EQuIP RUBRIC FOR SCIENCE EVALUATION

How can we design objects to balance and move in different ways?

Developer: OpenSciEd

Grade 3 | July 2024

equip
Educators Evaluating Quality Instructional Products

nsta
National Science Teaching Association

CATEGORY I Rating			CATEGORY II Rating			CATEGORY III Rating		
A.	Explaining Phenomena/ Designing Solutions	**Extensive**	**A.**	Relevance and Authenticity	**Extensive**	**A.**	Monitoring 3D Student Performance	**Extensive**
B.	Three Dimensions	**Extensive**	**B.**	Student Ideas	**Extensive**	**B.**	Formative	**Extensive**
C.	Integrating the Three Dimensions	**Extensive**	**C.**	Building Progressions	**Extensive**	**C.**	Scoring Guidance	**Adequate**
D.	Unit Coherence	**Extensive**	**D.**	Scientific Accuracy	**Extensive**	**D.**	Unbiased Tasks/ Items	**Extensive**
E.	Multiple Science Domains	**Extensive**	**E.**	Differentiated Instruction	**Extensive**	**E.**	Coherent Assessment System	**Extensive**
F.	Math and ELA	**Extensive**	**F.**	Teacher Support for Unit Coherence	**Extensive**	**F.**	Opportunity to Learn	**Adequate**
			G.	Scaffolded Differentiation Over Time	**Adequate**			
	SCORE CAT I	**3**		**SCORE CAT II**	**3**		**SCORE CAT III**	**3**
				SUM CATEGORIES	**9**			
				RATING	**E**			

Summary Comments

Thank you for your submission. It is evident that this unit was thoughtfully created and is strong in several areas, including these:

- **Explaining Phenomena/Designing Solutions.** Strong evidence of student sensemaking of the phenomena or students designing solutions. Teacher support for unit coherence (e.g., Navigate sections of lessons, Our Initial Ideas, A Successful Sculpture, DQB) is critical for allowing students to see their learning progress throughout the unit and assisting Successful Sculpture. The DQB is critical for allowing students to see their learning progress throughout the unit and for assisting them in making sense of the anchoring phenomenon.
- **Monitoring 3-D Student Performance.** This unit has strong emphasis on direct, observable evidence of three-dimensional learning. Artifacts of students using the practices with Disciplinary Core Ideas and Crosscutting Concepts to make sense of phenomena and/or design solutions appeared throughout this unit.

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

- **Scaffolded Differentiation Over Time.** Currently, some of the unit's SEP supports are gradually adjusted so that students are increasingly responsible for the three SEPs identified as the focus of the unit (Planning and Carrying Out Investigations, Developing and Using Models, and Asking Questions and Defining Problems). Consider increasing the opportunities for students to engage with more of the elements from these identified SEPs and adding more opportunities for differentiation within scaffolding.
- **Opportunity to Learn.** While the unit has coherent and interconnected assessment opportunities, it did not provide students with opportunities to receive feedback focused on improving their performance for all key claimed learning in each of the three dimensions. Consider including explicit teacher and peer feedback prompts to focus on student performance related to all key claimed learning in each of the three dimensions.

Please note that in the feedback provided in this report, black text indicates either neutral comments or evidence that the criterion was met. Purple text signifies evidence that does not support the claim that the criterion was met. The purple text in these reports is specifically related to the criteria and aims to highlight areas with potential for improvements. It is important to note that *not all purple text affects the score or rating*; much of it is too minor to impact the overall rating. For instance, even criteria rated as "Extensive" may contain purple text intended to aid in continuous improvement processes. In such cases, the criterion was indeed met, and the purple text is simply not part of the justification for the "Extensive" rating.

CATEGORY I
NGSS 3D Design

I.A. Explaining Phenomena/Designing Solutions

I.B. Three Dimensions

I.C. Integrating the Three Dimensions

I.D. Unit Coherence

I.E. Multiple Science Domains

I.F. Math and ELA

I.A. EXPLAINING PHENOMENA / DESIGNING SOLUTIONS — 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 a solution to a problem motivate student learning. Materials are organized to enable students to figure out the central phenomenon: a series of sculptures that balance and move in puzzling ways. Student questions and prior experiences related to the phenomenon and problem extensively motivate sensemaking and problem solving. When engineering is a learning focus, it is integrated with the development of Disciplinary Core Ideas from physical science.

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. The first lesson sequence focuses on the phenomenon of balanced sculptures, progressing through symmetrical to asymmetrical to moving sculptures. Students are motivated to figure out how the different sculptures work as they design and build their own art sculptures. The second lesson sequence focuses on the phenomenon of hovering magnetic sculptures. Again, student investigations relate to their own questions and problem-solving as they explore magnetism and use it to solve engineering challenges. The materials have a student centered focus on phenomena or problems. For example,

- The Unit Front Matter: "The anchoring phenomenon for this unit is a series of sculptures that balance and move in puzzling ways." There are two lesson sets where students engage with lesson level phenomena that culminate in design challenges to support students in better understanding the anchoring phenomenon." (Unit Front Matter, Teacher Guide)
- Lesson 1, Connect Section, Step 3: "Post new examples to Our Examples chart. Gather around the Our Examples chart. Elicit any examples that students brought from home using the Everyday examples from home and community handout." (Lesson 1, Teacher Guide)
- Lesson 3, Synthesize Section, Step 5: "Have students focus on two parts of the Handout First, have students turn and talk about something that caused their sculpture to balance. Have students share ideas with the group, and as each idea is shared, ask students to show (with a silent signal or raised hand) how many other groups noticed the same thing. Then, ask students to turn and talk to share their answer to the sentence starter at the end of the handout, "I was able to build a sculpture with different objects by…" and have a few students share what their partner did to build a successful sculpture." (Lesson 3, Teacher Guide)
- Lesson 7, Synthesize Section, Step 6: "Discuss predictable motions of sculptures. Say, We figured out how to get our sculpture to move. What can we say about all the factors we needed to think about to cause our sculptures to move in the way we wanted? Students will likely respond that they had to apply a light or gentle force, but strong enough to start the movement. Also look for ideas about the direction they had to tap or blow on the sculpture, and the type of balance point they chose. Guide the class to co-construct the statement like the following to add to the Our Growing Ideas chart." (Lesson 7, Teacher Guide)

- Lesson 9, Synthesize Section, Step 4: "Display the initial class model with the pre-drawn picture on it. Point out the different parts in the model - the two magnets, string, metal wire, and metal base. Elicit ideas for any additional parts to add. After everyone agrees on the key parts, elicit ideas for interactions between the parts. As students share, record ideas onto the class model. You may want to record "possible interactions" with a dashed line. Likewise, mark ideas with question marks to indicate uncertainty and curiosity for ideas that need to be investigated further. If students respond that they do not know how parts interact, use that as an opportunity to help them articulate a question. Ask, What is it that we don't know? Let's record that question." (Lesson 9, Teacher Guide)
- Lesson 10, Explore Section, Step 2: "Revisit the initial Class Model. Point to the two magnets in the initial Class Model. Revoice the ideas students had about how the two magnets interact with each other. Point out that they had some uncertainties and wanted to investigate these two magnets further. Revisit the DQB. Have students look for questions they had related to magnets pushing and pulling on each other." (Lesson 10, Teacher Guide)

The materials have consistent student-driven learning over time. Examples include,

- Lesson 3, Synthesize Section, Step 6: "Gather the class to share what they figured out. Using the Our Growing Ideas chart, record the lesson question on the chart: How can we make our sculpture more playful or puzzling? Move over any student questions from the DQB that might match this question. Read those questions aloud again as you move them. Summarize ideas about weight and update Our Growing Ideas chart. Summarize ideas developed throughout the lesson and write them onto the class chart. Revise ideas from Lessons 2-3 using force." (Lesson 3, Teacher Guide)
- Lesson 5, Navigate Section, Teaching Tip Callout Box: "Having the Driving Question Board nearby will make it easier to point to any questions students had about moving sculptures from Lesson 1. This helps remind students that they had questions about this and that they were motivated to investigate this." (Lesson 5, Teacher Guide)
- Lesson 6, Synthesize Section, Step 4: "Update Our Growing Ideas chart. Using the Our Growing Ideas chart, record the lesson question on the chart: How does the shape of the balance point and a force cause it to move? Move over any student questions from the Driving Question Board that might match this question. Read those questions aloud again as you move them. It is OK if there are none. Have students summarize what they figured out to the prompts on slide I. Encourage students to piggyback onto each other's ideas, especially when they have a similar idea. Likewise, encourage students to share new and different ideas." (Lesson 6, Teacher Guide)
- Lesson 13, Navigate Section, Step 1: "Revisit the Driving Question Board. Say, We've made so much progress in our understanding about magnets these past few lessons. We've done a lot of investigations and collected evidence to help us better explain what's going on with magnets and how they can be used to create movement. Have each student choose one question from the DQB that they can now answer. When ready, have students turn and talk with a partner. They should share how they would answer the question now, and the evidence they collected that helped them revise their thinking." (Lesson 13, Teacher Guide)

The materials have consistent student-driven learning when multiple phenomena and/or problems are used. For example,

- Lesson 8, Connect Section, Community Connections Callout Box: "Once students write about their designs, they can cut out their descriptions and place them on colorful paper to create a plaque to place with their sculpture for others to view. Then, invite caregivers, school staff, or peer students to view the sculptures created by the class. Alternatively, take photographs and create a digital art gallery to share with others." (Lesson 8, Teacher Guide)

- Lesson 9, Connect Section, Step 3: "Support students to identify other phenomena that may use magnets to connect the science work to their lives and broaden what they figure out in this unit to explain more than just magnetic sculptures." (Lesson 9, Teacher Guide)
- Lesson 13, Navigate Section, Step 6: "Brainstorm other problems. To close out this lesson, reflect on how the class used magnets to solve a design challenge around sculptures. Ask students to think of examples or experiences where magnets were used to solve a problem or make something work in a particular way. Ask students to think for a minute and then elicit a few ideas aloud. Say, These are great ideas! We're going to look at a new problem in the next class and think about how to use our new understanding about magnets to solve it." (Lesson 13, Teacher Guide)
- Lesson 14, Synthesize Section, Step 4: "Introduce the Magnet Design Task. Display slide F and pass out Using Magnets to Solve a Problem. Use the written assessment to assess whether students can apply their knowledge of magnets and forces to another context. Say something like, This is your final task for this unit! We are going to use our ideas to design something that solves a problem using magnets. It can be a design for something that we have a problem doing, such as putting on clothes, or it could solve another problem for ourselves, a friend, or a family member." (Lesson 14, Teacher Guide)

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

The materials have a close match between the phenomena/problems and the student learning objectives throughout the materials. For example,

- Lesson 2, Synthesize Section, Step 5: "Once the "Our Questions" column is complete, transition to the "What We Figured Out" column of the chart. Use the discussion to elicit ideas from students about what they included in the sculptures, what worked and did not work as they were building to make it balance, and how the procedures helped them accomplish their goals. Wait to record student ideas onto the chart until everyone shares, so that you can synthesize an idea across many groups. Suggestions are provided in parentheses in the discussion box below." (Lesson 2, Teacher Guide)
- Lesson 7, Synthesize Section, Step 5: "Ask students to share ideas about why this force causes the motion to change (there is no other force of the same size acting on the object in the opposite direction of the added force.) Have students share their explanation of why these are unbalanced forces (the force in the opposite direction is not the same size (or not even there.)" (Lesson 7, Teacher Guide)
- Lesson 11, Synthesize Section, Step 4: "Convene the class together to discuss the results. Add the lesson question to the Our Growing Ideas Chart: How does the strength of the magnets or where it is placed affect forces? Ask students to share the patterns they notice in the data, and invite them to share evidence from their handouts or use the investigation materials to demonstrate as they do so." (Lesson 11, 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.

Students design solutions to a problem with connections to physical science. Examples include,

- Lesson 3, Navigate Section, Step 1: "Remind students that they built a very symmetrical sculpture, which was identical or the same on both sides. Ask students to share a few of the ideas they had for building more playful or puzzling sculptures. Student ideas should include changing the objects on either side. Tell students they are now going to build a sculpture more similar to the Category A sculpture by changing the number, size, and shapes of objects on either side. Update the chart to include a new sub-criteria that the sculpture includes different objects on either side to make it more playful or puzzling." (Lesson 3, Teacher Guide)

- Lesson 4, Navigate Section, Step 1: "Ask students how they would modify the A Successful Sculpture Will chart to have a new need to make a sculpture balance like the image on slide A. Students might say to make it oddly balanced, off-centered and balanced, or asymmetrical. Add a new sub-criteria idea to the A Successful Sculpture Will chart to capture an off-centered design as a way to make it more playful or puzzling." (Lesson 4, Teacher Guide)
- Lesson 5, Explore Section, Teacher Tip: "Students continue to discuss "What our sculpture needs to do" and "What limited our designs" to prepare them to use the terms "criteria" and "constraints" later in the unit. You can encourage your students to include more ideas around limits as these may vary depending on whether you allow students to use objects from the classroom." (Lesson 5, Teacher Guide)
- Lesson 7, Synthesize Section, Step 5: "Make explicit that failures are part of the testing process. Students may share that their sculptures fell over or didn't work like they wanted them to. Highlight for students how important failure points are in our testing process. These are key points in which we learn what might be too much or too little to achieve the motion we want. Tell students that failure points are a helpful part of the design process and we learn new information from discovering what works and doesn't work in our designs." (Lesson 7, Teacher Guide)
- Lesson 13, Connect, Step 2, "Motivate this assessment by using the final portion of Magnets Book to elicit student ideas for how a design solution like adaptive clothing may make getting dressed easier for a wide range of people. Read aloud pages 18-22 to introduce how magnets are used in adaptive clothing and tools to help people get dressed and reach objects." (Lesson 13, Teacher Guide)

Suggestions for Improvement: NA

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.*

Document evidence and reasoning, and evaluate whether or not there is sufficient evidence of quality for each dimension separately.

Evidence needs to be at the *element level* of the dimensions (see rubric introduction for a description of what is meant by "element")

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 and lesson-level phenomena. The unit centers on students interacting with a series of sculptures that balance and move in various ways. The targeted elements of all three dimensions are outlined below and identified and addressed throughout the unit.

Rating for Criterion: SEP Extensive	i. Provides opportunities to *develop and use* specific elements of the SEP(s).

The materials include students developing and using grade-appropriate elements of all three dimensions to make sense of phenomena or design solutions to problems. Teacher materials, such as the Unit Overview and the 3.1 Forces and Interactions SEP-DCI-CCC-ELA-Math-Matrix, provide explicit descriptions regarding the elements that are developed and used. The 3.1 Forces and Interactions SEP-DCI-CCC-ELA-Math-Matrix identifies six SEPs that students engage in during the unit: Asking Questions and Defining Problems, Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, Constructing Explanations and Designing Solutions, and Obtaining, Evaluating, and Communicating Information.

AQDP: Asking Questions and Defining Problems

Claimed Element: AQDP: E1 Ask questions about what would happen if a variable is changed.
Claimed in Lessons 6, 7, 9, and 10. Evidence was found in lessons 6, 7, 9 and 10, examples include

- Lesson 6, Explore Section, Step 2, as students consider how to make a sculpture that moves: "Ask students, How can we change our sculpture to move without falling over? … Pass around 1 support bar with no shape, 1 support bar with a half-circle shape, and 1 support bar with a triangle shape. Have students examine the images on the slide and the examples you pass around…Say, I have these materials we can use. If we have these materials, what are some questions we can investigate using them?" (Lesson 6, Teacher Guide)
- Lesson 7, Explore, Section, Step 4: "Testing forces on the sculpture. Using Part 2 of the handout, ask students to show with gestures (like pointing) the direction of the force, where it will be applied to their sculpture, and then point to the body part they will use to apply the force (mouth or finger). Next, ask students to share ideas about how we could test the three sizes of force (strong, medium, weak). Remind students that we are working on fair tests and in this investigation, they will only change the force they apply to the sculpture." (Lesson 7, Teacher Guide)
- Lesson 9, Synthesize Section, Step 5, students use the If/Then model to ask and predict what happens when one variable is changed: "Point to the examples on the slide. Say, Here are some question frames that we can use to ask about cause and effect. How does _____ cause it to _____? Why does ____ cause it to _____? If we do ____ with the magnet, will it ____? What happens if we do ____?". (Lesson 9, Teacher Guide)
- Lesson 10, Navigate Section, Step 5: "If students wanted to test stronger magnets in the investigations earlier in this lesson, bring their ideas forward now. Say, If we test stronger or weaker magnets in the next class, what do we predict could happen to the forces between the magnets? Give students time to turn and talk, and if time permits, share a few predictions aloud with the class." (Lesson 10, Teacher Guide)

Claimed Element: AQDP: E2 Identify scientific (testable) and non-scientific (non-testable) questions.
Claimed in Lesson 10.

