: "Work together to use the table of contents to navigate to the desired information. Turn to the table of contents and remind students that the table of contents is useful for finding the information we

need. Read each section heading and have students raise their hand to indicate that is something we have done as engineers (ex: Engineers Define Engineering Problems, page 3.; students raise their hands). Anticipate that students will not raise their hands when you get to the section heading, "Engineers Test Designs," and suggest to students that is what we need to find out more about!" (Lesson 9, Teacher Guide)

ELA Writing

The following ELA Writing standard was claimed to be "explicitly used and named in the lesson with specific teacher support. (1.2 Waves Sound SEP-DCI-CCC-ELA-Math Matrix)

CCSS-ELA-LITERACY.W.1.2 Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure. Claimed to be explicitly used in Lesson 10.

- Lesson 10, Synthesize, Step 3, "As students are writing and drawing on Device Communication Plan handout, remind them to include sufficient details about how their design works. They can add a title, labels and drawn details, and a closing, summative sentence to ensure that their communicative partners understand how their device works. This work supports W.1.2 and SL.1.5 as students write explanatory texts and add drawings to visual displays to their work. (Lesson 10, Teacher Guide)

ELA Speaking and Listening

The following ELA Speaking and Listening standards were claimed to be "explicitly used and named in the lesson with specific teacher support. (1.2 Waves Sound SEP-DCI-CCC-ELA-Math Matrix):

CCSS-ELA-LITERACY.SL.1.1A Follow agreed-upon rules for discussion (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion). Claimed to be explicitly used in Lesson 2.

- Lesson 2, Synthesize, Step 7, "Reminding students about their classroom agreements provides an opportunity for students to develop and follow agreed-upon rules for discussion. Students' use of the classroom agreements, specifically as they listen to others with care and speak one at a time about the topics and texts under discussion, allows them to learn pragmatic rules for discussion and how to communicate in large and small group settings. This work supports SL.1.1A. (Lesson 2, Teacher Guide)

CCSS-ELA-LITERACY.SL.1.5 Add drawings or other visual displays to descriptions when appropriate to clarify ideas, thoughts, and feelings. Claimed to be explicitly used in Lessons 1, 5, and 10.

- Lesson 1, Connect, Step 2, "Sticky notes are recommended for Our Examples chart because students will add additional sticky notes in
- Lesson 5, Synthesize, Step 3, "As students individually develop their models, reiterate that labels and drawings on their models help to clarify their ideas (SL.1.5). (Lesson 5, Teacher Guide)
- Lesson 10, Synthesize Section, Step 3: "Review directions with students, showing them where to draw and write to explain how your device works. Tell students how drawing and writing our ideas about what we want to share helps us prepare to present to our classmates. Then support students in noticing how their ideas for what to share and how to share it are captured on the back of the handout!" "Complete Device Communication Plan handouts. As students draw, write, and otherwise prepare for their presentations, engage in individual conversations with the purpose of supporting students in using what they have figured out about engineering sound signal devices to prepare to communicate with their classmates." (Lesson 10, Teacher Guide)

CCSS-ELA-LITERACY.SL.1.6 Produce complete sentences when appropriate to task and situation. (See grade 1 Language standards 1 and 3 for specific expectations. Claimed to be explicitly used in Lesson 10.

- Lesson 10, Connect, Step 4, "Encourage students to communicate their science ideas alongside their written work. Students can use their written work on their Device Communication Plan handout to prompt communicating in expanded and complete sentences. For example students can say, "Our handout shows ____" or "In our plan, we wrote _____". (Lesson 10, Teacher Guide)

CCSS-ELA-LITERACY.L.1.1D Use personal, possessive, and indefinite pronouns (e.g., I, me, my; they, them, their; anyone, everything). Claimed to be explicitly used in Lessons 2 and 4.

- Lesson 2, Connect Section, Step 3: Literacy Supports, "As students ask and answer questions while reading, model how to use personal and possessive pronouns (e.g., I, me, my; they, them, their; our, ours) as students compare events in the book with actions that the class has taken personally and collectively to make observations in their investigations. Encourage students to use these forms in their oral language as they answer questions, too. (Lesson 2, Teacher Guide)
- Lesson 4, Navigate Section, Step 1: "Connect to the clocktower experience. Remind students of the initial story you shared in Lesson 1, when a sound like the clocktower's signal got your attention while you were reading your book. Convey (using words and/or gestures) how the clocktower was in one place ("over there") while you were somewhere else ('over here')." (Lesson 4, Teacher Guide)

CCSS-ELA-LITERACY.L.1.1I Use frequently occurring prepositions (e.g., during, beyond, toward). Claimed to be explicitly used in Lesson 4.

- Lesson 4, Navigate Section, Sep 1: Literacy Supports, "As students describe events from previous investigations or experiences, encourage them to use a variety of frequently occurring prepositions to explain how they know sound travels. For example, students might say, "I heard the whistle over there."or "I stood behind the door and heard my brother yelling". When students include a variety of prepositions in their speech, it increases the specificity of their ideas which in turn, helps students communicate their science ideas more clearly. (Lesson 4, Teacher Guide)

CCSS-ELA-LITERACY.L.1.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. Claimed to be explicitly used in Lesson 1.

- Lesson 1, Connect Section, Step 1: Literacy Supports, "Simple phrases are used to title charts, including Our Examples chart, to support students' understanding of spelling patterns in frequently used words." (Lesson 1, Teacher Edition)

CCSS-ELA-LITERACY.L.1.5 With guidance and support from adults, demonstrate understanding of word relationships and nuances in word meanings. Claimed to be explicitly used in Lessons 1, 2, 3, 4, 6, 7, and 9. Evidence found in all lessons, examples include,

- Lesson 1, Connect Section, Step 1: "Add communicate to the Word Wall. Review with students that communicate means to share information and add the prepared card to the Word Wall, or adjust the definition or image in a way that is more meaningful and relevant to your students." (Lesson 1, Teacher Guide)
- Lesson 3, Explore Section, Step 3: Broadening Access, "During the investigation, you may hear students using the word "vibrate" or "vibration." Consider asking questions like, "When you say vibration, what does that mean to you?", "What does vibration look like?" or "feel like?". This provides students an opportunity to apply prior knowledge of the term to their in-the-moment sensemaking. We will formally define the word "vibrate" and add it to the Word Wall in the Connect of this lesson." (Lesson 3, Teacher Guide)

- Lesson 6, Connect, Step 4: "The word engineer can be multiple parts of speech. It can be used as a noun, to mean a person's job, or as a verb to mean the action some people take to address problem(s) in the world around us. Draw students' attention to the way this word is used to help deepen their understanding of the multiple meanings and uses of the same word. Remind students about the differences between nouns and verbs to clarify how the different meanings can be applied in different contexts (L.1.5). (Lesson 6, Teacher Guide)
- Lesson 9, Connect Section, Step 2: Literacy Supports, "Note that the word test has multiple meanings and it can be used as a noun or a verb. You might consider explaining this with examples like: "A test can be a thing, like taking a spelling test. Or a test can be an action you do, like how we are going to test our designs." Support students in recognizing that two words that are spelled and said the same way can have different uses and meanings (i.e., homonyms)" (Lesson 9, Teacher Guide)

CCSS-ELA-LITERACY.L.1.5A Sort words into categories (e.g., colors, clothing) to gain a sense of the concepts the categories represent. Claimed to be explicitly used in Lesson 6.

- Lesson 6, Explore Section, Step 2: Literacy Supports, "Completing the Sound Signal Device Card sort guides students in recognizing that related words and concepts can be sorted into categories. This work supports L.1.5A and reinforces students' understanding of the different types of messages that people use sound signals to communicate." (Lesson 6, Teacher Guide)

CCSS-ELA-LITERACY.L.1.5B Define words by category and by one or more key attributes (e.g., a duck is a bird that swims; a tiger is a large cat with stripes). Claimed to be explicitly used in Lesson 2.

- Lesson 2, Explore Section, Step 2: "Some students may use the word "vibration," though it is not formally introduced until the end of Lesson 3. Validate students' use of the word and ask them what they think it means. Remind students that their knowledge of words can change and grow as they figure out more science ideas. Having explicit discussions about words, word meanings, and their usage supports L.1.5 as students practice understanding word relationships and nuances in meanings." (Lesson 2, Teacher Guide)

CCSS-ELA-LITERACY.RI.1.2 Identify the main topic and retell key details of a text. Claimed in Lessons 8 and 10.

- Lesson 8, Connect, Step 2, "Facilitate an interactive read-aloud. Engage students in an interactive read-aloud of pages 13-14 of the Meet the Engineer: Matias Dermond book, using the prompts below. Prompts to use: Page 13: What does Matias do as he gets ready to build his device? He gets his materials! He gets tools! Page 14: How does Matias use his drawn design while he builds? To know what parts to include To know how he thinks the parts will fit together" (Lesson 8, Teacher Guide)
- Lesson 10, Navigate, Step 1, "Read aloud pages 22-23 of the book. Take a few minutes to read aloud the last section of the Meet the Engineer: Matias Dermond book. Interact with students by using the prompts below to support them in figuring out what engineers do to share their solutions. Prompts to use: Page 22: What did Matias and his team do next after planning, building, and testing their bracelet? Shared it with others. Showed the bracelet to other engineers and people who are DeafBlind. Explained how the bracelet works. Invited people to try it. (Lesson 10, Teacher Guide)

Mathematics

CCCSS-MATH-Practice.MP2 Reason abstractly and quantitatively. Claimed to be explicitly used in Lesson 3. Evidence was found in the claimed lessons. Examples include:

- Lesson 3, Explore Section, Step 4: "Have students use the individual handout and the class data table to support their organization, representation, and interpretation of the multiple categories of the Instrument Investigation data (part

of 1.MD.C.4). Students reason abstractly and quantitatively as they make observations about and discuss the patterns in the class data with one another (MP2)" (Lesson 3, Teacher Guide)

CCSS-MATH-Practice.MP3 Construct viable arguments and critique the reasoning of others. Claimed in Lesson 5.

- Lesson 5, Synthesize Section, Step 4: Math Supports, "Have students use the evidence from their previous investigations to support the claims made in their models about how the clocktower makes and sends sound signals. During class discussion, guide students in critiquing the claims of others by asking questions such as, "What is similar or different about your claims?" and "What evidence supports your claim?" (MP3) (Lesson 5, Teacher Guide)

CCSS-MATH-Practice.MP5 Use appropriate tools strategically. Claimed in Lesson 1.

- Lesson 1, Connect, Step 2, "As students progress through this lesson, they will begin making sense of how tools can help us tell the time (MP5). For example, students will likely connect many of the objects discussed (clocktower, chime, whistle, etc.) to indicate it is time to transition between activities. Through discussions and explorations, students will learn more about how these tools can help us solve problems. (Lesson 5, Teacher Guide)

CCSS-MATH-Practice.MP6 Attend to precision. Claimed in Lesson 8.

- Lesson 8, Explore, Step 3, "As students build their designs, support partners in using precise mathematical language to help them clearly communicate their ideas about the construction. Ask partners to identify the shapes they are using in their shared design and to describe the relative position of the materials using words such as above, below, beside, in front of, behind, and next to. (MP6) (Lesson 8, Teacher Guide)

CCSS-MATH-1.MD.C.4 Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another. Claimed in Lesson 3, 4, 6, and 9.

- Lesson 3, Explore, Step 4, "Have students count with you as you count the number of students standing and then represent the value on the class data table to help support one-to-one correspondence and represent data in multiple ways (part of 1.MD.C.4). (Lesson 3, Teacher Guide)
- Lesson 4, Explore, Step 2, "The purpose of the Sprinkles Investigation data table is to help students represent their data in a way that facilitates sensemaking and pattern recognition. Have students use the co-constructed data table to organize, represent, and interpret their observational data during and after the investigation (part of 1.MD.C.4). (Lesson 4, Teacher Guide)
- Lesson 6, Explore, Step 2, "Have students organize each sound signal device card into a category based on the message they think it sends. As you walk around the room, ask students to share their reasoning for their decisions when sorting and organizing the sound signal device cards using the prompts in the prompt-response box (part of 1.MD.C.4). (Lesson 6, Teacher Guide)
- Lesson 9, Explore, Step 4, "Have students use the *Testing our Sound Signal Device* handout to organize the data they collect during the investigation. As they test their sound signal devices, students will circle a thumbs up or a thumbs down to represent whether or not each test worked, while also making note of qualitative observations (part of 1.MD.C.4)." (Lesson 6, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

CATEGORY II

NGSS Instructional Supports

II.A. Relevance and Authenticity

EXTENSIVE

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.

The reviewers found **extensive** evidence that the materials engage students in authentic and meaningful scenarios that reflect the practice of science and engineering as experienced in the real world because students have multiple opportunities to reflect on grade-appropriate experiences. Students experience the phenomena as directly as possible and have opportunities to connect the clock tower phenomena to their own experiences. Materials provide support to teachers to connect instruction to students' homes and communities.

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

- Lesson 4, Explore Section, Step 3: "Organize students into pairs and ensure each partnership has a drum with drumstick and a prepared tube. Ensure that the Sprinkles Investigation data table is displayed and students have access to writing utensils (or specific, class-determined recording tools such as sticky notes) to record their observations on the data table. (Lesson 4, Teacher Guide)
- Lesson 6, Explore Section, Step 2: Organize Data, students sort sound signal cards. Each of these cards has a picture of a device that is used to send sound signals. (Lesson 6, Teacher Guide)
- Lesson 8, Explore Section, Step 3: "Gather materials and begin building in pairs. As partnerships are ready, have them use their Materials Menu handout to gather their materials and begin building in their work zone using their drawn designs. If additional wait-time or staggering is needed, consider having students show and/or tell about their drawn designs to another pair before gathering materials." (Lesson 8, Teacher Guide)
- Lesson 9, Explore Section, Step 4: "Test sound signal devices. Organize engineering partnerships together into groups of 4 to test each partnership's sound signal devices, making sure each team has their built device from Lesson 8. Ensure each student has their own Testing our Sound Signal Device handout and writing utensil to record their observations. Circulate and use questions like the ones below to support students in using their observations as evidence to determine if their device works as planned." (Lesson 9, Teacher Guide)

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

- Lesson 1, Connect Section, Step 1-2: Community Connections, "This clocktower signaling the time is the anchoring phenomenon that drives students' science learning across this unit. If there is a clocktower in your community, consider using its images and sound signals in their community that may be unique to where they are from. Celebrate that there may be similar and different sound signals in everyone's home and/or community, and those differences are what make each home and community special and important." Community Connections: "The Out-of-School Sound Signals community connection is a way for students to share experiences and ideas from their homes and

communities with their classmates. Encourage students to identify sound signals in their community that may be unique to where they are from. Celebrate that there may be similar and different sound signals in everyone's home and/or community, and those differences are what make each home and community special and important." (Lesson 1, Teacher's Guide)

- Lesson 2, Instrument Connections Reference: "To increase relevance for students, you may consider additional opportunities for them to share and explore instruments that are meaningful to them or their communities as they make connections between sound and vibrations. This will further support students' understanding of science ideas in Lesson Set 1 (vibrations cause sound) that they will use in engineering their own sound signal devices in Lesson Set 2. It may be particularly helpful to include this in the third Explore of Lesson 3, where these additional instruments could be used to confirm the cause-and-effect pattern." (1.2 Lesson 2 Teacher Assessment Tool)
- Lesson 3, Connect Section, Step 5: Literacy Supports, "Students are introduced to the science term "vibration" on page 4 of the Make Some Noise! book, defined as "small, fast movements back and forth." Encourage students to connect this science term to observations they have made during their investigations. Additionally, encourage students to make connections to feeling vibrations in their everyday lives. This word and idea will be further explored in Lesson 4." (Lesson 3, Teacher Guide)
- Lesson 4, Navigate Section, Step 1: "Share experiences of sounds made somewhere else. Invite students to turn and talk with a partner about a time when they observed a sound that was made somewhere else, or even one made far away. When have you observed a sound that was made somewhere else, or even far away? What was that like? Then, engage students in a brief discussion through which students share some of their experiences." (Lesson 4, Teacher Guide)
- Lesson 5, Synthesize Section, Step 4: "Suggest to students that now that they have explained how the clocktower makes and sends its sound signal, we can explain other examples, too; we should be able to explain our lesson set question, How do objects make and send sound signals?. Remind students that they have been gathering other examples of objects that make and send sound signals in their communities using their Out-of-School Sound Signals community connection from Lesson 1. Also remind students how we have already started a chart (Our Examples chart) that has examples we added from our What's That Sound? book in Lesson 1." (Lesson 5, Teacher Guide)
- Lesson 6, Synthesize Section, Step 3: Broadening Access, "It is important to be thoughtful of the diversity of students in the classroom when students are identifying and discussing "good news" here in Lesson 6 and later as they engage in engineering. Consider avoiding the celebration of holidays and/or birthdays as "good news," because there may be students in your classroom who do not celebrate holidays or birthdays due to cultural or religious reasons." (Lesson 6, Teacher Guide)

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.

- Lesson 2, Navigate Section, Step 1: "Co-construct the lesson question. Build on students' questions about how objects make sound to suggest that we explore with the triangle to figure out more about how it makes sound. Together, co-construct a lesson question similar to, How does a triangle make sound? Revise the question on slide C to match the words used by your class and then display it. (Lesson 2, Teacher Guide)
- Lesson 3, Connect Section, Step 5: "Add to the Word Wall. After reading the Make Some Noise! book, review vibration with students; vibrations are small, fast movements back and forth. Add this word to the class Word Wall. To further make sense of this word and their experiences over the last few lessons while providing students with a movement break, invite them to stand up and use their bodies to represent what vibration means and tell a partner what object they are representing with their bodies." (Lesson 3, Teacher Guide)

- Lesson 4, Navigate Section, Step 1: "Play the drum. Play the drum and have students confirm they hear it in different locations around the room. A quick way to engage in this experience is to have students move to spaces all around the classroom and then you make sounds using the drum and drumstick in the middle of the room while asking students to raise their hands when they hear the sound." (Lesson 4, Teacher Guide)
- Lesson 5, Connect Section, Step 5: "Group students into pairs and ensure each pair has several (2-4) sticky notes and writing utensils. Provide students an opportunity to share and discuss examples they may have from their out-of-school community and/or to find objects that make and send sound signals in the classroom. As student pairs finish adding an object to a sticky note, have them place their example on Our Examples chart." (Lesson 5, Teacher Guide)
- Lesson 6, Synthesize Section, Step 3: "Connect to how we communicate in our classroom. Use the following prompts to support students in making connections between what they have just figured out (the different types of messages people communicate using sound signals) and their own classroom context. This connection is important in positioning students to identify a "problem" in their own classroom that they will address through engineering across the rest of this lesson set." (Lesson 6, Teacher Guide) Teachers prompting students to make connections is not an example of students authentically motivated to figure out or create a device that will help them communicate good news across the classroom.
- Lesson 7, Synthesize Section, Step 5: "Connect back to collaborative engineering work. Gather students' attention and remind them of the collaborative work of Matias and his team from the Meet the Engineer: Matias Dermond book and how they got many ideas for their designs by brainstorming together as a class and working with a partner to gather more information using familiar instruments. Ask students how they could get ideas to improve their designs and make them even better, anticipating they will suggest working with other students. Emphasize the importance of working together in engineering and that they will have a chance to work together on an engineering team (specifically, with a partner in an engineering partnership) just like engineers do!" (Lesson 7, Teacher Guide)
- Lesson 8, Navigate Section, Step 1: "Co-construct a lesson question. Use students' questions about building their devices to co-construct a lesson question related to this lesson's work, which will likely be similar to, How can we use materials and our drawn designs to build our sound signal devices? As needed, revise the question on slide B to match the words and ideas used by your class." (Lesson 8, Teacher Guide)
- Lesson 9, Synthesize Section, Step 6: "Continue the discussion about students' evidence. Connect to students' previous experiences in the unit of using evidence to explain their ideas. Explain that just like how scientists and engineers both use investigations, scientists and engineers also both use evidence. Ask students how they figured out the claims they made. As students share ideas, add them to the column titled, "How did we figure it out?" (Lesson 9, Teacher Guide)
- Lesson 10, Synthesize Section, Step 5: "Explain to students that our goal in this discussion is to come to agreement about our ideas and evidence related to our lesson set question, How can we make sound signal devices to communicate a good news message across the classroom? Encourage students to respond and build upon one another's ideas." (Lesson 10, Teacher Guide)

Criterion-Based Suggestions for Improvement

- Consider how students can be more authentically motivated to solve a compelling issue that is affecting people's lives—either students' own lives or the lives of others they can relate to (Detailed Guidance, p. 20) in the second lesson set.

II.B. Student Ideas

EXTENSIVE

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.

The reviewers found **extensive** evidence that the materials provide students with opportunities to share ideas with peers directly and elicit ideas from others. Teachers have support to act as an expert facilitator to draw out individual student ideas. The materials provide support to guide constructive feedback from teachers and peers. Artifacts show evidence of students' reasoning and changes in their thinking over time. There are some teacher-to-student and peer-to-peer feedback loops to help students clarify their understanding of sound and design a sound signal device.

Student ideas are clarified, justified, and built upon

- Lesson 1, Connect Section, Step 1: "Share initial ideas about what is being communicated. Invite students to share ideas about what they think people are communicating through the sound of the clocktower. Consider having students use hand signals to show agreement (e.g., "Thumbs up if you agree."). This will provide a way for all students to participate in this discussion while also providing an experience that students can relate to later in this Connect, when the word "signal" is introduced." (Lesson 1, Teacher Guide)
- Lesson 2, Navigate Section, Step 1: "Revisit our notice/wonder chart, students are presented with the following question, Have you ever seen something like the triangle? If so, share about your experience.", and are told to discuss it with their partner. Students then share their partner's response. "Introduce the triangle and striker. Connect to students' ideas and experiences with different musical instruments by displaying the image on slide B and holding up a triangle and striker. You might tell students something like, "I used your suggestions to find instruments for us all to play and explore. We have many of these cool instruments called triangles that we can use!" Have students turn and talk with a partner about the following question: Have you ever seen something like the triangle? If so, share about your experience. Invite a few students to share their or their partner's experiences with the class. Then, invite students to share the parts of the triangle or introduce the parts as you point to and name each part: handle, triangle, striker." (Lesson 2, Teacher Guide)
- Lesson 3, Explore Section, Step 4: "Talk with a partner about all sounds. Invite students to show their current ideas about all sounds being caused by movement by asking them the following question: Do you think that all sounds are caused by movement?" "Invite students to use a thumb up or thumb down to show their current thinking (thumb up: I think all sounds are caused by movement; thumb down: I do not think all sounds are caused by movement). Have students move to find a partner who thinks something different. For example, a student with their thumb up finds a partner with their thumb down. Invite students to briefly share their ideas with their partner." (Lesson 3, Teacher Guide)
- Lesson 3, Explore Section, Step 4: Make sense of data. Students are told that a pattern is something that "happens over and over again". Students are told to talk to their partner about this idea and are presented with the following prompt, "For every instrument, what do you notice about our data in the "Hear sound" columns?" (Lesson 3, Teacher Guide) It is implied that students should build on ideas about patterns versus repeating what they've been previously told.
- Lesson 4, Explore Section, Step 2: "Suggest to students that in this investigation, we work to compare and discuss our observations with our partners as we use the drum and prepared tube. We should come to agreement with our partner and record one tally mark for each agreed-upon observation. Invite students to turn and talk about what they can do if they and their partner do not agree on their observations and decide as a class that students can retest first and ask another pair (or adult) for help next." (Lesson 4, Teacher Guide)

- Lesson 5, Synthesize Section, Step 3: Develop a Model. Students individually develop models to explain how a sound signal device works. In step 4, students use these models as they participate in a class discussion designed to develop a consensus model collaboratively. (Lesson 5, Teacher Guide)
- Lesson 6, Explore Section, Step 2: Organize Data: students are asked to organize sound signal data cards so that they have grouped those that are sending similar messages. After they complete this task in partner groups, students are told, "We are sorting our cards in different ways!" Students are then told to "tour" other groups to see how they have grouped the data. The following guidance is provided, "Point out that we are sorting our cards in different ways! Suggest that students look at how other pairs sorted cards in order to notice similarities and differences in each others' groupings. Have students leave their sorted cards on their Placemats and take about a minute to move around the room to view other placements before returning to their own areas. Encourage students to look for similarities and differences between how they sorted and labeled and how other pairs sorted the cards and labeled the groups of sound signal devices." (Lesson 6, Teacher Guide)
- Lesson 8, Explore Section, Step 3: "Pause building to consider our built and drawn designs. Part way through this Explore, gather students' attention and invite them to pause their building and to review their drawn designs. Invite students to briefly talk with their engineering partner about how their built design is and is not like their drawn designs. If possible, invite students to share some of their experiences to explain how and why their built design is the same as or different from their drawn designs. Alternatively, you may have students raise their hands to show one experience (same) and the other (different). Use this opportunity to assure students that in engineering, we use our plans to prepare and get started, and we also sometimes need to make changes as we work. That is OK!" (Lesson 8, Teacher Guide)

Artifacts show evidence of students' reasoning and changes in their thinking over time

- Lesson 5, Navigate Section, Step 1: "The purpose of this discussion is to help students recall what they used to think and identify how their ideas have grown and changed since Lesson 1." (Lesson 5, Teacher Guide) While this provides an example of how the thinking of the class changes over time, it is unclear if this can be used as evidence to show how individual student thinking changes over time.
- Lesson 2, Preparation Checklist: "If possible, take photos of students investigating with the triangle and striker in the Explore and the class copy of the Triangle Investigation Observations handout (if completing it digitally or recording onto a projected copy on the whiteboard). Use these samples of students' Triangle Investigation Observations handouts, and/or images from the Printable Chart Images reference during the Synthesize to support the Building Understandings Discussion and recording ideas on Our Growing Ideas chart." (Lesson 2, Teacher Guide)
- Lesson 2 Teacher Assessment Tool: "Each lesson's learning goal and the specific work students do in the lesson are designed to move students forward in their use of Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. Throughout each lesson, jot down evidence of a few students' sensemaking. You can use copies of the following table, a seating chart, your class list, or another way to keep track of what students say, do, write, draw, objects they manipulate and how, etc. to note how they are demonstrating the listen-/look-fors." (Lesson 2, Teacher Assessment Tool)
- Lesson 5, Navigate Section, Step 1: "This turn-and-talk discussion is an opportunity to emphasize the classroom agreement, We let our ideas change and grow. As students identify areas of the initial class model that can now be updated, the sentence stem "I used to think _____, but now I think _____" can support them in expressing how their ideas have changed over time. Changing our ideas in response to new evidence is an important part of scientific endeavors and our classroom communities." (Lesson 5, Teacher Guide). Because evidence is not collected, no artifact has been generated to support this suggestion. This limits the teacher's ability to document students' reasoning and track changes in their thinking over time.

- Lesson 8, Explore Section, Step 3: "Revise drawn designs. As groups finish building, remind them that, in engineering, it is common to have our designs change once we start building. Invite students to compare their built design to their drawn design on their Sound Signal Device Design handouts (Part B. Engineering Partnership Design). Using a different color or kind of writing utensil, invite engineering partnerships to revise their drawn designs to represent their built design. This might be through circling what is the same; putting x's over what they did not include in their built design; and/or drawing and labeling any new parts or materials in their built design. Encourage students to use this opportunity to reflect on how they likely improved on their design as they were building it!" (Lesson 8, Teacher Guide)

Our Growing Ideas Chart:

- Lesson 2, Explore Section, Step 6: "Motivate creating Our Growing Ideas chart. Summarize for students that we had similar observations: when the triangle was not making sound, we saw/felt that it was still and when the triangle was making sound, we saw/felt that it was moving or shaking. Have students turn and talk about how we might keep track of our ideas as we're figuring them out so that we can return to them over time. Look and listen for students' suggestions for recording our class' ideas on a chart or other public space. (Lesson 2, Teacher Guide)
- Lesson 3, Synthesize Section, Step 6: "Display the class's Our Growing Ideas chart (refer to slide J). Remind students that we started this chart in our last lesson to keep a record of what we are figuring out about our lesson set question, How do objects make and send sound signals? This is a big question that we are answering through our investigations and science work in each lesson! Today, we will be able to add what we have figured out through our instruments investigation and our book." (Lesson 3, Teacher Guide)
- Lesson 4, Synthesize Section, Step 6: "Add to Our Growing Ideas chart. Display Our Growing Ideas chart (refer to slide K). Remind students that we are using this chart to keep track of what we figure out across our science lessons. If you have not already, ensure that your version of the lesson question is written on Our Growing Ideas chart. The following is an example of how your Lesson 4 row in Our Growing Ideas chart might look. Remember to use your own class artifacts, photos, and students' languages in the chart--this is only a sample." (Lesson 4, Teacher Guide)
- Lesson 5, Synthesize Section, Step 2: "Revisit Our Growing Ideas chart. Remind students that as scientists work to answer their questions, they use new evidence they gather. Display Our Growing Ideas chart (refer to slide C) and connect to its purpose as a tool we have used to keep track of the evidence we have gathered through our investigations. We can use this evidence as we decide what to include in our own models explaining how the clocktower makes and sends its sound signals." (Chapter 5, Teacher Guide)
- Lesson 6, Synthesize Section, Step 3: "Add to Our Growing Ideas chart. Display Our Growing Ideas chart (refer to slide H). Remind students that we are using this chart to keep track of what we figure out across our science lessons. If you have not already, ensure that your version of the lesson question is written on Our Growing Ideas chart. The following is an example of how the Lesson 6 row of your class' Our Growing Ideas chart might look. Remember to use your own class artifacts, photos, and students' languages in the chart." (Add to Our Growing Ideas chart. Display Our Growing Ideas chart (refer to slide H). Remind students that we are using this chart to keep track of what we figure out across our science lessons. If you have not already, ensure that your version of the lesson question is written on Our Growing Ideas chart. The following is an example of how the Lesson 6 row of your class' Our Growing Ideas chart might look. Remember to use your own class artifacts, photos, and students' languages in the chart." (Lesson 6, Teacher Guide)
- Lesson 7, Synthesize Section, Step 6: "Update Our Growing Ideas chart. Gather students in the Scientists Circle and display Our Growing Ideas chart (refer to slide J). Remind students of our Lesson Set 2 question, How can we make sound signal devices to communicate a good news message across our classroom?, and explain that keeping track of what we figure out as engineers will help us answer this question." (Lesson 7, Teacher Guide)
- Lesson 8, Synthesize Section, Step 5: "Gather students in the Scientists Circle. Gather students in a Scientist Circle for a Building Understandings Discussion, ensuring students can see Our Growing Ideas chart (refer to slide J)." "Prepare

to update Our Growing Ideas chart. Remind students of our lesson question, How can we use materials and our drawn designs to build our sound signal devices? If you have not already, ensure that your version of the lesson question is written on Our Growing Ideas chart. Then, co-construct our current understandings about what we have figured out using the prompts below." "The following is an example of how your Lesson 8 row in Our Growing Ideas chart might look. Remember to use your own class artifacts, photos, and students' languages in the chart. (Lesson 8, Teacher Guide)

- Lesson 9, Synthesize Section, Step 6: "Discuss our work as engineers and add to Our Growing Ideas chart. Gather students in a Scientists Circle and ensure students can see Our Growing Ideas chart (refer to slide J) and images and artifacts you have gathered from this lesson and/or printed from the Printable Chart Images reference to facilitate a Building Understandings discussion. If you have not already, ensure that your version of the lesson question is written on Our Growing Ideas chart." (Lesson 9, Teacher Guide)
- Lesson 10, Synthesize Section, Step 5: "Gather students in a Scientists Circle, again inviting them to sit next to their engineering partners, with their built sound signal devices on display in front of them, in the Scientists Circle. Ensure students can see their Device Gotta-Have-It Checklist and Our Growing Ideas chart (refer to slide H) as references during this discussion. Begin by acknowledging and celebrating everyone's hard work! Then suggest that we revisit our lesson set question that we have been working to figure out over the last lessons: How can we make sound signal devices to communicate a good news message across the classroom?" " Suggest to students that we begin with a focus on how we engaged in our figuring out work; how we used engineering. For Lessons 7-9, for each lesson's row on Our Growing Ideas chart, invite students to think first, then pair with a partner to consider what they recall figuring out in each lesson and what evidence we gathered to support our claims." (Lesson 10, Teacher Guide)

Notice and Wonder Chart:

- Lesson 3, Navigate Section, Step 7: "Return to the Notice and Wonder chart. Display the class Notice and Wonder chart (referenced in slide K), with your Initial Class Model from Lesson 1 attached to it or included as a picture. Provide a quiet minute for students to recall our writing and drawing on the chart." "Turn and talk about what we now know. Invite students to turn and talk about what we have figured out related to the first part of our lesson set question: How do objects make sound?" "Using a method that works well for your class, mark questions we have now answered (likely about how bells and other objects make sound and/or questions about bells or other instruments and objects) using a check, highlighting them in a specific color, or using a strike-through or underline." (Lesson 3, Teacher Guide)
- Lesson 5, Navigate Section, Step 1: "Decide to develop updated models. Summarize for students that we have many ideas that seem to have changed; it seems like we have figured out a lot! Ask students what we could do to show our new ideas. If students do not suggest developing new models, offer that idea and suggest that we use some time together to recall the work that we have done so far in this science unit. Invite students to point to resources around the room that we could use to help us recall our work, anticipating students will likely point to Our Growing Ideas chart, the Word Wall, the Initial Class Model, and/or the Notice and Wonder chart. Tell students we can begin using many of these resources next!" (Lesson 5, Teacher Guide)
- Lesson 6, Navigate Section, Step 6: "Gather students in a Scientists Circle in view of the prepared Ideas and Wonders chart (refer to slide K) for a discussion about making sound signal devices to solve our engineering problem of needing a way to communicate good news (send good news messages) across the classroom. Explain that in engineering it is important to share our ideas and questions (what we wonder) so we can keep track of our thinking as we try to solve our engineering problem; this chart will guide our work as engineers, just like our Notice and Wonder chart guides our work as scientists." (Lesson 6, Teacher Guide)

Students receive feedback and revise their thinking accordingly.