- Lesson 10, Explore Section Step 2: "Because we wanted to investigate these magnets further, let's think about how we can make these questions into ones that could guide our investigations. When scientists ask questions about a system, like our sculpture, they are usually looking to identify cause-and-effect relationships between its different parts. The parts we are looking at right now are the two magnets and how they might interact with each other. Let's practice writing questions that will help us test the cause-and-effect relationship between the two magnets." (Lesson 10, Teacher Guide) The teacher defines

testable questions as cause-and-effect questions and guides students to write this type of question, but students are not themselves asked to identify whether a question is testable.

Claimed Element: AQDP: E3 Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
Claimed in Lessons 1, 9, 10, and 14. Evidence was found in Lessons 1, 9, and 10, examples include

- Lesson 1, Synthesize Section Step 6: "Introduce cause-and-effect question frames. Remind students that we have been talking about effects like staying balanced or falling over and we brainstormed initial ideas for causes of these effects. Tell students it may be helpful to pose cause-and-effect kinds of questions to help us investigate our ideas. Preview these different cause-and-effect kinds of questions. Ask questions individually. Pass out 1-2 sticky notes and a dark marker to each student. Ask students to use a marker to write one question on each sticky note. They should write their questions so they are big and bold—we want to be able to see the questions clearly. Students can work on their own or with a partner to generate questions for the class' Driving Question Board." (Lesson 1, Teacher Guide) Students are not asked to predict the outcomes of their questions.
- Lesson 9, Synthesize Section, Step 5: "Set a purpose for asking cause and effect kinds of questions. Explain that they will get to add questions to the Driving Question Board. Remind students they will start by using the cause and effect question frames on slide J to write at least one question if they can. Tell students it is often helpful to pose cause and effect kinds of questions to help us investigate our ideas. To make cause-and-effect relationships more explicit, point to the examples on the slide. Say, Here are some question frames that we can use to ask about cause and effect." (Lesson 9, Teacher Guide) Students are not asked to predict the outcomes of their questions.
- Lesson 10, Explore Section Step 2: "Share the generic cause-and-effect frame shown on the slide with the example from Lesson 6. Connect to changes students made in their first balance sculptures and the effects they were trying to achieve (balance, movement, not falling over). Point out that they have been examining cause-and-effect relationships all along. Have students turn and talk to practice using the cause-and-effect sentence frame to share an example in their everyday life using a "when this, we observe that" statement. If students have been using the cause-and-effect question starters in Lessons 1 and 9, point out a few example questions already on the DQB that have used the cause-and-effect language. Tell students that they are going to continue working on asking these kinds of questions." (Lesson 10, Teacher Guide)
- Lesson 14 evidence not found. In Lesson 14, reviewers located evidence for ADQP-E5.

Claimed Element: AQDP: E5 Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
Claimed in Lessons 2, 3, 4, 13, and 14. Evidence was found in all claimed lessons; examples include

- Lesson 2, Synthesize Section, Step 6: "Revisit the "A Successful Sculpture Will…" chart. Focus students back on the original design challenge for the lesson – to build a sculpture that is balanced, similar to the Category A sculpture. Use this part of the lesson to revisit the goals for a successful sculpture and motivate students to try out a more complicated asymmetrical design." (Lesson 2, Teacher Guide)
- Lesson 3, Navigate Section, Step 1: "Remind students that they built a very symmetrical sculpture, which was identical or the same on both sides. Ask students to share a few of the ideas they had for building more playful or puzzling sculptures. Student ideas should include changing the objects on either side. Tell students they are now going to build a sculpture more similar to the Category A sculpture by changing the number, size, and shapes of objects on either side. Update the chart to include a new sub-criteria that the sculpture includes different objects on either side to make it more playful or puzzling." (Lesson 3, Teacher Guide)

- Lesson 4, Navigate Section, Step 1: "Ask students how they would modify the A Successful Sculpture Will chart to have a new need to make a sculpture balance like the image on slide A. Students might say to make it oddly balanced, off-centered and balanced, or asymmetrical. Add a new sub-criteria idea to the A Successful Sculpture Will chart to capture an off-centered design as a way to make it more playful or puzzling." (Lesson 4, Teacher Guide)
- Lesson 13, Synthesize Section, Step 3: "Remind students that when they designed Category A and B sculptures, they had to outline the goal. Add to the A Successful Sculpture Will chart or create a new one. Work together to outline a new goal. Introduce the term criteria and name some. Review that students have been naming things their sculptures need to do. Tell students that scientists and engineers use a term criteria for these things. Criteria are the things we want our designs or solutions to do to be successful. Elicit suggestions from students." (Lesson 13, Teacher Guide)
- Lesson 14, Synthesize Section, Step 4: "Read the Design Example text on the handout and watch the video to prepare students for the task. Tell students they will be thinking and writing about the design in the video, then they will be designing their own device to solve a different related problem." (Lesson 13, Teacher Guide)

CEDS: Constructing Explanations and Designing Solutions

Claimed Element: CEDS: E1 Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard.
Claimed in Lesson 7. Evidence was found in lesson 7, examples include

- Lesson 7, Synthesize Section Step 5: "Write an If/Then statement individually. Once each group completes their spinning sculpture diagram, point to slide G and ask, How can we explain in one sentence what we did to the spinning sculpture, and what type of movement happened afterward? Tell students to individually write their statement under part 3 of their handout." (Lesson 7, Teacher Guide)

Claimed Element: CEDS: E2 Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.
Claimed in Lessons 8 and 13. Evidence was found in lessons 8 and 13, examples include

- Lesson 8, Synthesize Section Step 3: "Apply ideas about force and motion to show learning. Display slide D and handout either Art Exhibit or Game Play. Use the introduction on the slide and handout to prepare students to complete the task. Additional slides are provided to support the art exhibit task." (Lesson 8, Teacher Guide)
- Lesson 13, Connect Section, Step 5: "Draw a model of your sculpture. A model should explain how the sculpture uses forces to balance or move. Label the parts in your sculpture. Use arrows to show how the parts interact (pull toward, push apart). Use words to describe the forces that keep it balanced or moving. Remember, you can use ideas from Our Growing Ideas chart!" (Lesson 13 Teacher Guide)

Claimed Element: CEDS: E4 Apply scientific ideas to solve design problems.
Claimed in Lessons 13 and 14. Evidence was found in lessons 13 and 14, examples include

- Lesson 13, Synthesize Section, Step 4: "Work in groups to plan sculpture. Arrange students into groups. Pass out 1 copy of Example Magnetic Sculptures to each group, and Magnetic Sculpture Build to each student. Read about the building task and look over examples of different magnetic sculpture ideas. You might also refer back to the Our Examples chart and encourage students to use what they have seen at home and in their communities for inspiration. Remind students of the agreed-upon criteria and constraints." (Lesson 13, Teacher Guide)

- Lesson 14, Synthesize Section, Step 3: "Revisit Our Growing Ideas about magnets to summarize our learning. Use the Our Growing Ideas chart to summarize the big ideas that students have figured out together over the few lessons. Have students summarize ideas from each lesson using their own words and the words and pictures on the chart. Read the Design Example text on the handout and watch the video to prepare students for the task. Tell students they will be thinking and writing about the design in the video, then they will be designing their own device to solve a different related problem. Ask if students have any questions about the task. Students may work independently for 30 minutes on this task." (Lesson 14, Teacher Guide)

DATA: Analyzing and Interpreting Data

Claimed Element: DATA: E1 Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.
Claimed in Lesson 11. Evidence was found in lesson 11, examples include

- Lesson 11 Handout Investigating Magnets Further, students fill in a table with data collected about magnets' strengths and forces, then look for patterns: "Interpret data. Based on the data in the chart, what can you say about the size of the force between magnets as the strength of the magnet increases?" (Lesson 11 Handout Investigating Magnets Further)

Claimed Element: DATA: E2 Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.
Claimed in Lesson 8. Evidence was found in lesson 8, examples include

- Lesson 8 Student Assessment Game Play, students analyze and interpret data about golf club height and ball distance to make sense of how the putt-putt game works: "5. Use the lines below to explain the pattern you noticed in what Marcus and Kyla did, and how far the ball went…This NEW part of the course has an uphill surface. Use the pattern you noticed from the flat surface to predict how much force they would now need to hit the ball uphill to the hole?" Lesson 8 Teacher Guide suggests teachers give students either the Game Play or Art Exhibit assessment. If students do not use the Game Play assessment, they may not use this element.

Claimed Element: DATA: E3 Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Claimed in Lessons 4, 6 and 7. Evidence was found in all claimed lessons, examples include

- Lesson 4, Explore Section, Step 5: "Read the Artist Test procedures together. Display slide E and pass out Sculpture Design: Artist Test. Tell students that now they figured out from the other tests to make their own off-centered sculpture design that balances. Read aloud Steps 1 and 2. Ask clarifying questions to gauge understanding (build first, then draw what you built). Once groups are close to done with Step 2, draw their attention to the ways they will label their drawings (Step 3). Once students are done with Steps 1-3, have them share some things their group changes to cause their sculptures to balance (Step 4), and encourage them to notice similarities and differences with ideas from other groups." (Lesson 4, Teacher Guide)
- Lesson 6, Synthesize Section, Step 4: "Compare predictions and observations. Convene students in a Scientists Circle, and have them bring their handouts. Also, consider placing materials from the lesson in the middle of the Scientists Circle. Being able to reference and use these materials during the discussion, in addition to their handouts, will support students in fully sharing their observations and ideas. Facilitate a brief Building Understandings Discussion (~5-minute) to share observations and compare the observations to the motion students predicted." (Lesson 6, Teacher Guide)

- Lesson 7, Synthesize Section, Step 5: "Facilitate a Building Understandings Discussion to share observations of moving sculptures. Ask several groups to describe how they got their sculpture to move like a see-daw, spin, or do both. Remind students to share what shape balance point they used for their sculpture and the direction, size, and location of the force they applied. Encourage students to share evidence from their data table. As students respond, build on responses that allow students to notice the patterns across the groups and also points at which the sculptures fell over or didn't work like they wanted." (Lesson 7, Teacher Guide)

INFO: Obtaining, Evaluating, and Communicating Information

Claimed Element: INFO: E1 Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.
Claimed in Lessons 10 and 11. Evidence was found in lessons 10 and 11, examples include

- Lesson 10, Connect Section, Step 4: "Return to the Meet the Artists: Using Science in Art book. Display slide O to introduce students to a new artist the class will read about (pp. 19-22). Introduce Panayiotis Vassilakis, also known as Takis. Prepare students to listen for evidence of how Takis used science ideas in his art. As you read, ask students to share ideas about what they are noticing and wondering about the magnetic art. Use the prompts in the book to guide the discussion. Probe students for their ideas about how Takis uses science in the art. After reading and discussing Takis' work, display slide P, and have students take a few minutes to relook at their own examples from the Our Examples chart. Give them a couple of minutes to turn and talk about where they see evidence of forces between magnets that push apart or pull together." (Lesson 10, Teacher Guide)
- Lesson 11, Lesson 11, Connect Section, Step 5: "Read aloud a text about magnets. Display slide H and prepare to read aloud the *Magnets Book*. Introduce the title of the book, the table of contents, and then read aloud pages 1-12, pausing to gather students' noticings and wondering about the different magnets." (Lesson 11, Teacher Guide)

Claimed Element: INFO: E2 Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.
Claimed in Lesson 4. Evidence was found in lesson 4, examples include

- Lesson 4, Connect Section, Step 5: "Read two more artist profiles in the book, Meet the Artists: Using Science in Art. Read about Jade Oakley. Discuss their work and show photos of their hanging mobiles. Let students share some ideas and tell them they will investigate these hanging mobile sculptures more in the next class." (Lesson 4, Teacher Guide)

Claimed Element: INFO: E4 Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.
Claimed in Lessons 2 and 3.

- Lesson 2, Navigate Section, Step 4: "Use the Our Initial Ideas: How They Work chart and the Symmetry book to think about other designs. Ask students what they notice and wonder now about the Category A sculpture, especially when thinking about symmetry and asymmetry. Invite students to share their ideas with the class." (Lesson 2, Teacher Guide) While students obtain information about symmetry from one book, they do not combine it with other books or sources. Though students are asked to recognize symmetry vs. asymmetry in their sculptures, evidence was not found of students being prompted to use or use the concept of symmetry after they were finished reading to explain the examples or solve a problem.
- Lesson 3, Synthesize Section, Step 5: "Connect to how the artists accounted for forces in their designs. Remind students that weight is a pull toward the ground. Heavier objects have a stronger pull to the

ground, so we say they weigh more. Lighter objects have a weaker pull to the ground so we say they weigh less. Tell students that weight is a type of force or a thing that has strength and direction. Use a digital scale and push down on it. Facilitate a discussion about how weight is a force." (Lesson 3, Teacher Guide)

Claimed Element: INFO: E5 Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts.
Claimed in Lessons 8, 13, and 14. Evidence was found in all claimed lessons, examples include

- Lesson 8, Connect Section, Step 4: "Communicate to the school community about sculptures. If doing the Art Exhibit, display slide E. As students finish sculptures, transition them to consider how they can communicate to others about their sculpture design. First, have students pair up and verbally tell a classmate about their design. This will let them practice communicating the important parts of their design. They can use sentence starters on the slide to help them communicate their ideas. Then have them write about their designs on a notecard or sheet of paper to prepare to communicate with others." (Lesson 8, Teacher Guide) As noted in III.C, this element is not developed if the Game Play assessment is used instead of Art Exhibit.
- Lesson 13, Connect Section, Step 5: "Write explanations individually. Pass out 1 copy of Explaining My Sculpture to each student. Tell students that they will write an explanation to the same audience - an audience who has never built a magnetic sculpture before - of how magnetic forces are causing their sculpture to move or not fall over." (Lesson 13, Teacher Guide)
- Lesson 14, Synthesize Section, Step 4: "If time allows, let students share verbally with a partner what they designed and how it works. Or, create a gallery walk of their designs to see others' ideas for designs. After the gallery walk, have students share ideas about similarities between designs, or ways of grouping similar designs into categories." (Lesson 14, Teacher Guide)

INV: Planning and Carrying Out Investigations

Claimed Element: INV: E1 Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
Claimed in Lessons 4-8 and 11. Evidence was found in all claimed lessons, examples include

- Lesson 4, Explore Section, Step 3: "Prepare the class for the Distance Tests. Display slide C and pass out Sculpture Design: Distance Tests. As a class, read aloud the investigation question and investigation procedures (Steps 1-3). Have students talk with their group about what they notice. What is changing? What is staying the same? Clarify student questions and the steps so that all students are in agreement about how they are testing distance and what they need to record as they observe each test." (Lesson 4, Teacher Guide)
- Lesson 5, Explore Section, Hanging Sculptures Student Handout, students work in groups to build and test initial hanging sculpture designs. They are asked to conduct two trials and explain their findings. (Lesson 5, Hanging Sculptures Student Handout) However, students are not made aware of using fair tests or controlled variables.
- Lesson 6, Explore Section, Step 2: "Draft a plan to change only 1 thing. Remind students that to carry out a careful investigation, they want to change only one thing at a time. Everything else should be kept the same. Elicit suggestions for the one thing to change. Students should recommend the balance point shapes. Record on the chart paper the one thing they want to change: the shape of the balance points. On the Investigation Plan chart, record ideas for everything that must stay the same. Ideas should include… Then record an idea for one thing that will change – the shape of the balance point. Tell students that in this investigation, they will do each test more than once, to see if the same thing happens every time. Remind students that these are called trials. As you discuss the term "trial" recall previous investigations, and why it's important to try a test more than once." (Lesson 6, Teacher Guide)