- Lesson 2, Explore Section, Step 5: "As students complete their investigation, have them compare their observations with another partnership. Encourage students to use their recorded observations on their Triangle Investigation

Observations handout to compare what they heard, saw, and felt. If groups of students notice their recorded observations are different, encourage students to use their triangle and striker to make additional observations and to update their Triangle Investigation Observations handouts. These comparisons support students in clarifying their experiences and recorded observations and help prepare for making sense of their data as a whole class. (Lesson 2, Teacher Guide)

- Lesson 5, Synthesize Section, Step 3: "Continue drawing and writing models. Provide students with additional time to follow through with the next steps in developing their models while you continue to interact with individuals to discuss and provide feedback and support." (Lesson 5, Teacher Guide) This is an example of verbal feedback, and it is not clear if feedback is specific to all students or if students have the opportunity to revise models according to the feedback.
- Lesson 7, Explore Section, Step 4: "Draw and write ideas. Encourage students to draw, write, and use labels and other representations (lines, arrows) to explain their ideas. While students draw and write their designs, circulate and use the following prompts to support students in expressing their ideas in their design. If needed, support students in drawing their ideas clearly by demonstrating how the materials can be drawn using familiar two-dimensional lines and shapes; for example, a three-dimensional rubberband can be drawn as a circle or oval." "While students are drawing and writing on their Sound Signal Device Design handout, you have an opportunity to gather evidence about learning goal 7 (aligned to Assessment Statement 2), with the purpose of providing feedback to support students in planning their designs and explaining how they will work to make a sound signal. Look and listen for students connecting parts and materials of the design plan to the items on the Device Gotta-Have-It Checklist." Suggested prompts include: "What will your device look like?" "How will the parts of your device work to make a sound signal?" (Lesson 7, Teacher Guide) This is an example of verbal feedback, and it is not clear if feedback is specific to all students or if students have the opportunity to revise models according to the feedback.
- Lesson 8, Explore Section, Step 3: "While students work in pairs to build their sound signal devices, you have an opportunity to gather evidence about learning goal 8, with the purpose of providing feedback to support students in using materials to design their sound signal devices. Use the provided prompts to give students feedback they can act on right away, particularly in ways that provide support around the device's structures/parts and their function in making and sending a sound signal across the room." "As students build, continue to support them in using their drawn designs and the Device Gotta-Have-It Checklist as a guide (refer to slide G). While partnerships build their sound signal devices, engage pairs in discussions using the prompts below." Suggested prompts include: "What parts/materials does your sound signal device have?" "Which parts/materials are you using in your device to make and send a sound signal? How does it work?" (Lesson 8, Teacher Guide)
- Lesson 9, Explore Section, Step 5: "Give peer feedback. Ensure engineering partnerships reconnect with the other partnership that formed their small groups used for testing their devices. Provide each partnership a few minutes to give feedback to the other partnership in their small group. Circulate and support students in using the sentence stems and evidence from their tests while they provide feedback. Ensure slide I is available for students to reference." Prompts include: "If we revised our designs, what could we do if our device did not make sound? What if it did not send a sound signal across the classroom?" "If we revised our designs, what could we do if our device did make sound? What if it did send a sound signal across the classroom?" (Lesson 9, Teacher Guide)

Criterion-Based Suggestions for Improvement

- Consider additional opportunities for students to receive individual feedback and revise their thinking accordingly.
- Consider additional ways to provide feedback, beyond verbal feedback, to make sure feedback is specific to help all students learn.

II.C. Building Progressions

EXTENSIVE

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.

The reviewers found **extensive** evidence that the materials identify and build upon students' prior learning in all three dimensions because a progression of learning toward targeted elements of all three dimensions is described for teachers. Learning progresses logically through the materials. However, there is limited evidence of the expected level of proficiency students should have with individual elements of all three dimensions.

i. Explicitly identifying prior student learning expected for all three dimensions

The Unit Front Matter, Unit Overview, pp. 22-24, includes prior learning expectations for the identified targeted dimensions in the unit. However, this guidance is not found at the element level for each dimension. For example:

- SEP: Planning and carrying out investigations: "Children enter school with experiences noticing things in the world and asking questions about what they experience. They may carry out investigations to answer these questions (e.g., if I kick the ball harder, does it go farther?). In kindergarten, students build on this work by learning that scientists make careful observations about the world around them to answer questions. If students have had experiences with OpenSciEd units in kindergarten, students will enter this unit with additional experiences with the practice of planning and carrying out investigations from the Unit K.1: Why do some surfaces get hot and how can we make them less hot? and Unit K.3: How can we move things to where we want them to go?. In kindergarten, the teacher guides students in planning and carrying out their investigations, and they always collaborate with the class or a partner. In 1st grade, students are supported in planning and carrying out investigations collaboratively within their small groups and then in partnerships, with students increasingly making decisions as units progress. In the Unit 1.1: How can we read under covers when it's dark?, students have multiple opportunities to determine what materials can be used, how to set up materials in ways that provide for shared data collection, and sequencing investigation steps in investigations involving light." (1.2 Waves Sound Unit Front Matter)
- CCC: Cause and Effect: Young children will enter 1st grade with many experiences with cause-and-effect relationships that help them understand this crosscutting concept. For example, students may understand that if they do something (e.g., flip a light switch up), something else happens (e.g., the light turns on). OpenSciEd kindergarten units allow students to deepen their use of Cause and Effect to explain patterns they observe. For example, students gain experience with this crosscutting concept with a card sort to identify examples of causes and effects. Students are then supported in identifying patterns we can observe from these relationships (e.g., "When that happens, what is usually the effect?"). In 1st grade, students continue to work on using observable patterns to identify cause-and-effect relationships and will begin designing and using simple tests to help gather evidence to uncover these relationships. Students that have completed the Unit 1.1: How can we read under covers when it's dark? will enter this unit with experiences using simple tests to gather evidence support and refute ideas about what causes us to see and what causes a certain amount of light to appear beyond a material." (1.2 Waves Sound Unit Front Matter)
- DCI: Sound: Students will enter first grade with everyday experiences and noticings related to sound such as hearing different sounds with their ears, making different sounds, and feeling vibrations from sounds, although the term vibration is likely new. First graders may also have ideas about how people and animals hear sounds and how these

organisms and varied objects make sounds. Students may consider sound as something that can be "released" from objects. They have experiences that they can hear things making sound from a distance, and may believe that sound travels only to the person/people who hear it. " (1.2 Waves Sound Unit Front Matter)

ii. Clearly explaining how the prior learning will be built upon.

- Unit 1.2, Front Matter, Unit Overview, a table is provided for each of the dimensions which explicitly describes how each will progress throughout the unit. "The following three tables explain how students engage in **Science and Engineering Practices**, use **Crosscutting Concepts**, and figure out **Disciplinary Core Ideas** in this unit's lessons." (1.2 Waves Sound Unit Front Matter)
- Unit 1.2, Front Matter, Unit Overview, answers the question "Where does this unit fall within the OpenSciEd Scope and Sequence?" and lists the SEPs and the K-2 OpenSciEd Units "bold blue indicates intentionally developed; gray indicates opportunities to practice. (1.2 Waves Sound Unit Front Matter) The chart includes the eight SEPs; however, it does not identify the SEP at the element level.

Some guidance is given for how particular dimensions will progress over time: Sidebars in Teacher Guides provide information about prior student learning and how prior learning in each of the dimensions will be built upon. For example in Lesson 2:

- **Science and Engineering Practices:** Lesson 2, Explore Section, Step 3: **Planning and Carrying Out Investigations**, "As students discuss their strategies for and observations of using the triangle to make sound, they have an opportunity to consider how they started their (informal) investigation with a question: How does a triangle make sound? They also identify a need for shared strategies for making sound and for making and recording observations. Such planning is an important part of scientific investigations because it leads to comparable observations that can be used as evidence." (Lesson 2, Teacher Guide)
- **Crosscutting Concepts:** Lesson 2, Synthesize Section, Step 7: Teaching Tip, "If your students already completed Unit 1.1: How can we read under covers when it's dark?, they will be familiar with using **cause-and-effect** relationships to explain investigation results. Support students in making sense of this lesson's new cause-and-effect relationship (movement/shaking of the triangle causes sound) by helping students recall how different materials cause it to be brighter/dimmer underneath and/or how illumination causes an object to be seen.
- **Disciplinary Core Ideas:** Lesson 2, Explore Section, Step 5: Teaching Tip, "In this lesson, students may focus on their initial action of striking the triangle and identify themselves as causing the triangle to move and/or make **sound**. Support students by instead helping them focus on making observations of the object (the triangle) making sound by looking at it and touching it when/while it is making sound and when/while it is not. For students familiar with Unit K.3: How can we move things to where we want them to go?, you can connect how their actions (pushing/pulling) caused the triangle's initial motion." (Lesson 2, Teacher Guide)

Criterion-Based Suggestions for Improvement

- Ensure that "materials explicitly identify the expected learning and communicate a plan for how that learning will be enhanced during the outlined learning experiences." Additionally, materials should "explicitly state the expected level of prior proficiency students should have with individual elements of all three dimensions for the core learning." [Detailed Guidance, p. 24]

II.D. Scientific Accuracy

EXTENSIVE

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

The reviewers found **extensive** evidence that students use scientifically accurate and grade-appropriate scientific information, phenomena, and representations to support students' three-dimensional learning. All science ideas and representations included in the material are accurate, and student-facing materials have precise, grade-appropriate wording.

An "About the Science" document includes a response to "What science ideas will students figure out in this unit?" and includes information about "What are the boundaries of the science ideas for this unit?" (1.2 Waves Sound About the Science) The books provided include accurate, grade-level appropriate information. For example:

- Lesson 1, Connect Section, Step 2: What's that Sound? book cover page includes a picture of a first-grade student, page 7 includes a picture of a steering wheel with the question "Someone honks the horn on the steering wheel of their car. Why is the car horn honking?" (What's that Sound book)
- Lesson 4, Connect Section, Step 5: "Summarize for students that some of us shared experiences where we have felt movement or vibration when we heard sounds in our homes and communities; we described other experiences when sounds caused objects to vibrate. Suggest to students that you have an "In Our Communities" book that we can use to connect to even more people's experiences with sounds and objects!" (Lesson 4, Teacher Guide)

Student-facing slides include accurate, grade-level, appropriate information. For example:

- Lesson 2, Navigate Section, Step 1: "Introduce the triangle and striker. Connect to students' ideas and experiences with different musical instruments by displaying the image on slide B and holding up a triangle and striker. You might tell students something like, "I used your suggestions to find instruments for us all to play and explore. We have many of these cool instruments called triangles that we can use!" Have students turn and talk with a partner about the following question: Have you ever seen something like the triangle? If so, share about your experience." (Lesson 2, Teacher Guide)
- Lesson 7, Slide 8 has images under the title "Plan a design." The images include a paper plate, pie tin, paperclips, plastic spoons, craft sticks, straws, plastic cup and lid, twine and rubber bands. Each image is labeled. (1.2 Lesson 7 Slides)

Students are encouraged to express their scientific ideas and re-examine their ideas in light of new evidence. For example:

- Lesson 3, Synthesize Section, Step 2: "Revisit the Triangle Investigation Plan. Remind students that in our last lesson, we planned an investigation that would help us make observations to answer our question, How does a triangle make sound? This time, we want to answer the question, How do other objects make sound? Display the class' Triangle Investigation Plan from Lesson 2 (refer to slide D) and invite students to briefly turn and talk about how we investigated with the triangle during the last lesson. This turn-and-talk and referencing the Triangle Investigation Plan (with its two columns for using the instrument and making/recording observations) supports all students in recalling experiences that can contribute to this lesson's decision-making." "Then, ask students how we could use our experiences with the triangle to plan an investigation to answer our new question, How do other objects make sound? Engage students in a brief discussion to plan an investigation using these instruments."(Lesson 3, Teacher Guide)
- Lesson 5, Navigate Section, Step 1: "Then invite students to turn and talk to each other about parts of the Initial Class Model. The purpose of this discussion is to help students recall what they used to think and identify how their ideas have grown and changed since Lesson 1." "Suggest students use the sentence starter, "I used to think _____,

but now I think _____" to support them in expressing how their ideas have changed over time. The "I used to think" stem supports students in identifying one part of the model, while the "now I think" portion asks them to connect to something they have figured out. Ask a few students to share their ideas, possibly inviting them to the Initial Class Model to point or air-draw as they share how their ideas have changed." "Summarize for students that we have many ideas that seem to have changed; it seems like we have figured out a lot! Ask students what we could do to show our new ideas. If students do not suggest developing new models, offer that idea and suggest that we use some time together to recall the work that we have done so far in this science unit." (Lesson 5, Teacher Guide)

- Lesson 6, Navigate Section, Step 1: "Revisit our questions about sound signals. Using our new vocabulary, remind students that we ended our last science lesson by asking some questions about the different messages that sound signals on Our Examples chart send." "Co-construct the lesson question. Summarize that our questions are all about the messages that sound signal devices send and what people communicate using sound signals. Use students' language and ideas to co-construct a lesson question similar to, What messages do people communicate using sound signals?" (Lesson 6, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

II.E. Differentiated Instruction

EXTENSIVE

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.

The reviewers found **extensive** evidence for teachers to support differentiated instruction by including strong support for whole-class, special needs, and deaf and hard-of-hearing students.