- Lesson 7, Explore Section, Step 4: "Testing forces on the sculpture. Using Part 2 of the handout, ask students to show with gestures (like pointing) the direction of the force, where it will be applied to their sculpture, and then point to the body part they will use to apply the force (mouth or finger). Next, ask students to share ideas about how we could test the three sizes of force (strong, medium, weak). Remind students that we are working on fair tests and in this investigation, they will only change the force they apply to the sculpture. Give students time to talk with their group about the investigation question and what they predict will happen when each size force is applied to their sculpture. They should write their predictions on the handout. Look at the table on the handout together. Point out where students will draw arrows showing the size and direction of the forces they will test, and use student responses and class posters to support students as they add arrows to the table. Ask students to notice the number of trials they will be doing for each size force (three)." (Lesson 7, Teacher Guide)
- Lesson 8, Synthesize Section, Art Exhibit Student Handout, students are given the option to complete the Art Exhibit Task, where they will create their own sculpture to test. Students build their sculptures twice before applying force and explaining their results (L; examples Exhibit Student Handout). However, students are not made aware of using fair tests or controlled variables. Also, this is optional; therefore, students may not have the opportunity to interact with this activity.
- Lesson 11, Explore Section, Investigating Magnets Further Student Handout: students ask a question they can investigate before collecting data with multiple trials. Then, they change one variable and run the investigation again before interpreting the data collected from both experiments. (Lesson 11, Investigating Magnets Further Student Handout)

Claimed Element: INV: E3 Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
Claimed in Lessons 2, 3 ,6, 8, 11, and 12. Evidence was found in all claimed lessons, examples include

- Lesson 2, Explore Section, Initial Design: Category A Student Handout: students create a sculpture, and after observing the success rate, they recreate the sculpture and try to balance it again. Students also determine the distance the object is from the center of their sculpture before identifying what was successful and what was not. (Lesson 2, Initial Design: Category A Student Handout)
- Lesson 3, Explore Section, Sculptures with Different Objects Student Handout: students build a sculpture using different objects on each side. They calculate the total weight of the objects on each side of the ruler before determining what combination makes the most successful sculpture. (Lesson 3, Sculptures with Different Objects Student Handout)
- Lesson 6, Explore Section, Balance Point Investigation Student Handout: students plan and conduct an investigation to determine if the shape of the balance point and a force causes it to move before explaining their findings. (Lesson 6, Balance Point Investigation Student Handout)
- Lesson 8, Synthesize Section, Art Exhibit Student Handout, students are given the option to complete the Art Exhibit Task, where they create their own sculpture to test out. Students built their sculptures twice before applying force and explaining their results. (Lesson 8, Art Exhibit Student Handout)
- Lesson 11 student handout Investigating Magnets Further, students measure the strength of magnetic force with different magnets, and use their data as evidence to explain the relationship between magnetic field force and magnet strength: "Measure the amount of force between the magnet when there is 1 only one magnet. Repeat the measurements when using 2 test magnets and then three test magnets. Record your data below… Based on the data in the chart, what can you say about the size of the force between magnets as the strength of the magnet increases?" They then collect data about the effect of varying distances on magnetic field strength, and use their data examples to explain the relationship between magnetic field force and distance: "Measure the amount of force between the magnets when they are 1 inch apart. Repeat the measurements when the magnets are held 2 and 3 inches apart. Record your data

below…Based on the data in the chart, what can you say about the size of the force between magnets as the distance gets further apart?" (Lesson 11, Handout Investigating Magnets Further)
- Lesson 12, Explore Section, Step 2:" Knowing what we know now about metals, could we replace the magnet on the bottom with a metal and still get it to hover? Elicit a few ideas from students for how to do this new investigation." (Lesson 12, Teacher Guide)

Claimed Element: INV: E4 Ma; examplesions about what would happen if a variable changes.
Claimed in Lesson 6. Evidence was found in lesson 6:
- Lesson 6, Explore Section, Step 2: "Make predictions. Explain that before applying force to the sculptures, students will make some predictions. Pause to discuss the term prediction. Ask students what they think of when they hear the word prediction. Elicit a few ideas, then share that prediction means to make a statement that something might happen or is expected to happen." (Lesson 6, Teacher Guide)

MATH: Using Mathematics and Computational Thinking

Claimed Element: MATH: E3 Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems.
Claimed in Lessons 3-5. Evidence was found in all claimed lessons; examples include
- Lesson 3, Explore Section, Step 2: "Find two objects that feel the same. Give groups a bag of objects and ask the students to find two objects that feel the same heaviness. Groups should come up with the same two objects. Let groups test the objects using a support block and ruler and holding the two sides in a "balanced" position. Most will not balance or will be hard to balance. Predict the heaviness of an object. Show students two identical mini plastic springs and show how they stretch when pulled on. Ask the class what the springs will do if an object is attached to one end and you hold the other end. Use the digital scale. Transition to using a digital scale to measure weight by placing the object with less weight on the scale. Either project the reading from the scale with a document camera or have the class gather around the scale." (Lesson 3, Teacher Guide)
- Lesson 4 in Student Handout Sculpture Design: Distance Tests, students measure distances between objects and between objects and a ruler's balance point to figure out how to balance an asymmetrical sculpture."Draw the test that did not fall over. Use counting to measure how far each block is from the balance point. Be sure to include the units (inches or centimeters). Record your ideas, in words or pictures; examples, the boxes below. What happened? What do you think caused it to happen?" (Lesson 4 Student Handout Sculpture Design)
- Lesson 5, Synthesize Section, Step 5: "Select one of the "lighter" and "heavier" hanging sculptures built by students for a demonstration. Ideally, the lighter sculpture has fewer objects than the heavier sculpture, making the difference more obvious without needing to use a digital scale. Hold up the sculptures in opposite hands and continue to gather their ideas about the forces acting on the hanging sculpture." (Lesson 5, Teacher Guide)

MOD: Developing and Using Models

Claimed Element: MOD: E2 Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.
Claimed in Lesson 10. Evidence was found in lesson 10; examples include
- Lesson 10, Synthesize Section, Step 3: "Update the class model. Then update the class model with a representation of the interactions occurring between the two magnets in the sculpture that the students

now have evidence to support. You will want to include arrows to show that the magnets are applying forces on each other even without any contact. Then, add the word noncontact force to the class word wall." (Lesson 10, Teacher Guide)

Claimed Element: MOD: E3 Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.
Claimed in Lessons 3, 6, 7, 8, and 13. Evidence was found in all claimed lessons, examples include

- Lesson 3, Synthesize Section, Step 5: "Revise ideas from Lessons 2-3 using force. Introduce students to an arrow to represent force. Say something like, We can represent forces with arrows to show the direction of the push and pull and we can make the arrows shorter or longer to show how strong the force is. Let's add these arrows to our class sketches to show where the forces are. Go back to science ideas and models for Lessons 2 and 3 and revise them using the new term "force" and the new symbol of an arrow." (Lesson 3, Teacher Guide)
- Lesson 6, Synthesize Section, Step 4: "Ask, can someone come up here and show the class how you caused the sculpture to move? When the sculpture starts to move you can connect back to the class observations showing the shape of the balance point and the type of motion. Then ask, Did someone else use a different way to cause the sculpture to move? Have another student demonstrate. As they demonstrate, point out the direction of the force (e.g., from the side or from the top) and how the force is being applied (e.g., light blowing or tapping)." (Lesson 6, Teacher Guide) The teacher draws more arrows on the "Our Growing Ideas" chart, but students do not use arrows themselves, nor are the arrows referred to in the class discussions.
- Lesson 7, Explore Section, Step 4: "Add force arrows to the sculpture design. Guide students using the handout to add arrows to their drawing to show the forces on the sculpture at rest. Then guide students to decide as a group, then add a RED arrow to show where and in what direction they will apply the extra force that they think will make the sculpture move. They will indicate (circle) on the handout how they will apply that force." (Lesson 7, Teacher Guide)
- Lesson 8, Synthesize Section, Art Exhibit Student Handout, students are given the option to complete the Art Exhibit Task, where they will create their own sculpture to test out. Students draw their final sculpture design and are asked to add arrows to show the forces acting upon the sculpture when it is at rest. (Lesson 8, Art Exhibit Student Handout)
- Lesson 13, Student Handout Magnetic Sculpture Build: Students create their own models, incorporating arrows to indicate forces: "Draw a model of your sculpture. A model should explain how the sculpture uses forces to balance or move. Label the parts in your sculpture. Use arrows to show how the parts interact (pull toward, push apart). Use words to describe the forces that keep it balanced or moving." (Lesson 13 Handout Magnetic Sculpture Build)

Claimed Element: MOD: E4 Develop and/or use models to describe and/or predict phenomena.
Claimed in Lessons 1, 9, 11, and 12. Evidence was found in all claimed lessons, examples include

- Lesson 1, Synthesize Section, Step 5: "Convene in a Scientists Circle to chart initial consensus ideas. Gather students around the Our Initial Ideas: How They Work chart that is placed near the Our Examples chart. This chart represents the class's initial consensus model. Students will first share ideas to explain Category A sculptures and objects (slide N), followed by sharing ideas to explain Category B (slide O)." (Lesson 1, Teacher Guide)
- Lesson 9 Handout Model To Explain Sculptures With Magnets and Metal:" You will create a model to explain: How do the magnets and other parts interact to cause movement?" (Lesson 9 Handout Model To Explain**),** and is supported by a suggestion for teacher talk in the Lesson 9 Teacher Guide, Synthesize Section, Step 4: "Explain that in science models are used to help scientists explain something or to make predictions. One kind of model scientists use is a diagram. This kind of model includes words and pictures,

but it's more than a picture. This kind of model is developed to answer a question. It is used to explain a phenomenon and to show relationships "(Lesson 9, Teacher Guide)

- Lesson 11, Synthesize Section, Step 4: "Add any new ideas to the class model. As you update the Our Growing Ideas chart, also add additional words or symbols to the class model to capture additional ideas about how magnets interact with one another. These ideas could show that strong magnets may push or pull more than weaker magnets, or that distance between magnets may have stronger or weaker forces." (Lesson 11, Teacher Guide)
- Lesson 12, Explore Section, Step 3: "Create models in small groups. When students are finished with their observations, direct them to keep the paper clip ready for testing, but set aside the magnet for now. Focus their attention on creating a model to explain how the paper clip hovered in some situations, and did not hover in other situations. Encourage them to use ideas from the Our Growing Ideas chart. They can also retest the paper clip if they need to see something again that will help with their model." (Lesson 12, Teacher Guide)

Claimed Element: MOD: E5 Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.
Claimed in Lessons 1, 2, 5, 7 and 14. Evidence was found in all claimed lessons; examples include

- Lesson 1, Explore Section, Group Sculpture: Build an Example Student Handout, students work together to build a balanced sculpture and are asked to sketch and label how it works. (Lesson 1, Group Sculpture: Build an Example Student Handout)
- Lesson 2, Explore Section, Initial Design: Category A Student Handout: students create a sculpture and sketch what design works and does not work. (Lesson 2, Initial Design: Category A Student Handout)
- Lesson 5, Synthesize Section, Step 6: "Prompt each student to draw a diagram of their final hanging sculpture on Hanging sculptures. Then have students show their drawings in their group and share ideas about how to add arrows to their diagram to show all forces pulling up and down on their sculpture." (Lesson 5, Teacher Guide)
- Lesson 7, Explore Section, Making Sculptures Move Student Handout: students plan and build their own moving sculpture and are asked to draw the sculpture and label the balance point with arrows showing the forces. (Lesson 7, Making Sculptures Move Student Handout)
- Lesson 14, Explore Section, Student Assessment Using Magnets to solve a Problem, students are asked to sketch and describe their design solution to help the designers. (Lesson 14, Student Assessment Using Magnets to solve a Problem)

Claimed Element: MOD: E6 Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Claimed in Lessons 5 and 6. Evidence was found in lesson 6; examples include

- Lesson 5, Synthesize Section, Hanging Sculptures Student Handout: students sketch two designs for a hanging sculpture that balances to show upward and downward forces acting on their sculpture. (Lesson 5, Hanging Sculptures Student Handout) Although students co-create a model, they do so after they do cause and effect tests rather than as a way to do the tests.
- Lesson 6, Explore Section, Balance Point Investigation Student Handout: students choose a structure in a sculpture that they will change before making predictions about how this change will affect the balance point of the sculpture. (Lesson 6, Balance Point Investigation Student Handout)

Criterion-Based Suggestions for Improvement: NA

Rating for Criterion: DCI Extensive	ii. Provides opportunities to develop and use specific elements of the DCI(s).

The materials include students developing and using grade-appropriate elements of the DCIs because students not only use, but also develop, over time, several specific elements of various DCIs involving both forces and engineering ideas.

ETS1.A Defining and Delimiting Engineering Problems

Claimed Element: **3-5-ETS1.A.1** ETS1.A Defining and Delimiting Engineering Problems: Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1) (secondary to 4-PS3-4)
Claimed in Lessons 2-5. Evidence was found in all claimed lessons, examples include

- Lesson 2, Synthesize Section, Step 6:" Use the following discussion to revise the chart to include limitations on the current sculpture designs and possibly new goals for an asymmetrical sculpture. Update the "A Successful Sculpture Will" chart to include limitations of the sculpture design and new criteria for success – that is, that the sculpture is playful or puzzling."(Lesson 2, Teacher Guide)
- Lesson 4, Navigate Section, Step 1: "Ask students how they would modify the A Successful Sculpture Will chart to have a new need to make a sculpture balance like the image on slide A. Students might say to make it oddly balanced, off-centered and balanced, or asymmetrical. Add a new sub-criteria idea to the A Successful Sculpture Will chart to capture an off-centered design as a way to make it more playful or puzzling."(Lesson 4, Teacher Guide) While students are identifying successful criteria, they do not identify constraints.
- Lesson 5, Explore Section, Teaching Tip: "Students continue to discuss "What our sculpture needs to do" and "What limited our designs" to prepare them to use the terms "criteria" and "constraints" later in the unit. You can encourage your students to include more ideas around limits as these may vary depending on whether you allow students to use objects from the classroom." (Lesson 5, Teacher Guide)

ETS1.B Developing Possible Solutions

Claimed Element: **3-5-ETS1.B.2** ETS1.B Developing Possible Solutions: Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)
Claimed in Lessons 6 and 7. Evidence was found in all claimed lessons, examples include

- Lesson 6 This DCI is implied but not made explicit. In Synthesize step 4, "When it didn't work or fell over (or When the test failed), why do you think that happened?" (Lesson 6 Teacher Guide) This implies that failures are important learning opportunities, though the DCI is not made explicit until Lesson 7.
- Lesson 7 Synthesize Step 5: "Make explicit that failures are part of the testing process. Students may share that their sculptures fell over or didn't work like they wanted them to. Highlight for students how important failure points are in our testing process. These are key points in which we learn what might be too much or too little to achieve the motion we want. Tell students that failure points are a helpful part of the design process and we learn new information from discovering what works and doesn't work in our designs." (Lesson 7 Teacher Guide)

PS2.A Forces and Motion

Claimed Element: **3-PS2.A.1** PS2.A Forces and Motion: Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1)
Claimed in Lessons 1-8 and 13. Evidence was found in all claimed lessons, examples include

- Lesson 1 Forces and Interactions Matrix, "This lesson only surfaces prior knowledge and will not fully develop any part of the DCI on its own, but rather sets the stage for future learning in subsequent lessons. It does not develop ideas about balanced forces yet, which will be introduced in lesson 5, but rather surfaces initial ideas about what students think is important to help the sculpture balance in an everyday meaning. These ideas will be developed more fully in subsequent lessons." (Forces and Interactions Matrix)
- Lesson 2, Explore Section, Initial Sculpture Design: Category A Student Handout: students investigate how the objects and distances must be equal or the same on both sides of the balance point to cause the sculpture to balance. (Lesson 2, Initial Sculpture Design: Category A Student Handout)
- Lesson 3, Synthesize Section, Step 5: "Revise ideas from Lessons 2-3 using force. Introduce students to an arrow to represent force. Say something like, We can represent forces with arrows to show the direction of the push and pull and we can make the arrows shorter or longer to show how strong the force is. Let's add these arrows to our class sketches to show where the forces are. Go back to science ideas and models for Lessons 2 and 3 and revise them using the new term "force" and the new symbol of an arrow." (Lesson 3, Teacher Guide)
- Lesson 4, Explore Section, Step 4: After students have conducted weight tests, the teacher facilitates a discussion to elicit ideas about what caused off-center sculptures to balance or not balance. In Synthesize step 6, students are asked to share what they figured out about weight and balancing: "Ideas to Look and Listen For: If we changed the distance and used the same weight, it fell over. We had to add more weight to the short side to get the sculpture to balance." (Lesson 4 Teacher Guide)
- Lesson 5, Handout Hanging Sculptures part D, students show the concept of balanced forces with arrows in models of their hanging sculptures: "Step 1. In the box below, draw a diagram of your final hanging sculpture. Step 2. Add arrows to show ALL the upward and downward forces acting on your sculpture." Lesson 5 Handout Hanging Sculptures)
- Lesson 6, Synthesize Section, Step 4: "Continue the discussion by asking, Is your force the only force on your sculpture? Answers will vary but look for ideas about multiple forces from Lessons 2-5. Continue by saying, We've been calling the force you applied to make the sculpture move an extra force. Help students to connect that the extra force and the motion of the sculpture are in the same direction." (Lesson 6 Teacher Guide)
- Lesson 7, Explore Section, Step 4: "As you walk around observing students, help students focus on the location and strength of the extra force by asking them questions like the following: What kind of movement are you expecting to see? What extra force will you apply to get your sculpture to move? Where will you apply your extra force? How much force do you need to apply to get the movement you want? What direction do you think the sculpture will move after you give it an extra force?" (Lesson 7 Teacher Guide)
- Lesson 8, Synthesize Section, Step 2: "Ask students to reflect on their learning about forces. Use the ideas and drawings on the class chart to help support a discussion on how we tested and represented forces over time on the Our Growing Ideas chart." (Lesson 8, Teacher Guide)
- Lesson 13, Synthesize Section, Magnetic Sculpture Build Student Assessment: students build a magnetic sculpture and explain how the parts interact and the forces that keep it balanced or moving. (Lesson 13, Magnetic Sculpture Build Student Assessment)