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

- OpenSciEd Elementary Teacher Handbook: UDL and Differentiation "OpenSciEd units are designed to use the principles of Universal Design for Learning to provide equitable and accessible learning throughout.." (OpenSciEd Elementary Teacher Handbook)
- OpenSciEd Elementary Teacher Handbook: "Additional differentiation strategies are available in the math and literacy sections of this handbook. Also, please see the Additional Accessibility Resources document for specific strategies to support all learners in using OpenSciEd Elementary materials. (OpenSciEd Elementary Teacher Handbook

- Lesson 1, Explore, Step 4: Broadening Access, "Placing investigation materials in the middle of the circle for students to refer to supports equitable student discussion and enhances their sensemaking. Materials help elicit ideas as they engage students by stimulating their visual, auditory, and tactile senses, making learning and discussions more accessible and memorable. Being able to reference and use these materials during the discussion also supports students in fully sharing their ideas and questions across modes of expression (e.g., gesturing to or manipulating the materials in addition to sharing verbally)." (Lesson 1, Teacher Guide)
- Lesson 2, Preparation Checklist: "Some students may benefit from additional support as they engage in recording written observations on the Triangle Investigation Observations handout. Review the "Supporting Literacy for All Students" section of the Teacher Handbook for ways to scaffold this task for students based on their individual needs." (Lesson 2, Teacher Guide)
- Lesson 2, Explore Section, Step 4: Broadening Access sidebar " Think, Pair, Share allows students a few moments to form their thoughts (Think), then discuss with a partner (Pair), then volunteer to explain their thinking to the class (Share). This structure is especially helpful for multilingual learners and children who are more comfortable sharing with one person than the whole class. Encourage student pairs to use whatever modalities of expression they choose: gestures, named languages other than English, etc." (Lesson 2, Teacher Guide)
- Lesson 3, Explore Section, Step 2: "When inviting volunteers to share ideas, we risk hearing from the same few students every time. For a more equitable distribution of science talk, ask students (during partner talk) who have not shared recently if they would like to share during the whole group discussion. This invites new voices in a way that feels socially safe, promoting confidence and willingness to engage in class discussions. (Lesson 3, Teacher Guide)
- Lesson 4, Navigate Section, Step 1: Broadening Access "Students briefly observe each other's ears to gather ideas that inform planning their investigation. In order to be inclusive of all students, recognize with your students that people who are deaf typically have ears and that other aspects of our complex body systems may make it difficult for them to hear. Having a hearing-related disability is not a deficiency. People who are deaf have many ways of engaging with sound, if they choose to, and many different ways of communicating. (Lesson 4, Teacher Guide)
- Lesson 5, Connect, Step 5: Broadening Access, "As students share and listen to examples of sound signals related, but not limited, to severe weather and safety that they or others have observed, various types of emotions might emerge. You can facilitate personal coping skills and strategies with the Teacher Handbook resource; which suggests strategies you can use to support students around these emotions using a three-step routine: Be Curious, Validate, and Thank the Student." (Lesson 5, Teacher Guide)
- Lesson 6, Explore Section, Step 2: Broadening Access, "If you have a student(s) with a disability related to mobility, you will need to adjust this table tour to ensure their equitable participation. Work with the student's case manager as needed, but ideas for providing multiple means of engagement include taking pictures of students' card sorts to view digitally or having each pair of students share and compare their card sorts with the pair next to them instead of moving around the room." (Lesson 6, Teacher Guide)
- Lesson 7, Synthesize Section, Step 5: "Take a movement break to put away materials. Before continuing with the lesson, have students stand up to put away their Sound Signal Device Design handouts and writing utensils, do a quick stretch together, then return to a Scientists Circle. Students will need their completed Sound Signal Device Design handouts again in Lesson 8." (Lesson 7, Teacher Guide)
- Lesson 10, Navigate Section, Step 1: Broadening Access, "If you have students with public speaking or social interaction anxieties, plan to speak privately with them before students' presentations to agree on accommodations that will help them accomplish the task while self-regulating and developing healthy emotional responses (e.g., pre-recording audio or video, presenting in smaller groups). If appropriate, motivate students who might be nervous to present by highlighting the fact that they have done a lot of hard work and that their ideas are important and worthy of sharing with others." (Lesson 10, Teacher Guide)

- Lesson 10, Synthesize Section, Step 3: "Both students in a pair need opportunities to present to their classmates, so encourage students to decide which information each student will share to ensure all voices are heard. Supporting all students in science classroom experiences is important for developing science identities, and is especially critical for those from non-dominant groups (girls, minoritized students of color) that have been historically excluded from science." (Lesson 10, Teacher Guide)

Differentiation strategies address the needs of students when an obvious need arises:

Emerging multilingual students learning English

- OpenSciEd Elementary Teacher Handbook: Supporting Multilingual Students, "OpenSciEd teacher materials also include educative features that are focused on multilingual students, such as callout boxes on the margins of the teacher guides. These educative features support teachers in considering whether particular learning moments might be spaces where they can leverage their multilingual students' language-related assets and/or address potential challenges the students might encounter. These educative features also help teachers provide additional in-time support and they explain why these instructional moves are important for multilingual students. They also range greatly, from suggesting particular ways to group students to unpacking the meaning of certain words in the context of students' scientific sensemaking work. (OpenSciEd Elementary Teacher Handbook)
- Lesson 2, Connect Section, Step 3: Teaching Tip Extension Opportunity: "Consider making this book (and others from the unit) available to students in the print version or on devices so they can read it again during other times of the day and can have access to the information in various ways. Offering ways of customizing the display of information can support students in further obtaining information from texts and/or noticing text features in ways that support both their science and literacy learning." (Lesson 2, Teacher Guide)
- Lesson 3, Explore Section, Step 3: Broadening Access, "Allow students to share their experiences of a time they felt vibrations and heard sounds outside of school (e.g. vibrations of drums, vibrating cell phones, electric toothbrushes). These opportunities maximize transfer and generalization, and can be an important opportunity for students with hearing related disabilities or who have family members with hearing related disabilities to pull from their background knowledge." (Lesson 3, Teacher Guide)
- Lesson 3, Synthesize Section, Step 6: Broadening Access, "To enhance students' language learning and language-use opportunities, consider using the Discussion Supports handout. This handout provides discussion phrases that students can use to support their sensemaking work. These phrases will help students fully explain their ideas, attune to and make sense of their peers' ideas, and build off of ideas shared by classmates." (Lesson 3, Teacher Guide)
- Lesson 6, Connect Section, Step 4: Literacy Supports, "The word engineer can be multiple parts of speech. It can be used as a noun, to mean a person's job, or as a verb to mean the action some people take to address problem(s) in the world around us. Draw students' attention to the way this word is used to help deepen their understanding of the multiple meanings and uses of the same word. Remind students about the differences between nouns and verbs to clarify how the different meanings can be applied in different contexts." (Lesson 6, Teacher Guide)
- Lesson 7, Connect Section, Step 2: Literacy Supports, "Remind students that text features, like headings and a table of contents, can be used in a variety of ways to locate and use important information in a text." (Lesson 7, Teacher Guide)

Learners with special needs (visual impairments, tactile engagement, etc.)

- Lesson 1, Connect Section, Step 1: Broadening Access, "Continue to activate and supply background knowledge, especially for any student(s) with hearing-related disabilities. As students make connections to sound signals in their everyday lives, you can encourage experiences with signals that rely on multiple senses (e.g., alarm clocks that ring and have a flashing light) as a way to support all students' equitable participation." "To offer alternatives for auditory

information and provide multiple means of engagement consider placing a hand on the speaker while the audio/video plays in order to feel vibrations caused by sound (a science idea students figure out in Lesson 4). If you have a student(s) with hearing-related disability, see accommodations on IEP or 504 plan and work with the student's case manager as needed."(Lesson 1, Teacher's Guide)

- Lesson 2, Navigate Section, Step 1: Broadening Access, "To minimize threats and distractions in this Explore, especially for any student(s) with hearing-related disabilities, provide accommodations for students following their IEP or 504 plan, or work with students' case managers as needed. Some ideas for fostering a safe space for students investigating sound and vibrations include: ensure students are in close proximity to the object making sound, provide every student with the opportunity to hold/touch the object, and validate students' experiences with the object." (Lesson 2, Teacher Guide)
- Lesson 3, Explore Section, Step 2: Broadening Access, "To ensure all students' access to learning, especially any student(s) with hearing-related disabilities, provide accommodations for students following their IEP or 504 plan. In this lesson, ensure every student has the opportunity to touch the instruments while they are making and not making sound. Additionally, consider partnering students and directing them to describe out loud to each other their auditory and tactile observations." (Lesson 3, Teacher Guide)
- Lesson 3, Explore Section, Step 3: Broadening Access, "This lesson could get loud, especially for students who are sensitive to loud sounds or experience other sensory challenges. Consider providing noise-canceling headphones for students who need them and establishing a calm, quiet area where students can take sensory breaks. You might also establish a signal for students to use when they need a break, especially if they might need to leave the classroom. Doing this investigation in a more open or outdoor area could also be beneficial." (Lesson 3, Teacher Guide)
- Lesson 6, Explore, Step 5: Broadening Access, "If there are students with hearing disabilities in your classroom, it may be important to design devices that communicate using different methods. With students, use the clocktower as an example: it has a bell and also has a clock to communicate the message about time auditorily and visually. Students can use this example as inspiration for how they might think about making their devices accessible to all students in your classroom. (Lesson 6, Teacher Guide)
- Lesson 9, Explore Section, Step 4: Broadening Access, "Some children may experience sensory challenges related to sound while multiple teams are testing signal instruments at once. If this occurs, the engineering partnerships could test their solutions in the hallway or a quieter location if another classroom adult is present. If available, students could wear noise-canceling headphones and make observations by feeling and looking for vibration." (Lesson 9, Teacher Guide)

Learners reading below grade level

- OpenSciEd Elementary Teacher Handbook: Supporting Literacy for All Students, "The reading and writing tasks included within the program are developed to offer students opportunities to engage with grade-level texts and practice writing skills appropriate for their grade level. However, individual learners' skill levels and needs vary and therefore some students may benefit from differentiated materials and/or instruction to enhance their science learning. In these instances, teachers can use their knowledge of the task and the students to use instructional scaffolds that support students' sensemaking. Literacy scaffolds afford students the opportunity to access grade-level texts and writing tasks alongside their peers. Scaffolding can occur before, during, and after literacy activities. Scaffolds listed in the following tables can be used during read alouds, scaffolded independent reading, and writing. These scaffolds provide options for increasing and lessening the demands of literacy activities throughout the program. Any of the suggested scaffolds or a combination of these could be applied to support students' science learning across grades K-5. However, it is important to reiterate that teachers should identify and use literacy scaffolds in response to students' needs to engage with texts in the program and complete writing activities. (OpenSciEd Elementary Teacher Handbook) This is generalized support for students reading below grade level.

- Lesson 2, Connect Section, Step 3: Literacy Supports, As students ask and answer questions while reading, model how to use personal and possessive pronouns (e.g., I, me, my; they, them, their; our, ours) as students compare events in the book with actions that the class has taken personally and collectively to make observations in their investigations. Encourage students to use these forms in their oral language as they answer questions, too." (Lesson 2, Teacher Guide) This is generalized support and not specific to students reading below grade level.

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

- Lesson 2, Synthesize Section, Step 7: Broadening Access, "Support equitable discussions by providing students with sentence starters. Consider adding these, as appropriate, to the unit slides or other public place in the classroom for students to reference during the Building Understandings Discussion in this and future lessons. "I think _____ because _____., I/we figured out _____. I /our group observed _____." (Lesson 2, Teacher Guide)
- Lesson 3, Explore Section, Step 4: Broadening Access, "Surface or suggest multiple different ideas about how cause and effect could be represented on the Instruments Investigation data table. These could include a combination of labels, written sentence, color codes, shading, arrows, or other representations. Use the multiple representations on the data table to engage in a brief discussion, raising students' awareness of the varied ways we can understand and represent science ideas." (Teacher's Guide, p. 28)
- Lesson 4, Step 2, Explore Section: "In this investigation, student pairs will be recording their observations directly onto the class Sprinkles Investigation data table. Differentiate this for any students who need additional support by providing a recording handout that parallels the Sprinkles Investigation data table. One way to do this is to edit the Instruments Investigation Observations handout from Lesson 3 by removing additional rows, changing one instrument to an image of a drum, and updating headers/text as needed." (Lesson 4, Teacher Guide)
- Lesson 5, Synthesize Section, Step 3: Teaching Tip, "Some students may need additional scaffolding as they individually develop models of how the clocktower makes and sends sound signals. Consider providing students an individual copy of the class Gotta-have-it checklist and suggest they check off or cross out items as each is added to their model. This can help break goals into smaller short-term objectives and give students time and space to think about and plan their model." (Lesson 5, Teacher Guide)
- Lesson 8, Navigate Section, Step 1: Broadening Access, "Provide multiple means of engagement as you review questions on the Ideas and Wonders chart by inviting students to read some questions aloud (a single student at a time or the whole class at once with quiet voices), point to similar questions after you read one aloud, use gestures to restate the questions, and/or explain the drawings and symbols on the chart. In addition to reorienting students to where we left off, this will help prepare all students to engage in co-constructing the lesson question." (Lesson 8, Teacher Guide)
- Lesson 9, Explore Section, Step 5: Teaching Tip, "If students need additional support in planning an investigation that involves making observations of their sound signal devices, consider re-reading the Scientists Make and Record Observations book from Lesson 2, referencing previous class Investigation Plans from Lessons 2-4, and/or referencing Our Growing Ideas chart to recall how we gathered evidence that support our claims in Lessons 2-4. (Lesson 9, Teacher Guide)

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.

- Lesson 4, Navigate Section, Step 1: Teaching Tip, "Extension opportunity: If students are interested in further exploration around the idea of sound traveling, consider supporting them in planning and carrying out additional investigations. Students may want to test how far away they can hear the sound of the drum; in what directions; and/or in what environments (in the gym, outside). They may also want to use different objects/instruments to make

sound." (Lesson 4, Teacher Guide) This is an example of high interest students and students who have already met the performance expectations being given additional work that does not develop a deeper understanding of the three dimensions.

- Lesson 5, Connect Section, Step 5: Broadening Access Extension Opportunity, "Consider expanding students' identification of sound signals into a "sound signal scavenger hunt" to include other spaces around the school. This may be familiar to students who went on the Light Scavenger Hunt in Unit 1.1: How can we read under covers when it's dark? For example, the schoolyard, gymnasium, and cafeteria are all places where students may be able to observe sound signals made by objects. These additional examples can further broaden and enrich students' experiences and connections across the science classroom and other spaces and further support students in the next lesson set as they consider how people use these objects and sound signals to communicate." (Lesson 5, Teacher Guide) While this is identified as an extension activity, it would be acceptable for all students to participate in it and does not help students deepen their understanding of the practices, disciplinary core ideas, and/or crosscutting concepts.
- Lesson 6, Navigate Section, Step 6: "Extension Opportunity: If your class has completed Unit 1.1: How can we read under covers when it's dark? and has access to those materials, you could consider incorporating light into design solutions. If your students are not already thinking about designing devices that communicate using multiple methods, but are interested in doing so, you may choose to extend their engineering work to include devices that use both light and sound to communicate a message. If students have begun to think about communicating in multiple ways to increase accessibility, you may use those materials to support that work and/or extend their use of visual communication to include light specifically." (Lesson 6, Teacher Guide)
- Lesson 8, Explore Section, Step 3: Teaching Tip, Extension Opportunity, "Students may want to use their device to come up with a unique signal they can use to communicate a very specific good news message. For example, they may build a sound signal device using a rubberband to make sound and then decide that a signal of two "twangs" means one kind of good news, while three "twangs" means a different kind of good news. This extension can be for students who finished creating a working built design early and have an interest in exploring different ways their device could use the same sound to send different signals." (Lesson 8, Teacher Guide)
- Lesson 9, Explore Section, Step 5: Teaching Tip, "If students are interested in using their recorded observations from testing to analyze the class' overall success in designing devices that send sound signals, support them in co-designing a data table to represent successful (thumbs up) and unsuccessful (thumbs down) tests for "across the classroom." Students can use data tables from Lessons 2-4 as a reference. You may also want to include pictures of the built designs (or use a floor chart with the built designs). This encourages a continued exploration of designs through the lens of structure-and-function while also ensuring the class is not emphasizing student engineers as successful or unsuccessful." "Students may be interested in revising their built devices. If time allows, give students the opportunity to revise, rebuild, and/or test improved sound signal devices. It is a regular practice for engineers to revise their ideas and move between planning, building, and testing while developing solutions." (Lesson 9, Teacher Guide)

Criterion-Based Suggestions for Improvement

- Ensure students who read below grade level are provided with additional support.
- Consider extensions that help students who have already met the performance expectation(s) or who have high interest in the subject matter and are ready to develop a deeper understanding (versus extending the learning) in any of the three dimensions.

II.F. Teacher Support for Unit Coherence

EXTENSIVE

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.

The reviewers found **extensive** evidence of teacher support for unit coherence. The materials support teachers in facilitating coherent learning experiences over time by supporting teachers to help students see how the lessons fit together and help students see how the learning objectives work together in service of sensemaking. Teachers are provided with facilitation suggestions to help students develop curiosity about learning that is planned for future lessons and ask questions that are then answered in subsequent lessons.

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.).