Claimed Element: **3-PS2.A.2** PS2.A Forces and Motion: The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-2)
Claimed in Lessons 1, 6, 7 and 8. Evidence was found in all claimed lessons, examples include

- Forces and Interactions Matrix: "In this first lesson of the unit, students observe patterns in the movement of sculptures. Students generate initial ideas of what causes movement. This lesson only surfaces prior knowledge and will not fully develop any part of the DCI on its own, but rather sets the stage for future learning in subsequent lessons."
- Lesson 6, Synthesize Section, Step 4: "Facilitate a brief Building Understandings Discussion (~5-minute) to share observations and compare the observations to the motion students predicted. While students share, there are two suggestions for documenting their ideas: use a different color marker to update the Investigation Plan chart with the observed motion. Place a check near a prediction that held up during the tests and add new motions that were not predicted but were observed. Create a simple observation chart to list which kinds of motion were observed (see Patterns callout for an example)"(Lesson 6, Teacher Guide)
- Students predict motion in Lesson 7, Handout Making Sculptures Move, and then look for patterns in observed motions: "Step 7. Our Predictions: If we apply a weak force, our sculpture will…If we apply a medium force, our sculpture will…If we apply a strong force, our sculpture will…" and "Step 9. Use the lines below to describe any patterns we notice in how the sculpture moves:" (Lesson 7, Teacher Guide)

PS2.B Types of Interactions

Claimed Element: **3-PS2.B.1** PS2.B Types of Interactions: Objects in contact exert forces on each other. (3-PS2-1)
Claimed in Lessons 1, 2, 3, 5, 6, 7, 8 and 12. Evidence was found in lessons 1, 2, 3, 5, 6, 7, 8, and 12, examples include

- Lesson 1 Forces and Interactions Matrix: "In this first lesson of the unit, students observe sculptures that balance and move because of the forces. This lesson only surfaces prior knowledge about causes for balance and movement and will not fully develop any part of the DCI on its own, but rather sets the stage for future learning in subsequent lessons."
- Lesson 2 Matrix "Students begin building and testing different types of symmetrical sculptures that balance, and as they do so, they are placing objects onto the sculpture in specific arrangements. The objects make contact with the ruler, which supports the weight on a support block. They will not label these as forces yet, nor will they label them as contact forces until lesson 7. However, they are building initial ideas about where and how to place the blocks to achieve a balanced sculpture. The lesson focuses students' attention on distance from the center point and symmetry vs. asymmetry, rather than on what's touching what." However, this distinction between focusing on balance/symmetry and not on "what's touching what" is not mentioned in the Lesson 2 Teacher Guide. Additionally, the matrix states "they are building initial ideas about where and how to place the blocks to achieve a balanced sculpture", which explicitly focuses on balanced forces, PS2.A.1 and implicitly builds towards the ideas of PS2.B.
- Lesson 3, Synthesize Section, Step 5: "Tell students that weight is a type of force or a thing that has strength and direction. Use a digital scale and push down on it. Facilitate a discussion about how weight is a force. Am I applying a force to this scale? How do you know I am putting a force on it? (the scale number changes) In which direction am I applying the force? Is it strong or weak? Can you think of other examples of things that touch each other and apply a force?" (Lesson 3, Teacher Guide)
- Lesson 5, Synthesize Section, Step 5: "Experience and then represent an upward force. Have a student from each group hold up the sculpture taking turns for all group members. As they hold it, encourage

students to consider the force being applied by their hand(s) or arm(s) to hold the sculpture up." (Lesson 5, Teacher Guide)

- Lesson 6, Synthesize Section, Step 4, the class discusses how they caused sculptures to move: "Ask, Can someone come up here and show the class how you caused the sculpture to move? When the sculpture starts to move you can connect back to the class observations showing the shape of the balance point and the type of motion. Then ask, Did someone else use a different way to cause the sculpture to move? Have another student demonstrate. As they demonstrate, point out the direction of the force (e.g., from the side or from the top) and how the force is being applied (e.g., light blowing or tapping)." (Lesson 6, Teacher Guide)
- Lesson 7, Synthesize Section, Step 5: "Explain to students that whether they pushed or blew on their sculpture to get it to move, they had to touch it somehow. Tell students that whenever there is a force that happens when two things touch, scientists call this a contact force." (Lesson 7, Teacher Guide)
- Lesson 8, Synthesize Section, Step 2: "Ask students to reflect on their learning about forces. Use the ideas and drawings on the class chart to help support a discussion on how we tested and represented forces over time on the Our Growing Ideas chart. What are the forces that act on the sculptures we've been building? What about when we applied an extra force to the sculpture? Can you use your body to show what happened when we applied an extra force to the sculpture?) (Lesson 8, Teacher Guide)
- Lesson 12, Summarize Section, Step 5, the class compares contact forces and noncontact forces: "Review contact and noncontact forces terms on the word wall so that students can apply their new experiences and ideas to these words." (Lesson 12 Teacher Guide)

Claimed Element: **3-PS2.B.2** PS2.B Types of Interactions: Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3), (3-PS2-4)

Claimed in Lessons 9-14. Evidence was found in lessons 11 and 12, examples include

- Lesson 9, Synthesize Section, Model to explain sculptures with magnets and metals Student Handout: students create a model to show that the magnets are attracting each other without touching. (Lesson 9, Model to explain sculptures with magnets and metals Student Handout) Students are not explicitly discussing the sizes of the forces in each situation depending on the properties of the objects and distances apart. Students are not discussing electric forces.
- Lesson 10, Synthesize Section, Step 3: "Discuss forces without touch or contact. Return to the sculpture seen in Lesson 9. Say, In the first sculptures we built, we learned that when two things touch they apply forces on each other. But these forces seem different. What evidence do we have that magnets can apply forces on each other even when they don't touch? Elicit evidence from students from any of the four investigations, but especially an investigation where the magnets could still push or pull on each other even when an object was between them. Update the first idea recorded on the chart to include "without touching" at the end of it: The magnets apply forces on one another without touching." (Lesson 10, Teacher Guide)
- Lesson 13 Student Assessment Explaining My Sculpture: students use their understanding of noncontact forces and how they work: "You will communicate about your sculpture to someone who has not made a magnetic sculpture before. Your written explanation should answer the following question: How do magnetic forces interact on your sculpture to cause it to stay still and not fall over or move in an interesting way?"
- Lesson 14 Student Assessment Using Magnets to Solve a Problem, students apply their understanding of noncontact forces and magnetism to design and explain a solution to a problem: "Step 4. Use the lines and box below to explain how your design works. Explain how the forces between magnets, or the forces between magnets and metals, cause your design to be successful."

Criterion-Based Suggestions for Improvement: NA

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.

CE: Cause and Effect

Claimed Element: CE-E1 Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change.
Claimed in Lessons 1-11, 13, 14 Evidence was found in all claimed lessons 1-11, 13, 14 examples include

- Lesson 1, Explore Section, Step 2: "Preview instruction for what students will do in their groups. Students will need to examine the materials and decide what to build together. Allow students to explore the materials and how they might be used before building the first sculpture. After they build, they will write down their ideas and/or sketch their ideas about what causes their sculpture to balance or balance and move." (Lesson 1, Teacher Guide)
- Lesson 2, Explore Section, Step 2:" As students are building, circulate among them asking questions to push their thinking about what is causing the sculpture to balance or not. What do you think you did to cause the sculpture to balance? What did you have to do?" (Lesson 2, Teacher Guide)
- Lesson 3, Handout 1, Step 1, "Build a sculpture that balances using different objects on each side." students were seeing how weight would cause the sculpture to have balance forces. (Lesson 3 Students Handout) Lesson 1, Explore Section, Step 2: "Preview instruction for what students will do in their groups. Students will need to examine the materials and decide what to build together. Allow students to explore the materials and how they might be used before building the first sculpture. After they build, they will write down their ideas and/or sketch their ideas about what causes their sculpture to balance or balance and move." (Lesson 1, Teacher Guide)
- Lesson 4, Explore Section, Step 4: "Tell students that they will now investigate what else can make their off-centered sculpture balance. Read aloud Steps 1 and 2. Ask students to describe in their own words what we mean by "add objects to only one side" to clarify that they can choose either side, but all new objects will be added on that side only. Once students are clear on the investigation procedures, give groups time to complete Steps 1-4. When complete, ask students to think about and share their new ideas for what caused the sculpture to balance and how to improve the procedures in Steps 5 & 6." (Lesson 4, Teacher Guide)
- Lesson 5, Synthesize Section, Step 5: "Demonstrate upward forces. Start with the class sculpture suspended over a table if possible, and tell students that you noticed that the string was very loose. Ask them to share ideas about what might happen if the string let go. Let the string go, and ask students to share explanations about why the sculpture fell. Then, grab the string of the sculpture and slowly start lifting. Ask students to share what they notice and their ideas about why the sculpture is moving, and in what direction. Of these two sculptures, which sculpture will I need to pull up on more to keep it off the ground? Why do you think that?" (Lesson 5, Teacher Guide)
- Lesson 6, Synthesize Section, Step 4: "Facilitate a brief Building Understandings Discussion (~5-minute) to share observations and compare the observations to the motion students predicted. Ask, Can someone come up here and show the class how you caused the sculpture to move? When the sculpture starts to

move you can connect back to the class observations showing the shape of the balance point and the type of motion. Then ask, Did someone else use a different way to cause the sculpture to move? Have another student demonstrate. As they demonstrate, point out the direction of the force (e.g., from the side or from the top) and how the force is being applied (e.g., light blowing or tapping)." (Lesson 6, Teacher Guide)

- Lesson 7, Explore Section, Step 4: "Facilitate small group discussions while they test. As you walk around observing students, help students focus on the location, strength, and direction of the extra force by asking them questions like the following: What kind of movement are you expecting to see? What caused it to fall over (not move)? What caused your sculpture to fall over or not move like you wanted?" (Lesson 7, Teacher Guide)
- Lesson 8, Synthesize Section, Step 2: "Take stock of all our ideas. Use the Our Growing Ideas chart to summarize the big ideas that students have figured out together over the last six lessons. Ask students to reflect on their learning about forces. Use the ideas and drawings on the class chart to help support a discussion on how we tested and represented forces over time on the Our Growing Ideas chart." It is implied that students would discuss the cause and effect relationships they observed throughout lessons 1-6.
- Lesson 9, Three-dimensional Learning goals, Develop a model to show how parts in a sculpture interact to cause movement. Then ask questions about the model to determine cause and effect (Lesson 9, Teacher Guide and Student Material)
- Lesson 10, Explore Section, Step 2: "Share the generic cause-and-effect frame shown on the slide with the example from Lesson 6. Connect to changes students made in their first balance sculptures and the effects they were trying to achieve (balance, movement, not falling over). Point out that they have been examining cause-and-effect relationships all along. Have students turn and talk to practice using the cause-and-effect sentence frame to share an example in their everyday life using a "when this, we observe that" statement." (Lesson 10, Teacher Guide)
- Lesson 11 Handout 1, Question on the handout "If the distance between magnets increases, how does this affect the size of the force?" (Lesson 11, Student Handout)
- Lesson 13 students create a hovering sculpture, then use ideas about cause and effect to communicate to others about why it works. In Student Assessment Explaining My Sculpture: "You will communicate about your sculpture to someone who has not made a magnetic sculpture before. Your written explanation should answer the following question: *How do magnetic forces interact on your sculpture to cause it to stay still and not fall over or move in an interesting way?"* (Lesson 13 Student Assessment Explaining My Sculpture)
- Lesson 14 Synthesize step 4 sidebar: "Where it makes sense, highlight cause-and-effect relationships between magnets and between magnets and other metal objects while students are developing their designs. Students identified and tested these relationships in previous lessons and are now applying these ideas to explain how the design works." (Lesson 14 Teacher Guide)

PAT: Patterns

Claimed Elements: PAT-E1 Patterns Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products.
Claimed in Lessons 1 Evidence was found in all claimed lessons, examples include

- Lesson 1 Community Connection 2, "Everyday examples from home and community looking at sculptures and balanced forces that are similar and different. (Lesson 1, Student Material)

Claimed Element: PAT-E2 Patterns of change can be used to make predictions.
Claimed in Lessons 6, 7 Evidence was found in lessons 6,7, examples include

- Lesson 6, Handout 1, Balance Point Investigation: Students did several tests to see which shape would work best to allow their sculpture to spin when they applied force. The lesson is scaffolded to teach students

how to carry out an investigation. Students also look for patterns based on the weight of the object to get their sculpture to balance and predict which one would allow the sculpture to spin. (Lesson 6, Student Handout)

- Lesson 7, Synthesize Section, Step 5: "Facilitate a Building Understandings Discussion to share observations of moving sculptures. Ask several groups to describe how they got their sculpture to move like a see-daw, spin, or do both. Encourage students to share evidence from their data table. As students respond, build on responses that allow students to notice the patterns across the groups and also points at which the sculptures fell over or didn't work like they wanted." (Lesson 7, Teacher Guide)

Claimed Element: PAT-E3 Patterns can be used as evidence to support an explanation.
Claimed in Lessons 8, 11, and 12. Evidence was found in Lessons 8,11,12, examples include

- Lesson 8: Students put on an art exhibit with the sculptures they had designed and had to explain how they were able to get their sculptures to balance. (Lesson 8, Teacher Guide)
- Lesson 11, Synthesize Section, Step 4: "Convene the class together to discuss the results. Add the lesson question to the Our Growing Ideas Chart: How does the strength of the magnets or where it is placed affect forces? Ask students to share the patterns they notice in the data, and invite them to share evidence from their handouts or use the investigation materials to demonstrate as they do so." (Lesson 11, Teacher Guide)
- Lesson 12, Explore Section, Patterns Callout Box: "As students work, circulate among the groups to ask questions about patterns they are noticing between the magnets and other objects. Highlight for students to consider what the object is made of as they look for patterns to support an explanation of a phenomenon." (Lesson 12, Teacher Guide)

SYS: Systems and System Models

Claimed Element: SYS-E1 A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot.
Claimed in Lessons 1 and 6. Evidence was found in claimed lessons 1,6 examples include

- Lesson 1, Explore Section, System and System Models Callout Box: "Systems and system models will be a focus in the second half of this unit. However, to lay the groundwork for systems thinking, when you discuss the term sculpture on slide B, point out that the kinds of sculptures they will explore are made from many parts. This kind of talk now and during lesson set 1 will set students up for creating system models later in this unit and in other third-grade units." (Lesson 1, Teacher Guide)
- Lesson 6, Handout 1, Balance Point Investigation: Students did several tests to see which shape would work best to allow their sculpture (Model system) to spin when they applied force. (Lesson 6, Student Handout)

Claimed Elements: SYS-E2 A system can be described in terms of its components and their interactions.
Claimed in Lessons 9,10,12,13 Evidence was found in Lessons 9 and 10

- Lesson 9, Synthesize Section, Step 4: "Introduce the term system to students. Once the whole class model has components and possible interactions represented, tell students that in science we often study systems. Systems are a group of things or parts that work together as a whole. Remind students that the sculptures they built in the first part of the unit were different parts all working together to either stay still and balance, or balance and move in a puzzling way. Have students consider how the magnetic sculpture is also a system with different parts that work together. Tell them that in science we can study parts of the system and how the whole system works, just like we can study this magnetic system that has many parts working together. The magnetic sculpture system will be further explored in subsequent lessons." (Lesson 9, Teacher Guide)

- Lesson 10, Explore Section, Step 2: "Say something like, These are excellent questions to help us explore magnets. Because we wanted to investigate these magnets further, let's think about how we can make these questions into ones that could guide our investigations. When scientists ask questions about a system, like our sculpture, they are usually looking to identify cause-and-effect relationships between its different parts. The parts we are looking at right now are the two magnets and how they might interact with each other. Let's practice writing questions that will help us test the cause-and-effect relationship between the two magnets." (Lesson 10, Teacher Guide)

Criterion-Based Suggestions for Improvement: NA

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 require student performances that integrate elements of the SEPs, CCCs, and DCIs. In the unit, students are expected to complete many targeted learning goals that require them to use grade-appropriate elements of the three dimensions simultaneously and not in isolation. In most activities in the unit, students are expected to figure out something that requires the use of three dimensions working together at grade level.

The materials have integrated learning that supports student sense-making over time. For example,
Each lesson was purposely built around a 3-dimensional learning target, which is then specifically and overtly addressed in the lesson. Students must use all 3 dimensions to make sense of a phenomenon.

- In Lesson 2, Explore Section, Step 3, students integrate the use of the elements when they make observations and measurements while using equal objects and distances that can cause a sculpture to stay balanced or not balanced in the three dimensions: CCC SPQ-E2 Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume, DCI 3-PS2.A.1 PS2.A Forces and Motion: Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1), and DATA MATH-E3 Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems.
- In Lesson 3, Explore Section, Step 3 students integrate the use of the elements when they make observations and measurements to find the weight of an object that will balance their sculpture in the three dimensions: CCC CE-E1 Cause and effect relationships are routinely identified, tested, and used to explain change, DCI 3-PS2.B.1 PS2.B Types of Interactions: Objects in contact exert forces on each other, and DATA INV-E3 Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
- In Lesson 5, Explore Section, Step 4 students integrate the use of the elements when they design and build a hanging sculpture to test and explain how it stays balanced with multiple forces acting on it in the three dimensions: CCC CE-E1 Cause and effect relationships are routinely identified, tested, and used to

explain change, DCI 3-PS2.A.1 PS2.A Forces and Motion: Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1), and DATA INV-E1 Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

- In Lesson 7, Synthesize Section, Step 5 students integrate the use of the elements when they plan and conduct an investigation to show the patterns in an object's motion caused by balanced forces in the three dimensions: CCC CE-E1 Cause and effect relationships are routinely identified, tested, and used to explain change, DCI 3-PS2.A.1 PS2.A Forces and Motion: Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1), and DATA INV-E1 Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

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 work together to provide sufficient opportunities for students to build proficiency in the targeted learning objectives. Each lesson builds directly on prior lessons and makes the links between lessons explicit to the students when there are callbacks to the anchoring phenomenon. Students' questions are incorporated to give purpose for later lessons. Students answer their questions during sensemaking opportunities by investigating the phenomenon that furthers the students' goal of designing their own balanced, moving, and/or hanging sculptures.

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.
The materials contain unit coherence over time from the student's perspective. These examples demonstrate how each lesson builds upon the previous one, and callbacks to the anchoring phenomenon and students' questions are incorporated to give purpose to later lessons. Examples include,

- The Navigate routine, present at the start and end of each lesson, calls back to the previous lesson's endpoint and the next step identified at the end of that lesson to ensure a through-line for the learning.
- Lesson 2, Navigate Section, Step 1: "Revisit the previous charts to elicit students' ideas again. Refer back to Our Initial Ideas: How They Work and the Ideas for Investigation charts from Lesson 1 and ask, What were some of our ideas for how we could build a Category A sculpture? What were our ideas to investigate them?" (Lesson 2, Teacher Guide)
- Lesson 3, Navigate Section, Step 1: "Recall if our sculptures match our list for a successful sculpture. Display slide A and have the A Successful Sculpture Will chart and Our Growing Ideas chart available for students to refer to. Ask students to briefly share what they figured out about how to balance a symmetrical sculpture." (Lesson 3, Teacher Guide)
- Lesson 3, Navigate Section, Step 6: "Navigate to the next lesson. Consider saying something like, We have seen that sometimes you can add up the weight of several objects to balance with one heavier object. Let's check these types of sculptures to see if they are successful sculptures. Check the sculptures against the list for a successful sculpture." (Lesson 3, Teacher Guide)
- Lesson 5, Navigate Section, Step 7: "Show images (or video) from Lesson 1 of moving sculptures. Also, have the Driving Question Board from Lesson 1 ready to reference. Ask students if they think that the same things that made their hanging sculptures move might also make a standing sculpture move. Listen to all responses and then say, Lots of you made interesting observations about the moving sculptures on the first day, and we had questions about them too. We may need to look more closely at what makes a sculpture move! If time allows, add any new questions to the Driving Question Board." (Lesson 5, Teacher Guide)
- Lesson 6, Navigate Section, Step 1: "Introduce a new purpose to investigate movement. Say something like, We've come a long way since we started the unit. We've figured out a lot of new science ideas about how to balance sculptures and we even made some new kinds that hang from above. When we started our exploration into these sculptures we were also curious about ones that can balance and move. Let's begin today by investigating some of our ideas for how to get movement in our sculptures. Rewatch the anchor video. Let students rewatch the video, Exploratorium Tinker Studio. This is the video of the Category B sculpture." (Lesson 6, Teacher Guide)
- Lesson 6, Navigate Section, Step 6: "Give students time to turn and talk with a partner about the shape of the balance point they want to test and ways to set up the test to find the ideal amount, or strength, of the extra force. If time permits, bring students back together to brainstorm other ways to apply a force beyond using our fingers to push something or our mouths to blow air on something. See if students have ideas for the forces in nature that we could use to move our sculptures. Students might wonder what artists do to make their sculptures move, too. Save at least 2 of the students' sculpture builds from this lesson to begin the next lesson." (Lesson 6, Teacher Guide)
- Lesson 8, Navigate Section, Step 1: "Revisit the video from Lesson 1. Watch the full video, Balancing Act by Walter Wick Studios - Full Video to see what happens after the sculpture is built. Facilitate a quick discussion to connect to ideas developed in lesson 7 to explain why the stack of blocks fell over." (Lesson 8, Teacher Guide)

ii. The lessons help students develop toward proficiency in a targeted set of performance expectations.
The Performance Expectations for this unit are:
3-PS2-1: Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

- Lesson 4, Explore Section, Sculpture Design: Distance Tests Student Handout: students investigate how to build an off-centered sculpture. As they move certain pieces, they make observations and use them to construct evidence, which they can then provide during the class discussion. (Lesson 4, Sculpture Design: Distance Tests Student Handout)

- Lesson 6, Explore Section, Balance Point Investigation Student Handout: students work together to create an investigation question to investigate. Then, they manipulate different pieces in their sculpture while making observations, which are provided as evidence during the creation of the class Growing Ideas Chart. (Lesson 6, Balance Point Investigation Student Handout)
- Lesson 7, Explore Section, Making Sculptures Move Student Handout: students design a sculpture to discover the patterns in an object's motion caused by unbalanced forces and then predict the future motion based on those patterns. Students' discoveries are brought back to the class to complete the Explaining Out Observations Student Handout. (Lesson 7, Making Sculptures Move Student Handout)

3-PS2-2: Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

- Lesson 8, Synthesize Section, Game Play Student Assessment: students make predictions about a game based on their understanding of force, motion, and patterns before predicting that object's future motion. (Lesson 8, Game Play Student Assessment)

3-PS2-3: Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

- Lesson 10, Explore Section, Asking Investigation Questions Student Handout: students conduct three investigations before writing their own cause and effect question to test two magnets. (Lesson 10, Asking Investigation Questions Student Handout)

3-PS2-4: Define a simple design problem that can be solved by applying scientific ideas about magnets.

- Lesson 13, Synthesize, Magnetic Sculpture Build Student Assessment: students work in groups to identify the criteria and constraints of their design before building and recording observations. They also complete the Explaining my Sculpture Student Assessment, where they must answer the question, "How do magnetic forces interact on your sculpture to cause it to stay still and not fall over or move in an interesting way?" (Lesson 13, Magnetic Sculpture Build Student Assessment)

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

- Lesson 14, Synthesize Section, Using Magnets to Solve a Problem Student Assessment: students define the problem, use the given criteria and constraints on materials before drawing the device, and explain how it will work and solve the problem. (Lesson 14, Using Magnets to Solve a Problem Student Assessment)

3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

- Lesson 7, Synthesize Section, Step 5: "Make explicit that failures are part of the testing process. Students may share that their sculptures fell over or didn't work like they wanted them to. Highlight for students how important failure points are in our testing process. These are key points in which we learn what might be too much or too little to achieve the motion we want. Tell students that failure points are a helpful part of the design process and we learn new information from discovering what works and doesn't work in our designs." (Lesson 7, Teacher Guide)

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 the unit allows students to make sense of the phenomena only using the physical science domain. As mentioned in I.B., a close match among all claimed DCI elements was found in the unit.

i. Disciplinary core ideas from different disciplines are used together to explain phenomena.
The phenomena of balancing sculptures, moving sculptures, and magnetic sculptures are explained through the physical science domain. DCIs from life science and earth/space science are not necessary for explaining how sculptures can balance, or balance and move, or hover with magnetism. For example,

- Lesson 1, Explore Section, Step 2: "Preview instruction for what students will do in their groups. Students will need to examine the materials and decide what to build together. Allow students to explore the materials and how they might be used before building the first sculpture. After they build, they will write down their ideas and/or sketch their ideas about what causes their sculpture to balance or balance and move. Explain that they only need to write 1 explanation and sketch per group, but it needs to represent all group members' ideas." (Lesson 1, Teacher Guide)
- Lesson 3, Synthesize Section, Step 5: "Have students focus on two parts of the Handout First, have students turn and talk about something that caused their sculpture to balance. Have students share ideas with the group, and as each idea is shared, ask students to show (with a silent signal or raised hand) how many other groups noticed the same thing. Then, ask students to turn and talk to share their answer to the sentence starter at the end of the handout, "I was able to build a sculpture with different objects by…" and have a few students share what their partner did to build a successful sculpture. Summarize ideas about weight and update Our Growing Ideas chart. Summarize ideas developed throughout the lesson and write them onto the class chart: Different objects can be used, but weight and distance must be equal on both sides." (Lesson 3, Teacher Guide)
- Lesson 5, Synthesize Section, Step 6: "Individually model the forces pulling up and down. Explain to students that they've just figured out that there are forces in two directions, those pulling down and those pulling up. Tell students that by modeling these forces, we can explain why the sculptures created by Nishikawa and Calder can stay balanced and not fall down. Prompt each student to draw a diagram of their final hanging sculpture on Hanging sculptures. Then have students show their drawings in their group and share ideas about how to add arrows to their diagram to show all forces pulling up and down on their sculpture." (Lesson 5, Teacher Guide)
- Lesson 7, Explore Section, Step 4: "Add force arrows to the sculpture design. Guide students using the handout to add arrows to their drawing to show the forces on the sculpture at rest. Then guide students to decide as a group, then add a RED arrow to show where and in what direction they will apply the extra force that they think will make the sculpture move. They will indicate (circle) on the handout how they will apply that force. Testing forces on the sculpture. Using Part 2 of the handout, ask students to show with gestures (like pointing) the direction of the force, where it will be applied to their sculpture, and then point to the body part they will use to apply the force (mouth or finger). Next, ask students to share ideas about how we could test

the three sizes of force (strong, medium, weak). Remind students that we are working on fair tests and in this investigation, they will only change the force they apply to the sculpture." (Lesson 7, Teacher Guide)

- Lesson 9, Synthesize Section, Step 4: "Focus on what might be causing these sculptures to move. Remind students of the sculptures they built previously, especially the moving sculptures, and what caused them to move (we usually pushed on the moving sculpture to cause it to move). Ask students to share the differences they notice with these magnetic sculptures and what causes them to move (we don't know but it doesn't look like anything is touching them.) Remind students that we call that push a force, and we figured out a force is a push or pull with a direction and strength." (Lesson 9, Teacher Guide)
- Lesson 11, Explore Section, Step 2: "Prepare to use scales to test forces between magnets. Tell students they will use a scale in a similar way to measure the force between two magnets so that they can test some of their ideas. It will not be the weight that they are measuring, but rather the pushing-pulling forces between magnets to see how the strength or the distance between magnets affects the size of the force. In this case, the scale will measure how much force is pushing away from two like sides of a magnet. Plan Investigation. Tell students that they will need to test two different situations with magnets to see what affects the size of a force between them. The first fair test will investigate stronger and weaker magnets and the second fair test will investigate the distance between magnets. Both tests will use a scale to measure the size of the force between the magnets as they push away from one another." (Lesson 11, Teacher Guide)
- Lesson 14, Synthesize Section, Step 4: "Introduce the Magnet Design Task. Display slide F and pass out Using Magnets to Solve a Problem. Use the written assessment to assess whether students can apply their knowledge of magnets and forces to another context. Say something like, This is your final task for this unit! We are going to use our ideas to design something that solves a problem using magnets. It can be a design for something that we have a problem doing, such as putting on clothes, or it could solve another problem for ourselves, a friend, or a family member." (Lesson 14, Teacher Guide)

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.

The materials explicitly state the mathematics and ELA standards used in the unit to help students see connections between content areas. Forces and Interactions SEP-DCI-CCC-ELA-MATH-Matrix includes a table that lists all of the ELA and Math standards that are claimed to be supported by the lessons throughout the unit.

ELA

- Unit Connections to the Common Core Standards: "OpenSciEd Elementary program, texts intended for use in interactive read-alouds are approximately two grade levels above the CCSS range for text complexity, and texts intended for scaffolded independent reading are within the CCSS text complexity range for that grade level. We have noted in the table below the standards that are supported within each lesson." (Forces and Interactions SEP-DCI-CCC-ELA-MATH-Matrix)

The following are examples of some of the **ELA Language standards** that were noted as "standards supported within each lesson" that the reviewers found evidence related to the connection of the standard in the lesson.

CCSS-ELA-LITERACY.L.3.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
Claimed in Lessons 8 and 13. Evidence was found in all claimed lessons, examples include

- Lesson 8, Synthesize Section, Literacy Supports Callout Box: "Both tasks provide an opportunity for students to practice writing in complete sentences using correct grammar, punctuation, and spelling, recall information from experiences in the units, and convey ideas and information they learned in the unit. This supports students in the development of L.3.1 and L.3.2." (Lesson 8, Teacher Guide)
- Lesson 13, Student Handout Explaining My Sculpture, asks students to write a response to a prompt: "You will communicate about your sculpture to someone who has not made a magnetic sculpture before. Your written explanation should answer the following question: How do magnetic forces interact on your sculpture to cause it to stay still and not fall over or move in an interesting way?" (Lesson 13, Handout Explaining My Sculpture).