- Unit 1.2 Waves/Sound Front Matter document, a storyline for the unit is provided. This storyline includes the following information for each lesson: The phenomenon, what students will do, what they will figure out, and how to navigate to the next lesson in the sequence. (1.2 Waves Sound Unit Front Matter)
- Each lesson begins with a narrative that explains what was accomplished in the previous lesson, what will be accomplished in the next lesson, and what students will do and figure out in the current lesson.
- Lesson 1, Explore Section, Step 4: "Support students in generating questions. Consider supporting the class in articulating ideas they are uncertain about or ideas they will investigate further as questions by saying something like, "I notice that we have some different ideas about how bells make sound. Is that something we are wondering? How can I write that as a question we have?" (Lesson 1, Teacher Guide)
- Lesson 1, Navigate Section, Step 6: Consider Where to Go Next, guidance is provided to the teacher on how to use the Notice/Wonder chart to determine the next steps in the lesson, "Point out how our lesson set question, *How do objects make and send sound signals?*, at the top of our Notice and Wonder chart has two big questions in it: how objects *make* sound and then how they *send* those sound signals. Suggest picking one of those things to start with and connect to where students had ideas and questions about making sound on the Notice and Wonder chart. You may consider circling or adding stars next to questions in a chosen color to help students see which of their questions on the Notice and Wonder chart are related to how objects make sound. Using the prompts below, engage students in a brief discussion generating ideas about how to pursue answers to our questions about how objects make sound. Invite students to turn and talk with a partner and then share ideas with the class. How do you think we could figure out how an object makes sound? We explored using handbells today; what are some other objects we could explore with? Why would you like to try that?" (Lesson 1, Teacher's Guide, p. 43) Students revisit the Notice and Wonder chart in lessons 2, 3, and 4.
- Lesson 2, Synthesize Section, Step 7: "Explain to students that it is important in science to keep track of what we figure out and how we figured it out, just like it is important to record our observations. For this reason, we will use this chart to keep track of what we have figured out throughout the unit. It will be important for us to listen to and

connect with what other students have shared as we discuss what we think we have figured out and where we still have questions." (Lesson 2, Teacher Guide) Students return to the Growing Ideas Chart in Lessons 3, 4, 6, 7, 8, and 9.

- Lesson 6, Navigate Section, Step 6: Create Our Ideas/Wonders chart, students "co-create our Ideas and Wonders chart by adding our initial ideas and questions about making sound signal devices and use the chart where to go next." (Lesson 6, Teacher Guide)
- Students routinely return to the Idea/Wonder chart to remind them of what questions they still have and to co-construct the lesson question to drive learning. Lessons 7, 8, 9, and 10 begin with students returning to the Ideas/Wonders chart.

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

- Lesson 1, Explore Section, Step 3: Planning and Carrying Out Investigations, "Students make observations using their senses when they listen to the clocktower's sound, watch and listen to the video of the clocktower, look at the image of the bells in the clocktower, and explore handbells in small groups using multiple senses. Students further build on these experiences in Lesson 2, when they will read a book about how scientists make, record, and use observations and then use this additional information to guide their planned investigation of triangles." (Lesson 1, Teacher Guide)
- Lesson 1, Explore Section, Step 4: Structure and Function, "Through this discussion comparing the bells in the clocktower to handbells used in the classroom, students have their first opportunity to consider this relationship (without naming it). Students use structure and function more explicitly starting in Lesson Set 2 when they engineer their own sound signal devices, drawing on their experiences with instruments from Lesson Set 1." (Lesson 1, Teacher Guide)
- Notice and Wonder and Our Growing Ideas Charts
  - Lesson 2, Preparation Checklist: "If you have space, plan to keep both the Notice and Wonder and Our Growing Ideas charts on display since they will be useful for the Navigate at the opening and closing of this and future lessons. Alternatively, some teachers keep both charts on an easel to quickly flip back and forth as needed. If you do not have the space or equipment to make both charts available during each Navigate, keep sticky notes within reach and use those to document students' questions and ideas in the moment, and then add them to the relevant charts at a later time." (Lesson 2, Teacher Guide)
- Lesson 3, Explore Section, Step 4: Cause and Effect. During this data analysis discussion, students use their observations of the instruments in this investigation as evidence that the instruments' movements cause sound. This extends the cause-and-effect relationship students identified in Lesson 2 (with the triangle) to other instruments. Students will continue to use cause-and-effect to make sense of data in Lesson 4, then with sounds causing vibrations in other materials. (Lesson 3, Teacher Guide)
- Lesson 4, Explore Section, Step 4: "Confirm sounds can cause other objects to move. Confirm with students that their observations - seeing the sprinkles on the plastic cover move and feeling the vibrations in the tube - are evidence that sounds can cause objects/materials to vibrate!" (Lesson 4, Teacher Guide)

Teacher Guides include "In the previous lesson," "What we do" in this lesson, and "In the next lesson" information. For example Lesson 3

- In the previous lesson: "In the previous lesson, we planned and conducted an investigation making observations of a triangle when it made sound and when it did not. We used these observations as evidence to make a claim about how a triangle makes sound."

- What we do: "In this Investigation Lesson, we want to figure out if other objects make sound when they move (like the triangle). We plan an investigation to observe different instruments making sounds. We use our recorded observations to determine what causes an instrument to make sound and identify a pattern that also applies to the triangle and bell from previous lessons. Then, we read a book to connect our experiences with instruments to examples of other objects and materials making sounds."
- In the next lesson: "In the next lesson, we will plan and carry out an investigation to make observations providing evidence that sounds travel and are received. We will co-develop a data table to organize our observations and then read a book to make connections across our and others' experiences."

Criterion-Based Suggestions for Improvement: N/A

II.G. Scaffolded differentiation over time

ADEQUATE

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.

The reviewers found **adequate** evidence that support is provided to help students engage in the practices and that supports can be gradually adjusted over time so that students are increasingly responsible for making sense of phenomena and/or designing solutions to problems. Materials claim that the following SEP elements are intentionally developed: MOD P3, INV P2 P4, and CEDS P2. These elements are claimed as intentionally developed. Scaffolding generally occurs at the level of the SEP and not at the level of the element. Several targeted elements occur in only one lesson, and can therefore not have scaffolded differentiation over time in this unit.

MOD: Developing and Using Models

MOD - P3: Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). Claimed in Lesson 5.

- Lesson 1, Synthesize Section, Step 5: Teacher guidance is provided to lead the students through the development of an initial consensus model. Suggested prompts are provided to guide the development of the initial model for the purpose of answering the question, "How does a clocktower make and send sound signals?" (Lesson 1, Teacher Guide)
- Lesson 5, Synthesize Section, Step 2: Build a Gotta-Have-It Checklist, guidance is provided to "facilitate a discussion about parts of the model". Students are asked to "turn and talk about what parts they should include in their own models." The teacher and the students then co-create a "Gotta-Have-It" checklist for the model the will create in step 3. (Lesson 5, Teacher Guide) This is an example of an additional tool to use when developing a model. It is not a scaffold for representing amounts or relative scales.
- Lesson 5, Synthesize Section, Step 3: Students develop a model to explain how the clocktower makes and sends sound messages."Once students have had an opportunity to engage in some drawing and writing, display slide F and the Gotta-Have-It Checklist. Gather students' attention and explain that we will be pausing to use the Gotta-Have-It Checklist to reflect on our progress so far. For each item on the checklist, ask students to give a thumbs up if they have included that in their drawing and writing, and a hand up if they are still working on it or have things

they would like to add or change. Explain that this is a way to help us figure out what we still need to work on." (Lesson 5, Teacher Guide) This is an example of students becoming independent in the development of a model; however, it provides the same tool as in Step 2 and does not show evidence of student knowledge and skills in using a model to represent amounts, relative scales, or patterns.

INV: Planning and Carrying Out Investigations

INV - P2: Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. While students engage in this element multiple times, they do not become more independent in their use of it.

- Lesson 2, Explore Section, Step 4: Plan an Investigation, the teacher is provided with a series of prompts to guide students through the co-creation of a "Triangle Investigation Plan." As they do so, they identify what observations they need to make. Students then conduct the investigation and record their observations on the Triangle Investigation Observation handout.
- Lesson 3, Explore Section, Step 2: Plan an investigation, students return to their "Triangle Investigation Plan" to help them "plan for investigating our new instruments." The teacher then leads the students through the co-creation of an "Instruments Investigation Plan." Students then conduct the investigation and record their observations on the Instruments Investigation Observation handout. While students are expanding this plan from one instrument to multiple instruments, students do not have increased independence in their use of the element.
- Lesson 4, Explore Section, Step 2: Plan an investigation, the teacher guides the students through the co-creation of an investigation plan using a cardboard tube and sprinkles. The teacher then guides the students through the co-construction of a data table to be used during their Sprinkles Investigation. "Notice columns in past Investigation Plans. Refer to the past investigation plan(s) from Lesson 2 and/or 3 and invite students to notice how we organized the plans into two sections or parts. Ask students to turn and talk with a partner to identify these two parts. Then ask a student to name each section as you point (or invite the student to point on the Investigation Plans): one section is about using an instrument and the other section is about making and recording observations. Suggest to students how these can guide our decisions for making a new investigation plan to answer our lesson question, How can we know sounds travel and are received? (Lesson 4, Teacher Guide) The co-construction of a plan does not demonstrate an increase in student independence in their use of this element.
- Lesson 9, Explore Section, Step 3: Planning and Carrying Out Investigations sidebar: "Students previously planned and carried out investigations to make observations that would provide evidence about how objects and sound interact in Lesson Set 1, addressing their questions about how objects make and send sound signals. Here, they build on that practice in a new context by planning and conducting tests of their designs to gather evidence (using their senses) about how well their devices solve their engineering problem. If students need additional support, consider re-reading the Scientists Make and Record Observations book from Lesson 2." This is an example of an additional portion of the element being addressed; however, planning and conducting tests with the option of reading a text about making and recording observations does not demonstrate an increase in student independence and reduced scaffolding in their use of this element. (Lesson 9, Teacher Guide)
- Lesson 9, Explore Section, Step 4: "Introduce the Testing our Sound Signal Device handout. Then display slide F and use it (or a paper copy) to show students the Testing our Sound Signal Device handout. Support students in noticing how their ideas for what to observe and how to test are captured in this handout! Continue to connect how the parts of the handout coordinate with our Device Gotta-Have-It Checklist." "Show students how Part A

coordinates with our checklist item about making sound by providing an opportunity to test if our device makes sound and providing a place to record our observations using our senses. Show students how they can circle if they hear the sound and if they see or feel vibrations, as well as a place to write the part of their device that moves or vibrates. Show students how Part B coordinates with our checklist item about sound traveling across the classroom. Show students how to circle a thumbs up or a thumbs down to show whether they can hear the device close by and/or across the classroom. Briefly decide with students where in the classroom would count as "nearby" the device (ex, standing next to it) and where would count as "across the classroom." Point out the boxes on the handout where students can draw and write their observations as they test their devices. Remind students how we are gathering data to help us know how well our sound signal devices work to solve the engineering problem of needing a way to communicate a good news message across the classroom." (Lesson 9, Teacher Guide) Teachers pointing out and reminding students is not evidence of students growing in their independence and proficiency with this element.

INV- P4: Make observations (firsthand or from media) to collect data that can be used to make comparisons.
While students engage in this element multiple times, they do not become more independent in their use of it.

- Lesson 2, Explore Section, Step 2: "Summarize for students how we explored with the triangle in different ways and we noticed different things. Some of us noticed the triangle swinging and some of us felt a tingly feeling in our fingers, but not all of us! Some of us paid attention to the triangle when it wasn't making sound, but not all of us did that! Point out how this makes it hard to compare our observations in order to answer our question, and we need to be able to do this as scientists! Suggest that we pause and use a book to figure out more about how other scientists make plans to explore in ways that support them making comparisons and finding answers to their questions." (Lesson 2, Teacher Guide) This is an example of students being told that it is important for scientists to plan and make investigations.
- Lesson 3, Explore Section, Step 3: Carry out an investigation, students conduct a collaboratively planned investigation of instruments (box guitar, shaker, tambourine). Students then engage in a class discussion using the evidence the collected on their instruments investigation handout. "show students the Instruments Investigation Observations handout. Support students in noticing how their ideas for what to observe and how to record observations are captured in this handout! Ensure students notice the two columns to record observations when the instrument is making sounds ("Hear sound") and when it is not making sounds ("Do not hear sound"). (Lesson 3, Teacher Guide) This is an example of students being introduced to a data table. It does not demonstrate increased student independence in the element
- Lesson 4, Explore Section, Step 2: Plan an investigation, the teacher guides the students through the co-creation of a data table to be used during their Sprinkles investigation. In step 4, students participate in a scientist's circle where they respond to teacher prompts to make sense of the data they have collected. Connect making observations to the prepared tube. Again referencing the previous investigation plan/s, point out the "Make and Record Observations" column/s. You may also want to remind students of our earlier suggestions to use our senses of sight and touch to make observations of how we know sound travels and is received. Then, display for students a prepared tube (refer to slide F) while reminding them how we looked at each other's ears to notice things that might help us plan an investigation about receiving sound (since we know that our ears receive sound when we hear things). (Lesson 4, Teacher Guide) This is an example of teachers and students co-constructing a table that can be used to collect observations, it does not demonstrate increased student independence in the element.

CEDS: Constructing Explanations and Designing Solutions

CEDS - P2: Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.

- Lesson 7, Explore Section, Step 4: Plan a Design, students use the Sound Signal Device Design handout to generate a model of their designs for a sound device that will "make and send a sound signal" (Lesson 7, Teacher Guide). Students are provided with a handout, which is an example of students engaged in one portion of the element (designing a device to solve a specific problem).
- Lesson 8, Explore Section, Step 3: Build a Design; students return to their collaborative "Engineering Partnership Design". Students then complete the "Materials Menu" to gather their materials and begin building their sound signal device. "Suggest to students that there are two steps they should complete before gathering their materials from the classroom materials center. First, invite them to turn and talk with their engineering partners to reacquaint themselves with their drawn Engineering Partnership Designs (Part B. on their Sound Signal Device Design handouts) by discussing what their build design will look like; what materials they will use; and how they think it will work. Second, they should circle the materials together using one copy of the Materials Menu handout. Then they will be ready to gather their materials! Turn and talk: What will our built design look like? What materials will we use? How do we think it will work? Complete the Materials Menu handout. While students turn and talk with their engineering partners, ensure each partnership has one copy of the Materials Menu handout and a writing utensil." (Lesson 8, Teacher Guide) This is an example of students engaged in using the element (using materials to build a device that solves a specific problem.) It is unclear if students are increasing in proficiency and independence since they are reacquainting themselves with their original design through discussion and a handout while they prepare to build.

Criterion-Based Suggestions for Improvement

- Ensure students become more independent in their use of all claimed intentionally developed SEP elements.
- Consider providing more teacher support for removing scaffolds over time, especially when the same element is claimed over multiple lessons.
- Consider explicitly identifying how and when scaffolding should decrease across the unit as students increase independence with identified SEP elements.

CATEGORY III

Monitoring NGSS Student Progress

III.A. Monitoring 3D Student Performance

EXTENSIVE

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.

The reviewers found **extensive** evidence that materials elicit direct, observable evidence of three-dimensional learning and that students are using practices with core ideas and Crosscutting Concepts to make sense of phenomena and/or to design solutions. Tasks are driven by well-crafted phenomena. Student performances produce artifacts of integrating the three dimensions in service of sensemaking. Students produce artifacts with evidence of using the grade-appropriate elements of the SEPs, CCCs, and DCIs that are targeted as learning objectives.

Formal tasks in the materials are driven by well-crafted phenomena- and problem-based scenarios that can elicit rich student performances.

The formal tasks are tied to an authentically puzzling anchoring phenomenon and engineering problem. Lesson set 1, Lessons 1 - 5, students are figuring out how the clock tower bells make sounds to send signals. For example:

- Lesson 1, Explore Section, Step 4: "Compare and contrast bells. Support students in noticing how the class handbells and the bells in the clocktower are similar. Engage students in a brief discussion comparing and contrasting the bells and continuing to welcome any previous experiences students may have had with bells. The purpose of this brief discussion is to ensure students recognize that the class handbells are similar objects to the clocktower bells, so observations of these handbells can help us better understand the clocktower bells." (Lesson 1, Teacher Guide)
- Lesson 2, Explore Section, Step 4: "Congratulate students on their work planning an investigation to figure out how the triangle makes sound! With students, review the class' decisions on the Triangle Investigation Plan, remind students to refer to it as they carry out their planned investigation next, and ensure students are prepared to work in partnerships that provide both partners opportunities to use materials and make observations." (Lesson 2, Teacher Guide)
- Lesson 3, Explore Section, Step 2: "Remind students that many of us had ideas about investigating other instruments to figure out how they make sound. Tell students that you were able to gather some different instruments for us to use in our investigation (box guitar, shaker, tambourine and stick) and place one or more of each instrument in the center of the Scientists Circle (refer to slide C)." (Lesson 3, Teacher Guide)
- Lesson 4, Explore Section, Step 2: "Summarize for students that we have ideas about making and recording observations by watching (with our eyes) and feeling (with our hands) the tube and/or its plastic cover. Show students how the plastic cover is difficult to see because it is clear by holding a prepared tube and/or passing it around. Invite students to turn and talk with a partner about how we could make the plastic cover easier to see." "Use students' ideas to make connections to the material you have (colored sugar sprinkles). You might say something like, "Lots of our ideas are really small pieces of something that are colored; I have these sprinkles that I think are like your ideas. We can use these!" As desired, add a title with the word "sprinkles" to the class investigation plan. Confirm and record students' decisions about making observations by holding the prepared tube (feeling) and watching the sprinkles in it to make observations when the drum is and is not making sound." (Lesson 4, Teacher Guide)

Student performances produce artifacts of integrating the three dimensions in service of sense-making or problem-solving.