CCSS-ELA-LITERACY.L.3.3 Use knowledge of language and its conventions when writing, speaking, reading, or listening.
Claimed in Lesson 13. Evidence was found in all claimed lessons, examples include

- Lesson 13, Connect Section, Literacy Supports Callout Box: "Writing an explanation supports students in developing their abilities to write for a specific purpose to share their ideas, include evidence from past investigations, and summarize and synthesize their thinking. It also gives students practice writing in complete sentences and communicating their ideas clearly using conventions of written English. This supports the development of L.3.2 and L.3.3." (Lesson 13, Teacher Guide)

CCSS-ELA-LITERACY.L.3.4 Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 3 reading and content, choosing flexibly from a range of strategies.
Claimed in Lessons 1-7 and 9-12. Evidence was found in lessons 1,2,4,5,6,7,9, and 10, examples include

- Lesson 1, Synthesize Section, Literacy Supports Callout Box: "Note that the word balance will have multiple meanings in this unit. In this lesson, students define the word balance in an everyday way - to stay upright and not fall over. Later in the unit, beginning in lesson 5, they will use balance in a new way to describe the forces acting on the sculpture. Supporting students as they clarify the meaning of multiple-meaning words supports L.3.4." (Lesson 1, Teacher Guide)
- Lesson 2, Connect Section, Step 4: "Read the book aloud and discuss prompts. Read the title and author's name or ask a student to read the title and author's name. If time allows, show students the contents within the first part of the book (e.g., table of contents). Read aloud each page with the class." (Lesson 2, Teacher Guide)
- Lesson 3 Synthesize step 5: "Introduce students to an arrow to represent force. Say something like, We can represent forces with arrows to show the direction of the push and pull and we can make the arrows shorter

or longer to show how strong the force is. Let's add these arrows to our class sketches to show where the forces are. Go back to science ideas and models for Lessons 2 and 3 and revise them using the new term "force"..." (Lesson 3 Teacher Guide)

- Lesson 4, Explore Section, Step 4: "Read the Weight Test procedures together. Display slide D and pass out Sculpture Design: Weight Tests. Tell students that they will now investigate what else can make their off-centered sculpture balance. Read aloud Steps 1 and 2. Ask students to describe in their own words what we mean by "add objects to only one side" to clarify that they can choose either side, but all new objects will be added on that side only." (Lesson 4, Teacher Guide)
- Lesson 7, Synthesize Section, Literacy Supports Callout Box: "Students were introduced to the term balanced forces in lesson 5. Now they will define unbalanced forces. Adding un- to the beginning of a word changes the meaning to be "not" something, or in this case, not balanced (i.e., the forces are no longer balanced on the sculpture). This is a good opportunity for students to determine the meaning of a new word when an affix is added to a known word (balanced/unbalanced) which supports the development" (Lesson 7, Teacher Guide)
- Lesson 9, Synthesize Section, Broadening Access Callout Box: "Take time to break down new words arising in this lesson that often hold multiple meanings, especially if there are multilingual learners in your class. Ask students, "Where have you seen the word "model" before? "interact"? "system"? If possible, ask students to translate these words into other languages they might know to identify cognates. You can support all students, particularly multilingual students, in forming a deeper understanding of newly encountered vocabulary by representing the term in multiple ways. For example, students can (1) write the term, (2) draw a representation of the term, (3) use their own words to write an explanation for what the term means or explain aloud to a partner, and (4) use the new term in a sentence." (Lesson 9, Teacher Guide)
- Lesson 10, Explore Section, Teaching Tip Callout Box: "Until students develop an understanding of Earth's magnetic field, north and south poles on magnets are arbitrary labels for students at this age. Instead of using words such as "like poles" and "opposite poles", use language such as "sides" for ring magnets and "ends" for bar magnets. Use force language such as "pushing apart" and "pulling together" as opposed to "repulsive forces" and "attractive forces". Students will develop these ideas in middle school" (Lesson 10, Teacher Guide)
- Lesson 11 Evidence is not located; the literacy supports in this lesson are for RI.3.7 and RI.3.3.
- Lesson 12 Explore step 4 Extension Literacy Supports sidebar: "Pause to clarify words in the text to support students in developing RI.3.4. This will support students in developing an understanding of academic and domain-specific words related to investigating noncontact forces. However, they can apply ideas about like/unlike sides of magnets to think about like and unlike "charges" of objects." (Lesson 12, Teacher Guide) If the Extension activity is not used, then the standard is not used in this lesson.

CCSS-ELA-LITERACY.L.3.4A Use sentence-level context as a clue to the meaning of a word or phrase.
Claimed in Lesson 14. Evidence was found in all claimed lessons, examples include

- Lesson 14 Synthesize Section, Literacy Supports Callout Box: "As you read aloud the steps on the infographic, provide the necessary support for the word **prototype**. Emphasize to students that they can use sentences and visual cues on the infographic to figure out what a word means.Students can read the sentences before and after the word **prototype** and look for clues, like underlined words, to figure out that prototypes are first draft designs. This connects with L.3.4A as students use sentence-level context as a clue to the meaning of a word." (Lesson 14, Teacher Guide)

CCSS-ELA-LITERACY.L.3.5C Distinguish shades of meaning among related words that describe states of mind or degrees of certainty (e.g., knew, believed, suspected, heard, wondered).
Claimed in Lesson 1. Evidence was found in all claimed lessons, examples include

- Lesson 1, Explore Section, Literacy Supports Callout Box:" Throughout the unit, change up words and phrases like "sculptures that balance in puzzling ways", "oddly balanced", and "surprisingly balanced". The use of synonyms to describe the sculptures supports students to recognize that there are a variety of words that can describe the sculptures or other things in the world around them. This supports L.3.5C as students learn to distinguish shades of meaning among related words." (Lesson 1, Teacher Guide)

CCSS.ELA-LITERACY.RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea.
Claimed in Lessons 10 and 12. Evidence was found in all claimed lessons, examples include

- Lesson 10, Connect Section, Literacy Supports Callout Box: "This is an opportunity to support students in using words and illustrations in a text to recount key details of what was read to explain how magnets can also be used to create sculptures that move or stay still in puzzling ways. As students discuss the book, they are also discussing the main idea of the text and recounting the key details that support the main idea which supports the development of.RI.3.2." (Lesson 10, Teacher Guide)
- Lesson 12, Connect Section, Literacy Supports Callout Box: "Students will use words and images from the text to answer questions to determine the main idea of this text which explains how we might use permanent magnets versus magnets that can turn on and off. An important idea to draw from this reading is that magnets have different purposes based on the problem they are being used to solve. The questions and discussion using this text support the development of RI.3.2 as students use information gained from illustrations and words in the text to show their understanding of the main idea and key details of a text." (Lesson 12, Teacher Guide)

CCSS-ELA-LITERACY.RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.
Claimed in Lessons 2, 3, 4, 6, 7, 11, and 12. Evidence was found in all claimed lessons, examples include

- Lesson 2, Explore Section, Literacy Supports Callout Box: "Students will follow steps to determine cause-and-effect relationships as they notice what happens when they place objects onto the sculpture base. This work connects with RI.3.3 as students read the technical procedures of a text" (Lesson 2, Teacher Guide)
- Lesson 3 Explore Section, Literacy Supports Callout Box: "Use the investigation procedures to prompt students about how to carry out the investigation, step-by-step. As students engage with the investigation procedures, they are also working to describe a sequence of steps in a procedural text which supports RI.3.3." (Lesson 3, Teacher Guide)
- Lesson 6, Explore Section, Literacy Supports Callout Box: "Since lesson 2, students have been working on following the steps in technical procedures to investigate cause-and-effect relationships. Students may need more or less support in doing so across the unit. See the Teacher Handbook for additional information about scaffolding reading for students. This work supports RI.3.3 as students describe the sequence of steps in a procedural text." (Lesson 6, Teacher Guide)
- Lesson 11, Explore Section, Literacy Supports Callout Box: "Throughout the unit, students have been working on following the steps in technical procedures to investigate cause-and-effect relationships. This practice supports the development of RI.3.3." (Lesson 11, Teacher Guide)

CCSS-ELA-LITERACY.RI.3.7 Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).
Claimed in Lessons 2, 3, 4 and 1. Evidence was found in all claimed lessons, examples include

- Lesson 4, Connect Section, Literacy Supports Callout Box: "Students use the illustrations and words in the text to ask and answer questions about the importance of procedures in everyday life, investigation

procedures, and observations and note-taking to carry out scientific work. This information helps students develop key aspects of planning and carrying out investigations. (RI.3.7)" (Lesson 4, Teacher Guide)
- Lesson 11, Connect Section, Literacy Supports Callout Box: "Students use words and images from the text to answer questions about how we use magnets daily. Importantly, students see both strong and weak magnets that are used for different purposes. This connects with RI.3.7 as students use information gained from photographs and words in the text to demonstrate that they understand what was read." (Lesson 11, Teacher Guide)

CCSS-ELA-LITERACY.SL.3.1B Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).
Claimed in Lessons 1, 8, 13, and 14. Evidence was found in all claimed lessons, examples include
- Lesson 8, Synthesize Section, Step 2: "Establishing 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, in each lesson allows them to learn pragmatic rules for discussion and how to communicate in large and small group settings. This work supports SL.3.1B." (Lesson 8, Teacher Guide)
- Lesson 14, Synthesize Section, Step 3: "In this Putting Pieces Together lesson, as we revisit Our Growing Ideas chart together, it is helpful to check in on class agreements and encourage our community to follow the agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion). This will support students in practicing agreed-upon rules for discussions and further cultivate a safe community for learning science together. This work supports SL.3.1B." (Lesson 14, Teacher Guide)

Mathematics

The following are examples of **Mathematics standards** that were noted as "standards supported within each lesson" that the reviewers found evidence related to the connection of the standard in the lesson.
CCSS-MATH-Practice.MP2 Reason abstractly and quantitatively.
Claimed in Lesson 5. Evidence was found in all claimed lessons, examples include
- Lesson 5, Synthesize Section, Math Supports Callout Box:"Students have used the terms equal and not equal in previous math classes. It is helpful to remind students the word equal means the same as, which may be difficult to conceptualize since the forces do not look the same, but will weigh the same. If students are struggling with the concept of equality, you can represent it in other ways such as with equations (3+2=4+1) or demonstrating how different objects can add up to equal weights on the scale. Students will reason abstractly and quantitatively while considering the relationship between various quantities, equal or unequal. (MP2)" (Lesson 5, Teacher Guide)

CCSS-MATH-Practice.MP4 Model with mathematics.
Claimed in Lessons 6 and 7. Evidence was found in lesson 7, examples include
- Lesson 6, Explore Section, Math Supports Callout Box: "Students will consider how the shape of the balance point impacts the movement of the sculpture As they complete the investigation, students can model the movement of the sculpture using hand motions, drawings, labels, and/or numbers. (MP4)" While there is a call out box to support students to model with mathematics, there are no additional suggestions or support for this Math Practice in the teacher or student materials for how the movement would or could be represented with numbers.
- Lesson 7 students use arrows to model amounts of force, to help explain a sculpture's motion. Student Handout Making Sculptures Move: "We will add an arrow to the table below to show the direction and size

of each force we will test. For each trial, we will record our observations in the table." (Lesson 7 Handout Making Sculptures Move)

CCSS-MATH-Practice.MP5 Use appropriate tools strategically.
Claimed in Lessons 2-5, 8, 11, and 12. Evidence was found in lessons 2,3,4,5,11, and 12, examples include

- Lesson 2, Explore Section, Math Supports Callout Box:"Students will use the ruler to measure the distance between the center point and the objects to build an understanding of the concept of balance. Allow students to measure in inches or centimeters to increase the accessibility of the measurement. A possible extension is allowing students to use both units of measure to explore similarities and differences between them. (MP5)" (Lesson 2, Teacher Guide)
- Lesson 3, Explore Section, Step 3: "As students find a combination with the same weight, they can attempt to balance their sculpture on one side of the ruler and the other objects on the other side. Once a group has made a sculpture that balances, they will add drawings of the shapes to their handout. Remind students to add a label with numbers to each object to show its weight." (Lesson 3, Teacher Guide)
- Lesson 4, Explore Section, Math Supports Callout Box:"Students will also measure distance using rulers to decide where to place objects in relation to the balance point. Rulers and digital scales are used as mathematical tools to support sensemaking in science. (MP5)" (Lesson 4, Teacher Guide)
- Lesson 5, Explore Section, Math Supports Callout Box:"Encourage students to think about how the combined weight of objects on either side of the balance point will influence whether the sculpture balances or not. Provide tools such as paper, calculators, and counters to support students with adding and comparing weights (MP5)" (Lesson 5, Teacher Guide)
- Lesson 8, Synthesize Section, Math Supports Callout Box: "The art exhibit assessment provides individual measurement practice using rulers and scales. Students will need to measure, and represent and interpret the data they generate when they build an individual sculpture (part of 3.MD.A.2 and MP5)" (Lesson 8 Teacher Guide). Evidence was not found that students must use measurement tools rather than trial-and-error approaches to get their sculpture to balance.
- Lesson 11, Explore Section, Math Supports Callout Box:" In the Strength of Magnet Investigation, students will use a digit scale to calculate the amount of force pushing between the magnets in grams. Students will add and compare numbers to support sense-making in how the values on the scale represent the force of the magnets. (MP5 and part of 3.MD.A.2)" (Lesson 11, Teacher Guide)
- Lesson 12, Explore Section, Math Supports Callout Box: "To provide additional practice with measurement, ask groups to measure and estimate the maximum distance they can achieve between the magnet and paper clip before the paper clip falls. Students will use both the ruler and estimation as tools to measure the maximum distance between the magnet and the paperclip. (MP5)" (Lesson 12, Teacher Guide)

CCSS-MATH-Practice.MP8 Look for and express regularity in repeated reasoning.
Claimed in Lessons 7 and 8. Evidence was included in lesson 7, examples include

- Lesson 7, Explore Section, Math Supports Callout Box: "Students are continuing to model their science sensemaking mathematically by considering the shape of the balance point and how it impacts the movement of the sculpture. Students will use what they have learned about different balance point shapes and the weight of forces to help them develop their model. (MP4 and MP8)" (Lesson 7, Teacher Guide)
- Lesson 8, Synthesize Section, Math Supports Callout Box: "The game play tasks provide students the opportunity to use whole numbers to consider predictable motion and the amount of force necessary to achieve the motion. Students will make predictions and generalizations about the motion of the golf ball. (MP8)" (Lesson 8, Teacher Guide). Note that the teacher is given the option of offering Art Exhibit OR Game Play.If Art Exhibit is chosen, then this standard is not addressed in the lesson.

CCSS-MATH-3.MD.A.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l).* Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.** (*Excludes compound units such as cm3 and finding the geometric volume of a container. **Excludes multiplicative comparison problems (problems involving notions of "times as much").)
Claimed in Lessons 3, 4, 8, and 11.Evidence was included in the examples below,

- Lesson 3, Explore Section, Math Supports Callout Box: "Students will use digital scales to measure the weight of objects in grams, while estimating, measuring, and using addition and subtraction to solve problems involving object weights. (MP5 and part of 3.MD.A.2)" (Lesson 3, Teacher Guide)
- Lesson 4, Explore Section, Math Supports Callout Box: "Students will measure, estimate, add, and subtract the weights in grams as they work to balance off-center sculptures (part of 3.NBT.A.2 and part of 3.MD.A.2)." (Lesson 4, Teacher Guide).
- Lesson 8, Synthesize Section, Math Supports Callout Box: "The art exhibit assessment provides individual measurement practice using rulers and scales. Students will need to measure, and represent and interpret the data they generate when they build an individual sculpture. (part of 3.MD.A.2 and MP5)" (Lesson 8, Teacher Guide) Evidence was not found that students must use measurement and/or estimating, rather than trial-and error approaches, to get their sculpture to balance.
- Lesson 11, Explore Section, Math Supports Callout Box: "In the Strength of Magnet Investigation, students will use a digit scale to calculate the amount of force pushing between the magnets in grams. Students will add and compare numbers to support sense-making in how the values on the scale represent the force of the magnets. (MP5 and part of 3.MD.A.2)" (Lesson 11,Teacher Guide)

CCSS-MATH-3.NBT.A.2 Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
Claimed in Lessons 3, 4, and 5. Evidence was included in the examples below,

- Lesson 3, Explore Section, Math Supports Callout Box: "Provide paper, calculators, and counters to support students in modeling and calculating the adding and subtracting of the weight of their objects to complete their sculpture design (part of 3.NBT.A.2)." (Lesson 3, Teacher Guide)
- Lesson 4, Explore Section, Math Supports Callout Box: "Students will measure, estimate, add, and subtract the weights in grams as they work to balance off-center sculptures (part of 3.NBT.A.2 and part of 3.MD.A.2)." (Lesson 4,Teacher Guide).
- Lesson 5, Explore Section, Math Supports Callout Box: "Students will practice adding and subtracting within 1,000 to support them in making sense of how the sculptures balance. (part of 3.NBT.A.2)" (Lesson 5,Teacher Guide)

Suggestions for Improvement

- Consider different ways for the math standards to explicitly support students in understanding the science content.

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 practices of science and engineering as experienced in the real world because students experience phenomena and design problems as directly as possible. The materials include suggestions for how to connect instruction to the students' home, neighborhood, community, and/or culture. The materials provide opportunities for students to connect their explanation of a phenomenon and/or their design solution to questions from their own experiences during lessons with the "Community Connection" piece in which students interact with the phenomena in various ways.

i. Students experience phenomena or design problems as directly as possible (firsthand or through media representations)
Seven of the fourteen lessons feature a read-aloud book that connects directly to the phenomena presented.There are also videos throughout the unit that showcase the phenomena. For example,

- Lesson 1, Explore Section, Step 1: "Watch a video of a sculpture balanced in a puzzling way. Tell students when you show the video, they will think quietly about their notices. When the video pauses, they will turn and talk with a partner about what they noticed." (Lesson 1, Teacher Guide)
- Lesson 2, Connect Section, Step 4:"Introduce the Symmetry book. Set the purpose for reading the book by acknowledging that students came up with some really interesting sculpture designs. Tell students that artists do that too, and we can learn more about those design approaches from this book." (Lesson 2, Teacher Guide)
- Lesson 5, Connect Section, Step 2:"Revisit Meet the Artists: Using Science in Art and learn more about another artist's approach. Remind students that we read about how Alexander Calder and Jade Oakley created standing balanced sculptures and hanging sculptures. Read about Yuko Nishikawa, another balance artist who creates balanced hanging sculptures. Be sure to point out that just like Calder and Oakley, Nishikawa's sculptures are asymmetric and therefore playful and puzzling." (Lesson 5, Teacher Guide)
- Lesson 9, Explore Section, Step 2:" Watch a video of a sculpture balancing and moving. . . Play the 45-second video, Takis Magnetic Sculpture, of the moving sculpture. Have students think about their noticings…Replay the video focusing on wonderings. In the whole group, elicit 6-8 noticings and 6-8 wonderings. Record them on chart paper." (Lesson 9, Teacher Guide).
- Lesson 13, Synthesize Section, Student Handout Magnetic Sculpture Build: "We have been working on creating sculptures using what we know about forces. We are going to make magnetic sculptures to share with people and tell them about how they work." (Lesson 13, Student Handout Magnetic Sculpture Build)
- Lesson 14, Connect Section, Step 2: "When the book is complete, facilitate a conversation about how magnets are used to solve problems in our world with an emphasis on how magnets can help people get dressed or reach things more easily." (Lesson 14, Teacher Guide)

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

Suggestions for connections are featured in lessons throughout the unit. For example,

- Lesson 3, Connect Section, Community Connections Callout Box:"Consider highlighting any local or culturally relevant art alongside reading the Meet the Artists: Using Science in Art book, particularly art that uses science ideas as part of its creation, how it looks, or functions." (Lesson 3, Teacher Guide)
- Lesson 6, Connect Section, Community Connections Callout Box:"Give students the opportunity to broaden to examples in their everyday lives where they have observed or experienced motion in predictable ways. Accept all ideas. Encourage students to connect the science ideas they just figured out in their sculptures to the other predictable motions they have experienced. For example, a student might say that they have to push off the ground to get a skateboard rolling, but they know that the wheels will spin and the skateboard will roll in the direction they push it toward." (Lesson 6, Teacher Guide)
- Lesson 10, Navigate Section, Community Connections Callout Box: "Consider asking students to bring a magnet from home (e.g., a refrigerator magnet) to test in this investigation or future investigations. If students bring in magnets, give space for them to share information about them (e.g., from a family trip? or given as a gift from a relative?). Use their magnets to highlight how common magnets are in our lives. If you have concerns about students bringing in magnets, consider bringing in some of your own. This may get students thinking about the magnets they have seen at home." (Lesson 10, 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.

Students are provided opportunities for students to connect their explanation of a phenomenon to their own experiences. For example,

- Lesson 8, Connect Section, Step 4:"Communicate to the school community about sculptures. If doing the Art Exhibit, display slide E. As students finish sculptures, transition them to consider how they can communicate to others about their sculpture design." (Lesson 8, Teacher Guide)
- Lesson 10, Navigate Section, Step 1: "Consider asking students to bring a magnet from home (e.g., refrigerator magnet) to test in this investigation or future investigations. If students bring in magnets, give space for them to share about it." (Lesson 10, Teacher Guide)
- Lesson 12, Navigate Section, Step 1: "Look at questions from the DQB about other kinds of materials. Display slide A and give students a moment to review the questions on the DQB that relate to materials other than magnets…summarize that the class has figured out a lot about the relationship between two magnets but we also had ideas related to other materials like wires and metals. Ask students, What would happen if we changed one of these magnets to a metal? "(Lesson 12, Teacher Guide)
- Lesson 14, Synthesize Section, Step 4:"Introduce the Magnet Design Task. Display slide F and pass out Using Magnets to Solve a Problem. Use the written assessment to assess whether students can apply their knowledge of magnets and forces to another context. Say something like, This is your final task for this unit! We are going to use our ideas to design something that solves a problem using magnets. It can be a design for something that we have a problem doing, such as putting on clothes, or it could solve another problem for ourselves, a friend, or a family member." (Lesson 14, Teacher Guide)

Suggestions for Improvement: NA

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 negotiate new understandings by clarifying their own ideas and comparing them to their peers' ideas encountered in the learning experience(s). The materials also provide opportunities for students to justify or build upon their ideas, and support students in reflecting on others' ideas or changing their own ideas.

The teacher has support to facilitate students expressing, clarifying and/or justifying their ideas. Examples include:

- Throughout the unit, teachers are given prompts to elicit student ideas when their thinking isn't clear from their conversation through the use of tables with headings "Prompts to Use", "Ideas to look and listen for," and "Follow-up response".
- Several opportunities for pair ideas are shared via "turn and talk" instructions in the Teacher Guides across Lessons 1, 2, 3, 4, 6, 9, 10, 11, and 13.

Students represent their reasoning with written words, pictures, and sometimes measurements and simple models in each lesson's handout. For example,

- Lesson 1, Explore Section, Group Sculpture: Build An Example Student Handout: "Write ideas for what causes it to balance or balance and move. Sketch it and label how it works. What causes our sculpture to balance, or balance and move, without falling over?" (Lesson 1, Group Sculpture: Build an Example Student Handout)
- Lesson 7, Explore Section, Explaining our Observations Student Handout: "Work with your class to write an "if… then…" claim that answers the following questions: What motion did we observe? What parts of the sculpture explain why it moved the way it did? How does the force we applied explain the motion we observed? Write the class claim on the lines below:" and part 2: "On your own, write an "if… then…" claim that answers the following questions: What motion did we observe? What parts of the sculpture explain why it moved the way it did? How does the force we applied explain the motion we observed? Write your individual claim on the lines below:" (Lesson 7, Explaining our Observations Student Handout).

Students express, share ideas and build on one another's ideas when working with groups to solve design challenges. For example,

- Lesson 3, Explore Section, Broadening Access Callout Box: "In small groups and one-on-one, encourage students to also communicate their observations and ideas using words and gestures. A student might be able to show you how they add multiple objects to one side to balance the sculpture and/or they can place the objects onto the scale to demonstrate how they found equal weight." (Lesson 3, Teacher Guide)
- Lesson 11, Explore Section, Step 3: "Give students time to work in their groups to interpret the patterns in their data. Encourage students to individual reflect on what the data show and think of 1-2 ideas they want to share with a partner. Then, bring them back together to share their findings." (Lesson 11, Teacher Guide)

The Growing Ideas Chart is an artifact used to track students' reasoning and changes in their thinking over time. It is used several times throughout the unit. For example,

- Lesson 4, Synthesize Section, Step 6: "After students finish their tests and complete the final questions, convene the students as a class to summarize the ideas they figured out. Add ideas to the Our Growing Ideas chart using words, drawings, and/or symbols." (Lesson 4, Teacher Guide)
- Lesson 8, Synthesize Section, Step 2: "Take stock of all our ideas. Use the Our Growing Ideas chart to summarize the big ideas that students have figured out together over the last six lessons. Have students lead this summary of ideas from each lesson using their own words and the words, pictures, gestures, and symbols on the chart." (Lesson 8, Teacher Guide)
- Lesson 10, Synthesize Section, Step 3: "Repeat the question they have been investigating and ask students to offer some summaries to the first question on the slide. Once you establish consensus that the magnets are pushing and pulling on each other, Record a new idea on Our Growing Ideas chart: The magnets apply forces on one another. Add additional ideas. Then ask students to share their ideas about the second question and what they figured out when they flip a magnet. When the class comes to an agreement, jot down new ideas that relate to what happens when you change the orientation of one of the magnets. Suggested ideas include: The forces between magnets can pull toward each other or push apart." (Lesson 10, Teacher Guide).

Students create a call chart called "A successful sculpture Will…" chart. Students return to the chart many lessons, and it is revised multiple times to track their learning over time. For example,

- Lesson 4, Navigate Section, Step 1: "Ask students how they would modify the A Successful Sculpture Will chart to have a new need to make a sculpture balance like the image on slide A. Students might say to make it oddly balanced, off-centered and balanced, or asymmetrical. Add a new sub-criteria idea to the A Successful Sculpture Will chart to capture an off-centered design as a way to make it more playful or puzzling." (Lesson 4, Teacher Guide)
- Lesson 6, Navigate Section, Step 1: "Add to A Successful Sculpture Will chart. Conclude the navigation by adding a new thing our sculpture needs to do to be successful – to move. Jot this down on the "A Successful Sculpture Will" chart." (Lesson 6, Teacher Guide)
- Lesson 7, Explore Section, Step 4: "Update the A Successful Sculpture Will chart to include any new ideas. Ask students what the sculpture would need to do to work and what their designs are limited by. Encourage students to consider the materials available as they consider the new limitations. Record any new student ideas on the A Successful Sculpture Will chart." (Lesson 7, Teacher Guide)
- Lesson 13, Synthesize Section, Step 3:"Remind students that when they designed Category A and B sculptures, they had to outline the goal. Add to the A Successful Sculpture Will chart or create a new one." (Lesson 13, Teacher Guide)

The Following Student Sensemaking Tool for Lessons 2-5, 6-7, and 10-12, is provided for teachers to track students' thinking over time.

- Lesson 2, Synthesize Section, Step 5:" Use Following Student Sensemaking (Lessons 2-5) to start tracking evidence of student ideas across lessons 2-5. Refer to the Assessment Guidance at the beginning of the lesson." (Lesson 2, Teacher Guide)
- Lesson 6, Explore Section, Step 3:"Listen to how they are talking about the forces in a still sculpture, forces that cause movement, and whether they claim that the balance point causes movement. Use Following Student Sensemaking (Lessons 6-7) to record evidence of student thinking." (Lesson 6, Teacher Guide)
- Lesson 12, Explore Section, Step 3:"Continue to document evidence of individual student learning on Following Student Sensemaking (Lessons 10-12)." (Lesson 12, Teacher Guide)

Students receive constructive feedback from both the teacher and peers. For example,

- Lesson 8, Synthesize Section, Step 3:"Provide peer feedback and update ideas. As students finish either task, use this as an opportunity for students to practicing giving and receiving feedback on either their sculptures or their ideas for how the games work. Pass out Giving and Receiving Feedback and read aloud as a class the suggestions for how to give and receive feedback. Then, in partners, let students practice giving feedback to one another and then revising their own thinking based on the feedback." (Lesson 8, Teacher Guide)
- Lesson 10, Explore Section, Step 2:" Revising cause-and-effect questions and having students practice writing a fourth question with their partner is your assessment opportunity for learning goal 10 with the purpose of providing feedback on how to develop questions that can be investigated to discover cause-and-effect relationship" (Lesson 10, Teacher Guide)
- Lesson 12, Explore Section, Step 2: "Use Magnets and Metals and the small group discussions to assess progress toward learning goal 12 with the purpose of providing feedback to students about their thinking in regards to how magnets interact with other objects." (Lesson 12, Teacher Guide)
- Lesson 13, Synthesize Section, Step 4:"Peer feedback and update designs. As students complete their magnetic sculptures and models of how they work, including the magnetic forces, use Peer Feedback for groups to provide feedback to one another about their sculptures and the models to explain them. Encourage students to ask questions of each other and consider how to incorporate peer feedback to improve their designs or better communicate their thinking." (Lesson 13, Teacher Guide)

The Lesson Assessment Guidance in each Teacher Guide offers suggestions on how to act on assessment information and often includes individual feedback suggestions. For example,

- Lesson 12 Lesson Assessment Guidance: "If a student does not recognize the patterns in metals that are pulled toward magnets and those that are not, have the student sort them into two groups. Or, do this as a class if many students could benefit from the sorting. Write down the kinds of metals for each group and then have students look for patterns. When hovering the paperclip, if a student experiences difficulty with identifying forces, focus first on the pull force from the magnet above. Then focus on the pull force from the string. Then move to gravity by asking the student, What other forces did we learn about that pull downward?" (Lesson 12, Teacher Guide).

Suggestions for Improvement: NA

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 the materials explicitly identify prior learning expected for all three dimensions. The supports provided for teachers clearly explain how the prior learning will be built upon.

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

The materials contain The Force and Interactions Unit Front Matter document that features a section titled, "What ideas and experiences will my students bring that can help them in this unit." It contains the expected learning students will come to third grade for three DCI concepts, two SEPs, and one CCC. This information covers the three dimensions but does not provide information about learning in the specific elements of the dimension. There is guidance about what a teacher should expect the students to be able to do upon arrival and of how to move students further in their use of the Practices, CCCs, and DCIs. For example,

- DCI:"Pushes and Pulls Students will have learned about the strengths and directions of pushes and pulls in Kindergarten (PS2-1; PS2-2). In Kindergarten Unit K.3, Mighty Movers, students conduct a series of investigations to figure out ideas about strength, direction, and speed as it relates to the motion of an object). These ideas will continue to be leveraged in this unit, but now students will track multiple forces acting on an object at one time. While the forces can still be described as pushes and pulls, 3rd grade students take this further by exploring situations when the forces on an object are balanced or unbalanced, or forces exist without anything touching (e.g., magnets)" This information does not specify which DCI elements are being addressed.
- DCI: "Everyday ideas about weight Students will bring with them ideas about weight from their everyday experiences. They will have been weighed at doctor's offices, or seen kitchen scales, or produce scales in grocery stores. Leverage their ideas about weight and connect them to the idea that weight is another pulling force. It is the pull of gravity toward the ground. Students will represent this pulling force with an arrow toward the ground. They will use their everyday experiences with heavy and lighter objects to think about how the arrow might change to show the different weights of objects."
- DCI: "Magnets Students will have experienced playing with magnets either inside or outside of school. There are many kinds of magnetic toys they may know about. They will likely know magnets stick together, and some may know they can push apart, too."
- SEP: "Asking Questions Throughout K-2 science learning, students will have tracked their questions about phenomena on Notice and Wonder Charts, Our Growing Ideas Charts, and other classroom artifacts where students are recording their questions and what they have figured out about the phenomenon. Use their experiences with asking questions to begin encouraging them to ask how and why questions, and questions they can test."
- SEP: "Planning and Carrying Out Investigations Students will have carried out many investigations before they begin third grade. Use their experiences from K-2 to introduce the ideas of having investigation procedures, changing only one variable at a time during an investigation, and recording clear observations and data from the investigations. These are all ways to leverage their experiences with investigations and add a new challenge to their practice." This information does not specify which SEP element(s) is being addressed.
- CCC: "Cause and Effect Throughout K-2, students will have developed ideas about cause-and-effect relationships arising from observable patterns. Use these ideas to support students as they begin to use their ideas about cause-and-effect to design fair tests and write if/then statements to capture their observations." This information does not specify which CCC element(s) is being addressed.

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

The materials contain The Force and Interactions Unit Front Matter document that includes a chart that gives a detailed description of the DCIs, SEPs, and CCCs that are intentionally developed in the unit. The table also describes, at the element level, the work students do in the unit to develop those practices, concepts, and science ideas. For example,

- DCI: PS2.A.1: "Throughout lessons 2-7, students develop an understanding of the multiple forces acting on a sculpture to cause it to balance or not, or to move in a specific way. Students first start with ideas about

weight as a downward force pulling toward the ground. They add additional ideas about an upward force that holds sculptures up. When the sculpture is balanced and at rest, these forces are equal (or, the net force sums to zero). They learn that balance can be used to describe the forces acting on the sculpture, and also can be used for the everyday meaning of staying upright and not falling over. In lessons 6 and 7, students add ideas about how adding an extra force to a sculpture to create movement causes the forces on the sculpture to be unbalanced (the net force no longer sums to zero). In lesson 8, they apply these ideas to either design a sculpture of an art exhibit or apply to them to explain playing games."