Lesson 3, Explore Section, Step 2: "As students plan their investigation of instruments and co-create their Instrument Investigations Plan, you have an opportunity to gather evidence about Learning Goal 3 (aligned to Assessment Statement 1)"

- Lesson 3, Lesson Assessment Guidance: "What will students do: **Plan and conduct an investigation to gather evidence** about **what causes objects to make sound."** (Lesson 3, Teacher Guide)

Lesson 4, Explore Section, Step 2: "Invite students to turn and talk with each other about how we should set up the investigation using a drum with its drumstick and a prepared tube. How can we use our materials to investigate how sounds are received?"

- Lesson 4, Assessment Guidance: "What will students do: **Plan and conduct an investigation to gather evidence** that **sounds** travel and **can cause materials to vibrate** (**effect**) when **sounds are received**."

Students routinely produce artifacts with evidence of using the grade-appropriate elements of SEPs, CCCs, and DCIs that are targeted as learning objectives

Teacher Guides include Lesson Assessment Guidance Charts which include responses to the questions "What will students do?" "Assessment Type" "Where can I check for understanding?" "What to Look and Listen for" and "How can I use this assessment information?" For example:

Lesson 2, Lesson Assessment Guidance:

- What will students do: "**Plan and conduct an investigation to gather evidence** about how a **triangle makes sound."** Assessment Type: "Formative" Where can I check for understanding: "In the Explore, when students are planning (slide F) and carrying out (slide G) their investigation, as well as in their recorded observations on their Triangle Investigation Observations handouts (slide G)." What to Look and Listen for: "Evidence of students' ideas may be expressed in words, drawings, written or spoken descriptions, movement, and/or gestures. Students' ideas while **planning their investigation** about **making observations using their senses** that will **provide evidence** about how the **triangle makes sound**. Students **carrying out their planned investigation** in pairs in order to **make and record observations** about how the **triangle makes sound.** Specifically, students will be: **Observing** (**see, feel**) **no movement/shaking** when **the triangle is not making sound** (**hear**). **Observing** (**see, feel**) **movement/shaking** when **the triangle is making sound** (**hear**). Students **recording observations of** the **triangle making** (and **not making**) **sound** on their Triangle Investigation Observations handout." How can I use this assessment information: "Use these formative assessment opportunities to determine how students' three-dimensional thinking around Assessment Statement 1 (aligned to 1-PS4-1) is progressing. You can use the Following Students' Sensemaking 1 tool to keep track of students' developing thinking. At this stage in the unit, it is OK if students have only identified that they can sense movement when there is sound. This cause-and-effect relationship will become more secure in Lesson 3. If students need more support in planning and carrying out their investigation: Draw on students' prior experiences making observations (hearing, seeing, and feeling) from their playing and exploring with triangles, as well as school and everyday life, to help make decisions about what to observe. Guide the student/partnership to focus on each sense one-at-a-time as they make and record observations on their Triangle Investigation Observations handouts. Work with the student/partnership to carry out the investigation one step at a time, referencing the Triangle Investigation Plan while demonstrating directions for using the triangle/striker and making observations. Work with the student/partnership to make observations first when there is sound (and therefore movement/shaking of the triangle) and then when there is no sound (and the triangle is still)."

- Lesson 2, Explore Section, Step 5: Carry Out and Investigation, students conduct an investigation using a triangle and a striker. They collect observations using the Triangle Investigation Observations handout. **Planning and Carrying Out Investigations: Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. (INV-P5). Planning and Carrying Out Investigations: Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. PS4.A. Wave Properties: Sound can make matter vibrate, and vibrating matter can make sound. Cause and Effect: Simple tests can be designed to gather evidence to support or refute student ideas about causes. (CE-P2)** (Lesson 2, Teacher Guide)

Lesson 8, Lesson Assessment Guidance:

- What will students do: "**Build a sound signal device (structure) to solve the problem** of needing a way to **communicate** a good news message **across our classroom (function)."** Assessment Type: "Formative, Self Reflection" Where can I check for understanding: "In the Explore, when students are working with their engineering partner to build their sound signal devices (slide G), and in the Synthesize, when students self reflect on their work in an engineering partnership (slide H) What to Look and Listen for: "**Using materials with particular shapes to build a device that makes sound (function)** How can I use this assessment information: "Use this formative assessment opportunity to determine how students' three-dimensional thinking around Assessment Statement 2 (aligned to 1-PS4-4) is progressing. You can use the Following Students' Sensemaking 2 tool to keep track of students' developing thinking. Though students should be able to use the cause-and-effect relationship that vibrating objects make sound (developed in Lesson Set 1) to design a sound-making device, they may not yet have enough experiences with materials to successfully use structure-and-function relationships in this context of building designs. If students need more support building their sound signal devices and considering how their selected materials function to make and send a sound signal: Invite students to point to each part/material in their built device and describe its function." "If additional support is needed, prompt students by asking about the part/material (structure), e.g.: "What is this rubberband for?" or "Why are you using this cup and plate?" or 'How does this string help your device make and send a sound signal? Alternatively, prompt students by asking about the function, e.g.: 'What part/s are making sound in your device?' Continue to encourage the student/partnership to go to the class Device Gotta-Have-It Checklist, point to each item on it, and point to the part of their built design that helps it do that 'gotta-have-it.'This is also an opportunity for students to reflect on their engineering work as a member of an engineering partnership. Use coordinating discussion and classroom agreements to support students in
- Lesson 8, Explore Section, Step 3: Build a Design, students return to their collaborative "Engineering Partnership Design" models. Students then gather the necessary materials and begin building their device. **Construct Explanations and Design 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. (CEDS-P2) PS4.A. Wave Properties: Sound can make matter vibrate, and vibrating matter can make sound. DCI PS4.C Information Technologies and Instrumentation: People use a variety of devices to communicate (send and receive information) over long distances ETS1.B-P1 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. Structure and Function: The shape and stability of structures of natural and designed objects are related to their function(s). (SF-P1)** (Lesson 8, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

III.B. Formative

EXTENSIVE

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

The reviewers found **extensive** evidence that formative assessment processes evaluate student learning to inform instruction. There are opportunities in every lesson for formative assessment information to be gathered, recorded, and used to inform future instruction.

Materials include explicit, frequent, and varied supports for formative assessment processes.

Each lesson in the teacher's materials begins with a "Lesson Assessment Guidance" that identifies "What will students do?", "Where can I check for understanding?" and "How can I use this assessment information?" The "What will students do?" includes three-dimensional learning goals, "Where can I check for understanding" includes where in the lesson to assess the students and specific look and listen fors, and the "How can I use this assessment information includes instructional guidance in response to the assessment. Some guidance is provided in this section; however, in-depth guidance for all three dimensions is provided in the supplemental Instructional Guidance documents. Formative Assessment Opportunities are clearly identified within the instructional materials. For example:

- Lesson 3, Explore Section, Step 3: "Key formative assessment: As students carry out their investigation of instruments and engage in related discussions, you have an opportunity to gather evidence about Learning Goal 3 (aligned to Assessment Statement 1), with the purpose of providing feedback to students and guiding instruction in upcoming lessons. Encourage students to use gestures, pointing, and spoken language in addition to their recorded observations on their Instruments Investigation Observations handouts as they make connections between the small movements (cause) of parts of the instruments and the production of sound (effect). Refer to the Following Students' Sensemaking 1 tool and the Assessment Guidance at the beginning of this lesson. (Lesson 3, Teacher Guide)
- Lesson 4, Explore Section, Step 3: Assessment Opportunity, "Key formative assessment: Partner discussions provide an opportunity to gather evidence about learning goal 4 (aligned to Assessment Statement 1), with the purpose of providing feedback to students and guiding instruction in upcoming lessons. Encourage students to use their agreed-upon plan to carry out the investigation, taking turns to make observations using their different senses, comparing these between partners, and recording agreed-upon observations on the Sprinkles Investigation data table. Record assessment information on the Following Students' Sensemaking 1 tool and refer to the Instructional Guidance 1 tool and the Assessment Guidance at the beginning of this lesson.
- Lesson 7, Sound Signal Device Design, "Part A: Draw your design in the box. Include your materials. Use lines, arrows, and labels to explain how your device will make and send a sound signal. Part B: Draw your shared design in the box. Use ideas from both partners. Include your materials. On the lines below, write how your sound signal device will make and send a good news message across the classroom." (Lesson 7, handout)
- Lesson 9, Explore, Step 4: Assessment Opportunity, "Key formative: Partner discussions as engineering partnerships test their sound signal devices provide an opportunity to gather evidence about learning goal 9 (aligned to Assessment Statement 2), with the purpose of providing feedback to students and guiding instruction in upcoming lessons. Record assessment information on the Following Students' Sensemaking 2 tool and refer to the Instructional Guidance 2 tool and the Assessment Guidance at the beginning of this lesson for more ideas for how to support students in connecting the materials and parts of their design to their function in making and sending sound signals. (Lesson 9, Teacher Guide)

Teachers are provided with an "Instructional Guidance Tool" which includes possible next steps in response to assessment data collected in the "Following Students Sensemaking Tool" for all three dimensions. This tool is to be used for lessons 2-5. Examples of "If you notice students…" and "Possible next steps…" guidance includes:

- Lesson 3, Lesson Assessment Guidance: If you notice students…: "are not yet carrying out an investigation to gather data related to cause-and-effect relationships between sound and materials." Possible next steps: "Before Lesson 4: Use investigation-focused resources from previous units for support, such as the Scientists Plan and Carry Out Investigations book from Unit 1.1: How can we read under covers when it's dark? or the Planning and Carrying Out an Investigation Sorting Cards reference from Unit K.3: How can we move things to where we want them to go? Before Lesson 4: Use cause-and-effect-focused resources from previous units for support, such as the Cause and Effect Card Sort reference in Lesson 5 of Unit K.1: Why do some surfaces get hot and how can we make them less hot? or the Light in Our Communities book from Lesson 2 of Unit 1.1: How can we read under covers when it's dark?. Before Lesson 4: Display the Triangle Investigation Plan from Lesson 2 and invite students to re-enact their investigation using triangles in pairs. Concurrently, engage in a whole class discussion about carrying out the investigation in ways that support gathering evidence. To further support cause-and-effect relationships, ensure one student holds the triangle by the hanger and uses the striker to hit the triangle while the other student touches the triangle to feel its vibration while making sound. During Lesson 4: After students have planned the investigation, invite a pair of students to act out each of the planned steps, including making observations and recording data." (1.2 Lesson 3 Teacher Assessment Tool)

A "Following Student Sensemaking Tool" is provided. This tool includes a checklist of three-dimensional look and listen fors, possible student responses (verbal and non-verbal), examples of what students might draw or write, and possible teacher feedback. This tool is to be used for lessons 7-10. "Each lesson's learning goal and the specific work students do in the lesson are designed to move students forward in their use of **Science and Engineering Practices**, **Crosscutting Concepts**, and **Disciplinary Core Ideas**. Throughout each lesson, jot down evidence of a few students' sensemaking. You can use copies of the following table, a seating chart, your class list, or another way to keep track of what students say, do, write, draw, objects they manipulate and how, etc. to note how they are demonstrating the listen-/look-fors. Use recorded evidence to formatively evaluate students' progress in Lessons 7-10." (1.2 Lesson 7 Teacher Assessment Tool)

- Lesson 9, Lesson Assessment Guidance: Teachers are provided with an "Instructional Guidance Tool" which includes possible next steps in response to assessment data collected in the "Following Students Sensemaking Tool". Examples of "If you notice students…" and "Possible next steps…" guidance includes: If you notice students…: Designed and built a device but it does not yet have materials/parts (structure) that are functioning to make sound. Possible next steps: If this describes most or all of your class: "Prior to Lesson 10, have the class do the suggested extension from the Explore of Lesson 9 to rebuild their devices using evidence from their testing and peer feedback. Note that this next step does not suggest students will/should be assessed on how well their devices work. Instead, this next step is suggested because it will be important for at least some student devices to successfully make sound in order for students to compare and discuss their engineering in Lesson 10 and notice that there are many possible solutions to an engineering problem." "If this describes some of your class, During Lesson 10, encourage students to present their ideas for how they would improve their design, focusing on the materials/parts that are intended to move/vibrate in order to make sound. Students can demonstrate this using their built design and/or students can use the drawn design on their Device Communication Plan handouts to reflect their ideas for improvement (a revised design)." (1.2 Lesson 9 Teacher Assessment Tool)

Formative assessment processes routinely provide varied support for student thinking across all three dimensions.

- OpenSciEd Elementary Teacher Handbook, Formative Assessment, "Each lesson has multiple opportunities for formative assessment. Formative assessment opportunities are aligned with one of the three-dimensional lesson-level learning goals. These opportunities include prompts (verbal, gestures, written) embedded into activities that allow teachers to "quickly" determine whether students are building understanding. These prompts are included in tables that have ideas that teachers should look for and listen for in student responses. There are also suggestions for follow-up questions or prompts for teachers to use to support students' ongoing learning. In addition, at the beginning of each lesson, there is a table that provides information for teachers on how to use the information that they elicit to best support learning.
  - Waves Sound Assessment System Overview, Key Formative, "These key formative assessment opportunities indicate a place to "take stock" of where students are in their sensemaking and decide how to move forward. Suggestions for interpreting and responding to students' sensemaking is provided in the teacher guide and associated assessment materials. In Lesson 3 and 4, use the evidence you gathered on the Following Students' Sensemaking 1 tool in Lessons 2, 3, and 4 as well as students' Triangle Investigation Observations handout and Instruments Investigation Observations handout to evaluate students' progress towards Assessment Statement #1. Use the Instructional Guidance 1 to provide feedback to students and plan your upcoming instruction. When you get to Lesson 5, focus on supporting students who are not yet secure in their sensemaking. In Lesson 9, use the evidence you gathered on the Following Students' Sensemaking 2 tool in Lessons 7-9 as well as students' Lesson 7 Sound Signal Device Design handouts and Lesson 9 Testing our Sound Signal Device handouts to evaluate students' progress towards Assessment Statement 2. Use the Instructional Guidance 2 to provide feedback to students and plan your upcoming instruction.
  - Waves Sound Assessment System Overview, Ongoing Formative, "As students engage in these lessons, there are multiple opportunities to gather formative evidence of students' ongoing and developing sensemaking. This evidence can be used to support students by providing individual and group feedback and/or making minor instructional modifications as suggested in unit materials. Ongoing formative assessment opportunities related to class discussions, handouts, and other student work are described in the front matter of each lesson and noted in the teacher guide with a yellow "Assessment Opportunity" box where they happen in the lesson. (OpenSciEd Elementary Teacher Handbook)
- Lesson 3, Explore Section, Step 3: "As students carry out their investigation of instruments and engage in related discussions, you have an opportunity to gather evidence about Learning Goal 3 (aligned to Assessment Statement 1), with the purpose of providing feedback to students and guiding instruction in upcoming lessons. Encourage students to use gestures, pointing, and spoken language in addition to their recorded observations on their Instruments Investigation Observations handouts as they make connections between the small movements (cause) of parts of the instruments and the production of sound (effect)." (Lesson 3, Teacher Guide) This is an example of generic support for thinking across all three dimensions.

Formative assessment processes routinely attend to multiple aspects of student equity.

- Lesson 1, Connect Section, Step 1: Community Connections, "Though unlikely, it is possible that the provided sound of the clocktower may elicit feelings of fear or other heightened emotions for some students because of connections to scary movies and TV shows, etc. For more information and trauma-informed strategies you can use to support students around these emotions - including a three-step routine of Be Curious, Validate, and Thank the Student - see the Teacher Handbook resource." (Lesson 1, Teacher Guide)

- Lesson 2, Navigate Section, Step 2: Community Connections, "Provide multiple means of engagement to optimize relevance, value, and authenticity by validating ways shared by students for how they have played and explored objects that make sound in the past, including those that a student may have done in an informal capacity, such as in their community, as well as those studied in a formal context of a school setting. Emphasize that scientists use different ways to study the world." (Lesson 2, Teacher Guide)
- Lesson 3, Explore Section, Step 2: Community Connections, "Instruments like guitars, shakers, and drums, have unique cultural histories and may hold particular meaning or importance in students' lives or communities. Inviting students to share their experiences with these instruments helps make our learning about sound more personalized and contextualized to their lives. Prior to the investigation, consider leveraging students' funds of knowledge by asking if any students know how these instruments are played and would be willing to share or demonstrate. See the Instrument Connections reference for support." (Lesson 3, Teacher Guide)
- Lesson 4, Navigate Section, Step 1: Broadening Access, "This activity relies on students using their hearing to recognize how sound travels. To help ensure students who are hard of hearing have access to the learning objective, you might: make sure the classroom is silent before playing the drum, position students closer to the drum as needed, and encourage students to notice where the sound travels by visually observing when their peers raise their hands." (Lesson 4, Teacher Guide)
- Lesson 5, Synthesize Section, Step 3: Broadening Access, "Support planning and strategy development by providing students with an opportunity to review their developing models using the Gotta-Have-It Checklist. Doing so helps promote expectations and student beliefs that these goals can be met, which ultimately optimizes motivation. Further, this builds students' science identities and their metacognition by reassessing and revising their work in progress." (Lesson 5, Teacher Guide)
- Lesson 6, Explore Section, Step 2: Community Connections, "The sound signal devices on the Sound Signal Device Cards and the messages they send help motivate students' engineering in Lesson Set 2. To develop relevance, it is important to make connections to the diverse ways that science appears in students' homes and local communities. Blank Sound Signal Device Cards are provided for you to add examples identified by your students in order to leverage their lived experiences, interests, and identities in support of the classroom community's sensemaking work." (Lesson 6, Teacher Guide)
- Lesson 7, Synthesize Section, Step 5: Community Connections, "Before students meet with their engineering partners, consider revisiting the classroom agreements: "we look, listen, and respond to each others' ideas" and "we let our ideas change and grow." Ask students why it is important to uphold these agreements and what it might look and sound like to do so while working with their engineering partners. This conversation can support productive collaboration and prepare students to let their individual designs change and grow as they create new Engineering Partnership Designs." (Lesson 7, Teacher Guide)
- Lesson 8, Explore Section, Step 3: Community Connections, "When reviewing collaboration among engineering partnerships, there is a natural opportunity to reconnect students with their classroom agreements. "We look, listen, and respond to each other's ideas" and "We let our ideas change and grow" are particularly relevant to working in partnerships during this lesson's engineering. While building, unexpected issues can arise (parts don't fit together as planned; sound is not made as anticipated) that can be addressed well when both partners contribute to in-the-moment solutions and acknowledge plans and ideas change." (Lesson 8, Teacher Guide)
- Lesson 9, Explore Section, Step 5: Community Connections, "Many of the classroom agreements support the work of providing feedback. Before groups give each other feedback, connect to the agreements that best align with how your class approaches respectfully sharing and listening to the ideas of others. For example, connecting this work to the classroom agreement "We look, listen, and respond to each other's ideas" may help students share ideas respectfully and listen to each others' feedback. (Lesson 9, Teacher Guide)

- Lesson 10, Synthesize Section, Step 5: Community Connections, "Provide students an opportunity to share what they are doing and learning in science by providing resources to support their out-of-school communication and connections. Consider sending home photographs of students' sound signal devices along with students' completed Device Communication Plan handouts. These serve as prompts for students' recollections and discussions, while also providing family and community members resources to ask their student questions about. You may also encourage students who provided materials for engineering to thank their families/caregivers by sharing how classmates used these materials." (Lesson 10, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

III.C. Scoring Guidance

EXTENSIVE

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.

The reviewers found **extensive** evidence that the materials include scoring guidelines that provide suggestions for interpreting student performance along the three dimensions to support teachers in (a) planning instruction and (b) providing ongoing feedback to students.

Support for planning instruction

- Each lesson begins with a Learning Plan Snapshot that explains the sections of the lesson, duration, slide numbers, hyperlinked list of materials needed, a detailed Preparation Checklist with estimated times, a table of the lesson vocabulary in the sections that they will be encountered, the 3D Learning Goal(s), and Lesson Assessment Guidance.
- Waves Sound Storyline: A table of each lesson with the lesson questions, phenomenon, what we do, what we figure out, and navigation to the next lesson. (Waves Sound Storyline)
- Lesson 3, Lesson Assessment Guidance: Teachers are provided with an "Instructional Guidance Tool" to be used with lessons 2-5, which includes possible next steps in response to assessment data collected in the "Following Students Sensemaking Tool" for all three dimensions(Lesson 3, Teacher Guide)
- Lesson 9, Lesson Assessment Guidance: Teachers are provided with an "Instructional Guidance Tool" to be used with lessons 7-9 which includes possible next steps in response to assessment data collected in the "Following Students Sensemaking Tool." (Lesson 8, Teachers Guide)

Support for ongoing feedback

Lesson Assessment Guidance Charts are provided for every lesson, the final column of these charts responds to the question, "How can I use this assessment information?" However, individual students do not explicitly track their individual progress toward learning goals. Additionally, due to the reliance on partner groups throughout the unit, the provided feedback is often designed for groups of students rather than targeted feedback for individual students. For example:

- Lesson 1, Assessment Guidance: "Since this is an initial opportunity to record observations and ideas, some observations (e.g., parts of the bell moving or being still) or ideas about cause-and-effect relationships may be incomplete or not present. These ideas and relationships will be further developed through investigations in Lessons 2-4, and evidence from these investigations will further support or refute students' initial ideas about what causes sounds. Students will have an opportunity to develop an individual model reflecting the anchor phenomenon (clocktower making and sending a sound signal) in Lesson 5." (Lesson 1, Teacher Guide)
- Lesson 3, Assessment Guidance Chart: Instructional Guidance 1: "Use the evidence you have gathered on the Following Students' Sensemaking 1 tool in Lessons 2, 3, and 4 as well as students' Triangle Investigation Observations handout and Instruments Investigation Observations handout to evaluate students' progress towards the above assessment statement and plan your upcoming instruction accordingly." "When you get to Lesson 5, focus on supporting students who are not yet secure in their sensemaking. Based on which of the statements below align with what you notice about your students (most of the class, some of the class, or a few students), you may choose to take action on some or several of the next steps suggested here." For example: "If you notice students: "Are not yet carrying out an investigation to gather data related to cause-and-effect relationships between sound and materials." Possible next steps: Before Lesson 4:" Use investigation-focused resources from previous units for support, such as the Scientists Plan and Carry Out Investigations book from Unit 1.1: How can we read under covers when it's dark? or the Planning and Carrying Out an Investigation Sorting Cards reference from Unit K.3: How can we move things to where we want them to go? Before Lesson 4: Use cause-and-effect-focused resources from previous units for support, such as the Cause and Effect Card Sort reference in Lesson 5 of Unit K.1: Why do some surfaces get hot and how can we make them less hot? or the Light in Our Communities book from Lesson 2 of Unit 1.1: How can we read under covers when it's dark?. Before Lesson 4: Display the Triangle Investigation Plan from Lesson 2 and invite students to re-enact their investigation using triangles in pairs. Concurrently, engage in a whole class discussion about carrying out the investigation in ways that support gathering evidence. To further support cause-and-effect relationships, ensure one student holds the triangle by the hanger and uses the striker to hit the triangle while the other student touches the triangle to feel its vibration while making sound. During Lesson 4: After students have planned the investigation, invite a pair of students to act out each of the planned steps, including making observations and recording data." (Lesson 3, Teacher Assessment Guidance)
- Lesson 7, Assessment Guidance: "Use these formative assessment opportunities to determine how students' three-dimensional thinking around Assessment Statement 2 (aligned to 1-PS4-4) is progressing." "If students need more support in designing their sound signal devices and considering how their selected materials will function to make and send a sound signal: Prompt the student/partnership to demonstrate how an instrument makes sound, identify the part/material that moves to make sound (ex: box guitar rubberband), and then add that to their drawn design or point to where it is already in the design and describe it. Encourage the student/partnership to go to the class Device Gotta-Have-It Checklist, point to each item on it, and point to the part of their drawn design that they think will do that 'gotta-have-it.'" (Lesson 7, Teacher Guide)
- Following Student Sensemaking 1, Lessons 2-5, "Assessment Statement 1: In order to answer questions, students can **collaboratively plan and conduct investigations to gather evidence** that **vibrating materials make sound** and **sound can cause other materials to vibrate**. (aligned to 1-PS4-1) Each lesson's learning goal and the specific work students do in the lesson are designed to move students forward in their use of **Science and Engineering Practices**, **Crosscutting Concepts**, and **Disciplinary Core Ideas**. Throughout each lesson, jot down evidence of a few students' sensemaking. You can use copies of the following table, a seating chart, your class list, or another way to keep track of what students say, do, write, draw, objects they manipulate and how, etc. to note how they are demonstrating the listen-/look-fors. Use recorded evidence to formatively evaluate students' progress in Lessons 2-5 (see the Instructional Guidance 1 tool to plan next steps based on the evidence you have collected). You will summatively evaluate students' progress in Lesson 5 using the Summative Guidance 1 tool; if needed, evidence gathered using this Following Students' Sensemaking 1 tool can also be used to summatively evaluate students' progress.

- Following Student Sensemaking 2, Lessons 7-10: "Assessment Statement 2: Students can **design and build** a **sound signal device** that **has parts** (**structure**) that **make sound** **to solve the problem** of wanting to **communicate** good news **across the classroom** (**function**) (aligned to 1-PS4-4 and K-2-ETS1-2). Each lesson's learning goal and the specific work students do in the lesson are designed to move students forward in their use of **Science and Engineering Practices**, **Crosscutting Concepts**, and **Disciplinary Core Ideas**. Throughout each lesson, jot down evidence of a few students' sensemaking. You can use copies of the following table, a seating chart, your class list, or another way to keep track of what students say, do, write, draw, objects they manipulate and how, etc. to note how they are demonstrating the listen-/look-fors. Use recorded evidence to formatively evaluate students' progress in Lessons 7-10 (see the Instructional Guidance 2 tool to plan next steps based on the evidence you have collected). You will summatively evaluate students' progress in Lesson 10 using the Summative Guidance 2 tool; if needed, evidence gathered using this Following Students' Sensemaking 2 tool can also be used to summatively evaluate students' progress.
- Lesson 7, Lesson Assessment Guidance: A "Following Student Sensemaking 2" tool for lessons 7-10 is linked. This tool includes a checklist of three-dimensional look and listen fors, possible student responses (verbal and non-verbal), examples of what students might draw or write, and possible teacher feedback. (Lesson 7, Teacher Guide).
- Lesson 10, Lesson Assessment Guidance: Teachers are provided with the "Teacher Assessment Tool Summative Guidance 1" document. This document identifies the three dimensional assessment statement, an example of student responses from "Not Yet Secure", "Secure with Prompting", and "Secure", and possible feedback. Some instructional next steps are also provided. However, the provided feedback does not help teachers discern which dimension(s) students are struggling with. (Lesson 10, Teacher Guide)
  - Summative Guidance 1, "Assessment Statement 1: In order **to answer questions**, students can **collaboratively plan and conduct investigations to gather evidence** that **vibrating materials** **make sound** and **sound can** **cause other materials to vibrate**. (aligned to 1-PS4-1) Use the evidence you have gathered on the Following Students' Sensemaking 1 tool from this and prior lessons to make a summative claim about students' understanding of Assessment Statement 1. If you have not yet checked off all four boxes for certain students, make sure to talk individually with those students about their Sound Signal Model handout so they have an opportunity to explain their thinking, and use this to inform your summative assessment of their progress. See the range of samples shown here and use the suggested prompts as you provide feedback and evaluate the ideas students explain in and about their Sound Signal Model handout.
  - Lesson 10, Lesson Assessment Guidance: "Assessment Statement 2: Students can **design and build** a **sound signal device** that **has parts** (**structure**) that **make sound** **to solve the problem** of wanting to **communicate** good news **across the classroom** (**function**) (aligned to 1-PS4-4 and K-2-ETS1-2). Use the evidence you have gathered on the Following Students' Sensemaking 2 tool from this and prior lessons to make a summative claim about students' understanding of Assessment Statement 2. If you have not yet checked off the box for certain students, make sure to talk individually with those students about their Device Communication Plan handout so they have an opportunity to explain their thinking, and use this to inform your summative assessment of their progress." (Lesson 10, Teacher Guide. On the Teacher Assessment Guidance: "See the range of samples shown here and use the suggested prompts as you provide feedback and evaluate the ideas students explain in and about their Device Communication Plan handout." (Lesson 7 Teacher Assessment Tool)

Criterion-Based Suggestions for Improvement

- Consider providing specific guidance for students to interpret their own progress.
- Consider adding additional supports to help teachers provide guidance for targeted, individual student feedback for all three dimensions.

III.D. Unbiased Tasks/Items

EXTENSIVE

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

The reviewers found **extensive** evidence that tasks/items assess student proficiency using methods, vocabulary, representations, and examples that are accessible and unbiased for all students.

Multiple modes of communication

Teacher guidance is provided to include sketches and/or visual prompts to all classroom charts.

- Following Student Sensemaking Tools: Look and listen examples are provided to assess student sensemaking. These include examples of what students might say and what students may gesture/manipulate.
  - Lesson 2 Teacher Assessment Tool Following Students' Sensemaking 1 (Lessons 2-5), "Possible evidence of student sensemaking: Remember that students are often using multiple means of communication to express their sensemaking. As you are looking for evidence that students have a secure grasp of the assessment statement, look and listen for these examples. Students might say...and Students might gesture/manipulate."
  - Lesson 7 Teacher Assessment Tool Following Students' Sensemaking 2 (Lessons 7-10), "Possible evidence of student sensemaking: Remember that students are often using multiple means of communication to express their sensemaking. As you are looking for evidence that students have a secure grasp of the assessment statement, look and listen for these examples. Students might say...and Students might gesture/manipulate."
- Lesson 1, Synthesize Section, Step 5: Develop an initial class model, teachers are guided to, "Invite students to share ideas with the whole group by talking out loud, using gestures, using the handbell, "air-drawing" from their seat, showing or pointing to their Bell Sound Observations and Ideas handouts, and/or coming up to the Initial Class Model to point or trace." (Lesson 1, Teacher Guide)
- Lesson 3, Explore Section, Step 2: "Decide how to use instruments and what to observe. Next, invite students to decide how we should use the instruments to make sound and record decisions using words and drawings on the 'Use the Instrument' side of your class' Instruments Investigation Plan. During this discussion, ensure these instruments are available in the Scientists Circle and that students are considering and discussing what part of the instrument to observe during the investigation. How should we use the box guitar? Students use hand gestures to demonstrate plucking/pulling with finger." (Lesson 3, Teacher Guide)
- Lesson 4, Navigate Section, Step 1: "Discuss about our bodies' sound receivers. Use the following prompt to make connections to students' knowledge of ears as a body part that enables our receiving sounds. Note that it is okay if not all students have this prior knowledge about ears. We already said we receive sounds when we hear them. What parts do our bodies have for hearing sounds? Student points to or pulls on ear Student cups hand behind ear in c-shaped gesture." (Lesson 4, Teacher Guide)
- Lesson 5, Synthesize Section, Step 4: "Co-develop a Consensus Model. Facilitate a discussion to collectively construct a model that explains how the clocktower makes and sends sound signals. During this discussion, support students in finding areas of agreement and follow up to ask what evidence supports those ideas. Once the class comes to agreement, add this to the class consensus model. Welcome student participation by inviting students to approach the Class Consensus Model and use their finger to air-draw or point, to use their bodies to act out or gesture, and/or to record consensus decisions using a marker, sticky notes, etc." (Lesson 5, Teacher Guide)

- Lesson 6, Explore Section, Step 2: Organize data, the sound signal device cards include words and pictures of the sound signal devices that are to be grouped. "To ensure all students have access and familiarity to the different sound signal devices on the Cards, use slides D-F to introduce each by having students observe the image and listen to the associated audio file. Encourage students to use words, sounds, and their bodies as they briefly turn and talk, using the prompts below to connect with and describe each sound signal." (Lesson 6, Teacher Guide)

Supports success for all students

- Lesson 1, Synthesize Section, Step 5: "Throughout this discussion co-developing the Initial Class Model, use these steps to welcome all students' participation:1. Elicit students' initial ideas by having students turn and talk with a partner about the prompt, referencing their Bell Sound Observations and Ideas handouts as a resource. 2. Invite students to share ideas with the whole group by talking out loud, using gestures, using the handbell, "air-drawing" from their seat, showing or pointing to their Bell Sound Observations and Ideas handouts, and/or coming up to the Initial Class Model to point or trace. 3. Invite students to use a hand signal to show agreement or disagreement." (Lesson 1, Teacher Guide)
- Lesson 3, Explore Section, Step 2: Broadening Access, "To ensure all students' access to learning, especially any student(s) with hearing-related disabilities, provide accommodations for students following their IEP or 504 plan. In this lesson, ensure every student has the opportunity to touch the instruments while they are making and not making sound. Additionally, consider partnering students and directing them to describe out loud to each other their auditory and tactile observations." (Lesson 3, Teacher Guide)
- Lesson 4, Explore Section, Step 3: Broadening Access, "It is important that all students in your class feel that their contributions are valuable. There are many ways to notice and recognize students' ideas beyond asking to hear from each student in the class. For instance, a teacher can share something they overheard while moving around the class, display a students' representation of data, or they can shed light on the ways a student group engaged in an investigation." (Lesson 4, Teacher Guide)

Multiple modalities and student choice

Students are given some opportunities to respond using multiple modalities and are given choices about how they will respond.

- Lesson 1, Synthesize Section, Step 5: Develop an initial class model, teachers are guided to, "Invite students to share ideas with the whole group by talking out loud, using gestures, using the handbell, "air-drawing" from their seat, showing or pointing to their Bell Sound Observations and Ideas handouts, and/or coming up to the Initial Class Model to point or trace."
- Lesson 2, Explore Section, Step 4: Broadening Access, "Think, Pair, Share allows students a few moments to form their thoughts (Think), then discuss with a partner (Pair), then volunteer to explain their thinking to the class (Share). This structure is especially helpful for multilingual learners and children who are more comfortable sharing with one person than the whole class. Encourage student pairs to use whatever modalities of expression they choose: gestures, named languages other than English, etc." (Lesson 2, Teacher Guide)
- Lesson 5, Lesson Assessment Guidance: Lesson 5 Summative Assessment Tool, Sound Signal Model, Students are able to respond using drawings and text. Use the boxes and lines to draw and write a model showing how the clocktower makes and sends sound signals." (Lesson 5, Lesson Assessment Guidance) However, the expectation is that students will use both and not choose between the two modalities.

- Lesson 6, Explore Section, Step 5: Teaching Tip, "The remainder of this lesson and the lessons that follow focus on designing a device to communicate a good news message across the classroom. Your classroom may choose to pursue a different communication purpose; that is OK! Adjust the language in each lesson to reflect the type of message your students select for their engineering." (Lesson 6, Teacher Guide)
- Lesson 10, Synthesize Section, Step 3: Teaching Tip, "Depending on the needs and interests of students, you may consider alternative formats for the Device Communication Plan handout. Some possible options could include having students record a video showing how their sound signal device works while using the device and pointing to materials, taking a photograph of students' devices and having them label it along with a written description or voice-over of how their device works, or some combination of these options." (Lesson 10, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

III.E. Coherent Assessment System

EXTENSIVE

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

The reviewers found **extensive** evidence that the materials include pre-, formative, summative, and self-assessment measures that assess three-dimensional learning. The Assessment System Overview includes an assessment map that contains the type of assessment, the lesson in which the assessment will occur, any associated tools or handouts, and the purpose of the assessment. Three-dimensional learning goals are provided for each lesson; however, there is no guidance as to which specific element is being assessed in each lesson in this provided resource. The Assessment System Overview and the Lesson Level Guidance provide extensive guidance to teachers related to how the assessments work together to inform instructional guidance.

Matches three-dimensional learning objectives

Three-dimensional learning goals are provided at the beginning of each lesson in the Lesson Assessment Guidance table. However, the specific element being assessed in each lesson is not identified. For example:

Lesson 2

- Three-dimensional learning goal: **Plan and conduct an investigation to gather evidence** about how a **triangle makes sound.**
- Assessment goal: **Plan and conduct an investigation to gather evidence** about how a **triangle makes sound.**

Lesson 4

- Three-dimensional learning goal: "**Plan and conduct an investigation to gather evidence** that **sounds** travel and **can cause materials to vibrate** (**effect**) when **sounds are received**."
- Assessment goal: **Plan and conduct an investigation to gather evidence** that **sounds** travel and **can cause materials to vibrate** (**effect**) when **sounds are received**.

Lesson 8

- Three-dimensional learning goal: **Build a sound signal device (structure) to solve the problem** of needing a way to **communicate** a good news message **across our classroom (function).**
- Assessment goal: **Use patterns** in how **people use** sound signal **devices to communicate** to **define a simple problem** about **communicating** good news **across the classroom**.

Pre-, formative, summative, and self-assessment

Pre-Assessment

- Lesson 1, Synthesize Section, Step 5: "Pre-assessment: The Initial Ideas discussion in which the class co-develops the Initial Class Model provides an opportunity to gather evidence about learning goal 1 (aligned to Assessment Statement 1), with the purpose of determining any support students may need in upcoming lessons as they continue to answer their questions about how objects make and send sound signals. Addressing the model's question (How does the clocktower make and send sound signals?) provides a context for students' figuring out cause-and-effect relationships between sound and materials over the course of this lesson set that is connected to core ideas about how people use devices to communicate over a distance that are figured out in Lesson Set 2. Accept all student ideas and refer to the Assessment Guidance at the beginning of the lesson." (Lesson 1, Teacher Guide)
- Lesson 6, Explore Section, Step 5: "The whole class discussion to define the engineering problem provides an opportunity to gather evidence about learning goal 6 (aligned to Assessment Statement 2), with the purpose of determining any support students may need in upcoming lessons as they continue to engage in engineering by planning, building, and testing a sound signal device they can use to communicate over a distance. In their engineering, students will use structure-and-function relationships of materials/objects as well as continuing to use the cause-and-effect relationships they developed in Lesson Set 1." (Lesson 6, Teacher Guide)

Formative Assessment

- See III.B

Summative Assessment

There are two summative assessments in the unit found in Lessons 5 and 10.

- In Lesson 5, Synthesize Section, Step 3: Use the evidence you gathered on the Following Students' Sensemaking 1 tool to make a summative claim about students' understanding of Assessment Statement 1. If you have not yet checked off all four boxes for certain students, make sure to talk individually with those students about their Sound Signal Model handout so they have an opportunity to explain their thinking, and use this to inform your summative assessment of their progress. "Students' individual models on their Sound Signal Model handouts are an opportunity to gather evidence about Learning Goal 5 (aligned with Assessment Statement 1) with the purpose of summatively assessing students' use of cause-and-effect relationships to explain how objects make and send sound signals." (Lesson 5, Teacher Guide)
- Lesson 10, Synthesize Section, Step 3: Students' individual designs on their Device Communication Plan handouts are an opportunity to gather evidence about learning goal 10 (aligned to Assessment Statement 2) with the purpose of summatively assessing students' designed solutions for communicating a good news message across the classroom." (Lesson 10, Teacher Guide)

Self Assessment

- Lesson 5, Synthesize Section, Step 3: The discussion prompts offer an opportunity for students to use the Gotta-Have-It Checklist to reflect on their Sound Signal Model handout with the purpose of supporting students in reflecting on what parts, ideas, and evidence they have used so far and determining next steps for their model development. "These prompts offer an opportunity for students to use the Gotta-Have-It Checklist to reflect on their Sound Signal Model handout with the purpose of supporting students in reflecting on what parts, ideas, and evidence they have used so far and determining next steps for their model development." (Lesson 5, Teacher Guide)
- Lesson 8, Explore Section, Step 4: "The thumb-up and thumb-down prompts suggested alongside the bolded statement, 'Reflect on our engineering so far,'(and slide G) offer an opportunity for students to consider their experiences so far, with the purpose of helping them celebrate what went well and find ways to improve. Notice engineering partnerships (either one or both members) who privately indicate 'thumb down' for working together, in order to provide additional support for their collaboration. (Lesson 8, Teacher Guide)

The coherent three-dimensional assessment system rationale is clearly described.

The assessment system rationale is communicated in the Teacher Guides, Assessment Guidance, and Assessment System Overview documents. The Teacher Guides include Lesson Assessment Guidance Charts which include responses to the questions "What will students do?" "Assessment Type" "Where can I check for understanding?" "What to Look and Listen for" and "How can I use this assessment information?" For example:

- Lesson 2, Lesson Assessment Guidance: "**Plan and conduct an investigation to gather evidence** about how a **triangle makes sound."** "How can I use this assessment information: Use these formative assessment opportunities to determine how students' three-dimensional thinking around Assessment Statement 1 (aligned to 1-PS4-1) is progressing." (Lesson 2, Teacher Guide)
- Lesson 7, Lesson Assessment Guidance: "What will students do: "**Design** a **sound signal device** that **uses materials** (**structure**) **to solve the problem** of needing a way to **communicate** a good news message **across our classroom** (**function**)**."** "How can I use this assessment information: Use these formative assessment opportunities to determine how students' three-dimensional thinking around Assessment Statement 2 (aligned to 1-PS4-4) is progressing." (Lesson 7, Teacher Guide)
- Lesson 10, Lesson Assessment Guidance: "What will students do: **Communicate information about** how the **parts** (**structure**) of a **sound signal device enable it** to **communicate a good news message across our classroom** (**function**)." (Lesson 10, Teacher Guide)

Criterion-Based Suggestions for Improvement

- Ensure the Assessment System Overview provides guidance on which specific element is being assessed in each lesson.

III.F. Opportunity to Learn

ADEQUATE

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

The reviewers found **adequate** evidence that the materials provide multiple opportunities for students to demonstrate the performance of practices connected with their understanding of Disciplinary Core Ideas and Crosscutting Concepts and receive feedback. While there are extensive opportunities for teachers to give oral feedback, there was only one instance of students formally giving feedback to one another. There was no evidence that students were given the opportunity to use the feedback given to improve their performance in preparation for the next assessment opportunity.

The materials have multiple, interconnected opportunities for students to demonstrate their progress to proficiency over time. For example, students build towards 1-PS4-1: Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.

Lesson 1, Learning Goal 1: "**Develop an initial model** to explain **how clocktower bells make sound** and how **people communicate over a distance by using objects that make and send sound signals**."

- Lesson 1, Synthesize Section, Step 5: "Introduce an initial class model. Display slide M and the blank Initial Class Model with the question at the top, "How does the clocktower make and send sound signals?" Remind students that - when we make our model - we will use words and pictures to explain our beginning ideas about this question. Assure students that we have not yet figured out how everything works! This initial model will help us put together our different ideas and identify what we are not yet sure about. Also assure students that it is expected that we will not all agree on everything. We will try to figure out parts we do agree on and parts we are unsure. The following is an example of how your Initial Class Model might look after this discussion. This is only a sample; remember to use your own class ideas, drawings, and students' languages in your chart." (Lesson 1, TG)

Lesson 3, Learning Goal 3: "**Plan and conduct an investigation to gather evidence** about **what causes objects to make sound."**

- Lesson 3, Explore Section, Step 3: "Compare recorded observations with a partner. Once students have completed moving through the stations (making observations for each instrument), invite them to find a different classmate and compare their recorded observations on their Instruments Investigation Observations handouts. If time permits, encourage students with different recorded observations to return to a station to retest the instrument/s and try to come to agreement." (Lesson 3, Teacher Guide)

Lesson 4, Learning Goal 4: "**Plan and conduct an investigation to gather evidence** that **sounds** travel and **can cause materials to vibrate** (**effect**) when **sounds are received**.

- Lesson 4, Explore Section, Step 2: "Connect making observations to the prepared tube. Again referencing the previous investigation plan/s, point out the 'Make and Record Observations' column/s. You may also want to remind students of our earlier suggestions to use our senses of sight and touch to make observations of how we know sound travels and is received. Then, display for students a prepared tube (refer to slide F) while reminding them how we looked at each other's ears to notice things that might help us plan an investigation about receiving sound (since we know that our ears receive sound when we hear things)." (Lesson 4, Teacher Guide)

Lesson 5, Learning Goal 5: "Develop a simple model using evidence from investigations to explain what causes an object to make sound signals that can be observed over a distance."

- Lesson 5, Synthesize Section, Step 3: Developing and Using Models, "In science, ideas are supported with evidence. Students' individual models include their ideas explaining "How the clocktower makes and sends sound signals." These ideas include the cause-and-effect relationships between sound and materials that students have figured out in this lesson set. Images from the investigations are included on the Sound Signal Model handout to support students in recalling their investigation experiences and connecting their changing ideas to their evidence. In this lesson, students progress from developing one class model (in Lesson 1) to developing individual models that they can use to contribute to a class-level consensus model. (Lesson 5, Teacher Guide)

Students are engaged in multi-modal feedback loops. However, this feedback is primarily oral, and there is no evidence that students will be able to draw on it to support future sensemaking.

- Lesson 2, Explore Section, Step 4: "In this discussion, look and listen for students' sensemaking with the purpose of providing feedback and supporting students in planning an investigation to gather evidence about what causes a triangle to make sound. Look and listen for students suggesting ways to make observations (hearing, seeing, feeling) that will enable them to notice the triangle is moving/shaking/vibrating (cause) when it is making sound (effect) and it is not moving/shaking/vibrating when it is not making sound." (Lesson 2, Teacher Guide) While feedback suggestions are provided in the Lesson 2 Teacher Assessment Tool Following Student Sensemaking, students will receive this feedback. This feedback is primarily oral, and there is no evidence that they will be able to draw on it to support their sensemaking in future lessons.
  - This is also true for lesson 3.
- Lesson 4, Explore Section, Step 2: "Encourage students to actively reference investigation plans from Lesson 2 and/or Lesson 3 as they discuss and make decisions about how to use materials and make and record observations in ways that will enable them to answer the lesson question, How can we know sounds travel and are received?" (Lesson 4, Teacher Guide) This is an example of students having an opportunity to use feedback from earlier investigations to improve performance on a later investigation; however, the feedback that they received is oral, so it is unclear if they will be able to draw on that previous feedback to support their sensemaking in this lesson.
- Assessment System Overview, Lesson 9, "These lessons provide opportunities to support students in working together to give and receive feedback on their ongoing work. Students have opportunities to use the feedback to make revisions. Peer feedback is closely tied with the classroom agreement 'We look, listen, and respond to each other's ideas' and 'We let our ideas change and grow.' In Lesson 9, use lesson discussion prompts to support partners in sharing their Testing our Sound Signal Device handouts (based on the Device Gotta-Have-It Checklist) and reviewing their built devices with peers. They will provide feedback to support each other in recognizing what worked as planned in their devices as well as sharing ideas for improving their solution. They will then use the feedback to improve their device."
  - Lesson 9, Explore Section, Step 5: Student groups exchange sound signal devices and test them to determine if they are meeting the established goal of the project. Student groups then provide feedback to the designing group using a series of sentence starters and the Gotta-Have-It checklist. (Lesson 9, Teacher Guide) However, this comes at the end of the lesson sequence, and there is no evidence that students will use this feedback to advance their performance in the future.

Criterion-Based Suggestions for Improvement

- Consider adding increased clarity on how performances are iterative opportunities to demonstrate progress toward full proficiency over time.
- Ensure students have opportunities to use their feedback to construct new learning and improve their performance in preparation for the next assessment opportunity.

Category Ratings

CATEGORY I	**NGSS 3D Design**	0	1	2	(3)
CATEGORY II	**NGSS Instructional Supports**	0	1	2	(3)
CATEGORY III	**Monitoring NGSS Student Progress**	0	1	2	(3)
TOTAL SCORE				**9**	

Overall Ratings

Overall ratings:

The score total is an approximate guide for the rating. Reviewers should use the evidence of quality across categories to guide the final rating. In other words, the rating could differ from the total score recommendations if the reviewer has evidence to support this variation.

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)

Overall rating below:

E