- DCI: PS2.A.1: "In lessons 6 and 7, students observe patterns in motion that occur when a force is applied to sculptures with differently-shaped balance points. They then carry out investigations and make observations about the strength and direction of extra forces applied to a sculpture to initiate movement. Students use these ideas to create sculptures with predictable motion and they apply these ideas in a summative assessment in lesson 8."
- DCI: PS2.B: "In lessons 2-8, students are developing ideas about contact forces between objects that are touching each other. These forces are applied as students place objects onto sculptures or add extra forces by tapping or blowing on the sculptures. This term is defined in lesson 7. Then, in lesson 9, they are introduced to a new phenomenon in which a sculpture moves without any contact between the sculpture objects (magnets). Throughout lessons 10-12, students investigate the size of forces between magnets and between magnets and some metal objects. They apply these ideas in summative assessment tasks in lessons 13 and 14. While the emphasis is on magnetic forces in the second lesson set, there is an opportunity to apply these ideas about noncontact forces to electric forces in lesson 12."
- DCI:3-5-ETS1.A.1: "Throughout the unit, students track ideas about the goal of their designs, including what their sculptures need to do to be successful (criteria) and how their designs are limited (constraints). These ideas are not labeled as criteria or constraints until lesson 13 when students reflect on their design challenges, and later third-grade units will leverage these terms from the outset. This unit provides a conceptual foundation for the meaning of these words. Students often reflect in the unit on how well their sculptures met the criteria and constraints, despite their different designs."
- DCI: 3-5-ETS1.B.2:"Students run tests of different sculpture designs in the unit, recording what worked and didn't work in the designs. The focus of this unit is around "difficulties" or "what didn't work" rather than "failure points" and there are small group and whole class discussions that include prompts to talk about what didn't work and why it was difficult. Throughout the building processes and discussions, students can learn from one another about how they might improve their designs as they continue to work on sculptures."
- DCI: 3-5-ETS1.C.1:"Students design many iterations of sculptures in small groups. Each group tests and records data and observations about their designs and then discusses what worked well and did not work well in those designs. There is time for students to tinker with sculpture designs to optimize how they work. It is through these investigations that students figure out which designs best solve the problem."
- SEP: "Asking Questions and Defining Problems Throughout the unit, students are focused on developing different aspects of this practice. There are specific points within lessons 1 and 9 where students will ask questions that can be investigated and place them onto a Driving Question Board. At the beginning of the unit, students are provided with example investigation questions, but will increasingly generate their own investigation questions in later lessons with a particular emphasis on cause-and-effect relationships. In lesson 10, there is a scaffolded activity where students turn close-ended testable questions into more open-ended testable questions. Finally, in the last lessons, students begin developing how to define a simple problem. While they have been tracking what sculptures need to do and how they are limited (lessons 2-7), in lesson 13, they are specifically introduced to the terms criteria and constraints and they begin using these ideas as they create a design that uses magnets."

- SEP: "Developing and Using Models This unit explicitly supports students as they practice modeling their ideas about how the sculptures work. They use diagrams and simple prototype sculptures throughout the unit to convey how the sculptures work. In lesson 3, students develop ideas for how to represent the strength and direction of forces using arrows (an abstract representation), and they also learn about the different ways we can represent what we learned through words and pictures (lessons 3-8). Students reflect on these diagrams and define models in lesson 9, and they continue to develop models across lessons 10-13, which are summatively assessed in lesson 14 when they sketch a design and use it to explain how it works. Some of this work is done collaboratively with whole class models on either the Our Growing Ideas chart or a separate Class Model chart (started in lesson 9), but most lessons provide students an opportunity to develop models and use them to explain how they think something works on the sculptures."
- SEP: "Planning and Carrying Out Investigations Students are introduced to investigation procedures across both lesson sets with the intentional work in lessons 2-7 to learn how to read and follow procedures, how to modify procedures for clarity, how to make note of observations and record data as they carry out the investigation procedures, how to change one variable at a time to ensure a fair test in their investigations, and how to use multiple trials of each test. These investigations are done collaboratively and students make observations to produce data that are then are shared within groups and across the class. Students continue to plan and carry out investigations in lessons 10-12 to explore cause-and-effect relationships with magnets. Their findings across lessons 2-7 and 10-12 are used as the basis for explanations of how they think the sculptures are working or how they can design either a sculpture or a solution to a problem. They also make predictions about what would happen if they changed a variable, such as changing the balance point (lesson 6), changing the size of force applied (lesson 7), and then practice changing questions in lessons 9-10 to "if we do ___, what will happen?" types of questions. Note: In 3rd grade students are not yet introduced to the term "variable," but they have conceptual practice by changing only one thing at a time with each test."
- CCC: "Patterns Students investigate the patterns in predictable types of motions by using differently-shaped balance points (lessons 6 & 7). They gather data from fair tests and compare the data to determine if a specific balance point is more likely to cause a predictable motion. Students again use patterns in lessons 11 and 12 to better understand cause-and-effect relationships between magnets and magnets and other objects. They are summatively assessed on applying their ideas about patterns to explain how something works in lessons 8, 13, and 14."
- CCC: "Cause and Effect Students work throughout this unit to develop ideas about cause-and-effect relationships between different forces acting on a sculpture. They routinely identify, test, or use results to explain how sculptures work or why they might not work. They also ask cause-and-effect questions and track their results using scaffolds that help them record if/then relationships as they change one variable at a time. They are summatively assessed on this element in lessons 8, 13, and 14 as they have to use the cause-and-effect relationships identified and tested in lessons 2-7 and 10-12 to explain how something works or not."
- CCC:"Systems and System Models This unit intentionally develops this crosscutting concept in lesson set 2 as students consider the parts of the magnetic sculpture system and how the parts interact. The idea of a sculpture as containing multiple parts is introduced in lesson 1 and added to the Word Wall. The class models the different sculptures on the Our Growing Ideas chart in lessons 2-7, but students do not develop the term system until lesson 9. In lessons 9-11, students develop a deeper understanding by representing the different parts and interactions in the system in a class model."

The Teacher Guide and experiences students engage in support learning that moves students towards aligned ideas in all three dimensions. Explicit support is embedded into the unit to help students negotiate their understandings of potential alternate conceptions. Some of these alternative conceptions are also pointed out to the teacher. For example,

- Lesson 1, Lesson Materials and Preparation: Materials overtly call out the misconception that can arise through multiple uses of the word "balance" throughout the lesson sequences. "Throughout this unit, students will use the word "balance" to mean different things. This is a great opportunity to reinforce a third-grade literacy standard for students to learn how a word can have multiple meanings. In lessons 1-4, students will use the word balance to describe objects/sculptures that stay upright, stable, and do not fall over. In these lessons, students use balance in everyday, non-scientific language. Beginning in lesson 5, students will start to use the word balance to describe the forces acting on the sculpture - these forces can be balanced (the same amount of force in opposite directions resulting in an object not moving or moving at a constant speed) or unbalanced (unequal forces acting on an object that causes a change in motion, such as falling over, speeding up, or slowing down). For lesson 1, leverage students' prior experiences to develop a shared understanding of the everyday meaning of balance of objects, such as an object staying stable and not falling over. Avoid using balance to describe forces acting on objects until lesson 5." (Lesson 1, Teacher Guide).
- Lesson 5, Lesson Assessment Guidance, How can I Use The Information I Gather From This Assessment: "During Synthesize, if students miss the upward force in their models, repeat the demonstration with a mobile. Draw arrows to show the force of the weight downward and the force holding the sculpture upward as the students hold the sculptures. Have all students hold the sculpture so that they can feel the upward force from their arm holding up the downward force from the weight of the sculpture."(Lesson 5, Teacher Guide) A common student misconception is that an object whose motion doesn't change has no forces acting on it. This misconception is not called out in the materials, but guidance is provided about what to do if this misconception reoccurs after learning.
- Lesson 12 Teacher Guide "How can I use the information I gather from this assessment?" section: "If a student does not recognize the patterns in metals that are pulled toward magnets and those that are not, have the student sort them into two groups. Or, do this as a class if many students could benefit from the sorting. Write down the kinds of metals for each group and then have students look for patterns." (Lesson 12, Teacher Guide) While teachers are given guidance about what to do if a student needs help to recognize patterns in what attracts to magnets, the Teacher Guide does not call out that a common student misconception is that a magnet will pull on any metal.

Suggestions for Improvement

- Considering adding element identifiers (e.g., ADP:3.E1) to the discussion of prior learning in the Unit Overview.
- Consider providing additional information about the alternate conceptions that students or teachers may have in one location, such as the About the Science document, so that teachers can anticipate common alternate conceptions in all three dimensions.

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 student**s** use scientifically accurate and grade-appropriate scientific information, phenomena, and representations to support students' three-dimensional learning.

The unit shows evidence of effort to ensure grade-appropriateness of language and ideas. Examples include,

- Lesson 4 uses a grade-appropriate approach to looking for patterns in balancing unequal weights, and clarifies for teachers in the Lesson Assessment Guidance: "For the purpose of the unit-level performance expectations for balanced forces, students do not need to understand the mechanism for why or how off-centered sculptures work (these ideas about torque will be figured out in high school)." (Lesson 4, Teacher Guide).

The technical word "components" is not used with students, but the idea of "important parts" is present when modeling during the magnetism lesson sequence.

- Lesson 9, Synthesize Section, Step 4: "Point out the different parts in the model - the two magnets, string, metal wire, and metal base. Elicit ideas for any additional parts to add. Students may not have any more parts to add but could suggest that someone had to get the top magnet swinging or moving in the first place so they may want you to add a hand or motor. After everyone agrees on the key parts, elicit ideas for interactions between the parts." (Lesson 9, Teacher Guide)

Care is taken to avoid potential common misconceptions. For example, teachers receive guidance to help students distinguish between "balanced" as in a balanced sculpture, vs. "balanced" as in balanced forces.

- Lesson 1, Preparation Checklist: "Throughout this unit, students will use the word "balance" to mean different things. This is a great opportunity to reinforce a third-grade literacy standard for students to learn how a word can have multiple meanings. In lessons 1-4, students will use the word balance to describe objects/sculptures that stay upright, stable, and do not fall over. In these lessons, students use balance in everyday, non-scientific language. Beginning in lesson 5, students will start to use the word balance to describe the forces acting on the sculpture - these forces can be balanced (the same amount of force in opposite directions resulting in an object not moving or moving at a constant speed) or unbalanced (unequal forces acting on an object that causes a change in motion, such as falling over, speeding up, or slowing down). For lesson 1, leverage students' prior experiences to develop a shared understanding of the everyday meaning of balance of objects, such as an object staying stable and not falling over. Avoid using balance to describe forces acting on objects until lesson 5." (Lesson 1, Teacher Guide)
- Lesson 5, Synthesize Section, Step 5: "Introduce the term, balanced forces. As students consider how they are representing the upward and downward forces as the same, introduce a new way to use the word balance. Say something like, In science, we can use the word balance to mean something different. When we are describing forces on the sculpture, and they are equal to one another, such as when the downward force is equal to (or the same as) the upward force, we say those forces are balanced. Add the balanced forces card to the Word Wall." (Lesson 5, Teacher Guide)
- Lesson 6, Lesson Materials and Preparation:"This lesson transitions to consider balanced and moving sculptures. In this context, the word balance means the sculpture is staying upright and not falling over. The lesson introduces a new idea about applying an extra force to initiate motion on the sculpture. However, students will not account for how this extra force creates an unbalanced force situation until lesson 7." (Lesson 6, Teacher Guide)

The materials provide opportunities for students to express their scientific ideas and continually re-examine their ideas in light of new evidence. For example,

- The "Growing Ideas" chart and the "A successful sculpture Will…" chart are frequently updated throughout the unit to show how students' learning has changed over time.

Suggestions for Improvement: NA

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 of guidance for teachers to support differentiated instruction. The materials provided guidance for teachers to support multiple modality expressions and multiple means of engagement. Detailed guidance and support that all teachers would recognize for multilingual learners—including students who are learning English, those who read well below grade level, or those who have already met the performance expectations—are also included in the materials.

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.
The materials provide information for teachers to support students of different levels to learn and engage with the content.

- The Forces and Interactions Unit Front Matter document contains a section titled, "What unit-specific strategies are important for supporting equitable science learning in this unit?" that explains the design of the OpenSciEd Units and the use of the Universal Design for Learning.
- The Teacher Handbook document also contains UDL and differentiation supports, including: "Building an equitable classroom culture for science, Integrating literacy (has support for readers and writers and word development), Using math to support science sensemaking, Incorporating trauma-informed approaches, University Design for Learning (UDL), and Supporting multilingual students."
- The Additional Accessibility Resources document contains additional strategies and resources for teachers to access if needed. One strategy included states: "Utilize Descriptive Transcripts, Alt Text, and Closed Captioning. All OpenSciEd elementary materials (except field test version) have descriptive transcripts, alt text, and closed captioning for video and image files. This is a good resource to provide alternate options for students to engage in learning from a video or image. If utilizing a screen reader technology, it should read aloud the alt text of an image in line with the text on the page. When viewing a video, you may need to enable closed captioning. Finally, descriptive transcripts are provided for each video, which gives both a narrative account from the video, with visual and auditory descriptions of what is happening during the video."

The materials provide support for the teacher to assist students in reading informational text.

- The Teacher Handbook states: "Students engage in two types of informational text reading across the units: Students in all grades participate in interactive read-aloud texts in which the teacher reads the text aloud to students and students engage in a text-based discussion. The read-aloud experience is "interactive" in the sense that students are asked questions and are encouraged to ask their own questions as they read. Prompts are provided for teachers to support interaction around the text. Students use

information in the text, their prior knowledge, and class discussion to make sense of what is being read and to connect text-based ideas to their learning from explorations and other experiences across the unit. Interactive read-aloud texts are written to be approximately two levels above the students' current grade level (for example, a 2nd grade teacher reads aloud 4th-grade-level text)." (Reading Informational Text, Teacher Handbook)

- The Teacher Handbook States: "Independent reading texts are written to be on grade level for students (e.g., students in third grade read a third grade level text). Some students may find independent reading challenging, and supports are provided in the Teacher Guide to scaffold these independent reading experiences. These scaffolds may include reading and discussing a text with a small group or reading with a partner. Teachers may also be encouraged to show, pronounce, and briefly explain the meaning of new or challenging words directly before students read a text containing these words. This will scaffold students' decoding and comprehension of the text. Before and after reading, the Teacher Guide will provide supports for discussion of the text. Independent reading texts provide students the opportunity to practice reading science texts on their own in a scaffolded environment. Reading these texts helps students contribute to large group discussions about the text itself and consider how information from tests can help them to make sense of the phenomena that they are studying." (Reading Informational Text, Teacher Handbook)

The "Broadening Access" Callout Boxes are placed in lessons throughout the unit to provide guidance for teachers to provide opportunities for students multiple modality expressions, multilingual students and support teachers when discussing disabilities with students.

- Lesson 5, Explore Section, Broadening Access Callout Box: "Invite students to share their learning across multiple modalities. They can write and/or draw on the handout, verbally share, and/or use gestures and materials to show how they were able to balance the hanging sculpture. This allows students to share the full range of their thinking and will provide more rich information for their peers to build on, as well as for teacher feedback and adjusting instruction." (Lesson 5, Teacher Guide)
- Lesson 8, Synthesize Section, Broadening Access Callout Box:"Encourage students to share their ideas using words, pictures, and gestures. It may be helpful to also have materials available so that students can point to previous sculptures as they summarize their learning. Students may show with words and gestures where they placed certain objects or point in the direction where the forces are either pulling downward, pushing upward, or being applied from the side or above onto a sculpture. This review of the Our Growing Ideas chart can be helpful in preparing students for the Art Exhibit or Game Play." (Lesson 8, Teacher Guide)
- Lesson 9, Synthesize Section, Broadening Access Callout Box:"Take time to break down new words arising in this lesson that often hold multiple meanings, especially if there are multilingual learners in your class. Ask students, "Where have you seen the word "model" before? "interact"? "system"? If possible, ask students to translate these words into other languages they might know to identify cognates. You can support all students, particularly multilingual students, in forming a deeper understanding of newly encountered vocabulary by representing the term in multiple ways. For example, students can (1) write the term, (2) draw a representation of the term, (3) use their own words to write an explanation for what the term means or explain aloud to a partner, and (4) use the new term in a sentence." (Lesson 9, Teacher Guide)
- Lesson 12, Synthesize Section, Broadening Access Callout Box: "As you record ideas on the charts, include visual representations of the ideas. Additionally, ask a student to use the materials from the investigation to demonstrate the ideas they figured out during the lesson. Both strategies will benefit multilingual students, as well as all students." (Lesson 12, Teacher Guide)

- Lesson 14, Connect Section, Broadening Access Callout Box: "Adaptive clothing is designed for many people, such as people with disabilities, the elderly, someone with limb differences or limb injury, or anyone who might struggle to get dressed on their own. Some students might recall experiences with this as their caregivers helped them button, zip, or snap their clothes until they were able to do it on their own. Some students might have disabilities or other circumstances that currently affect their ability to get dressed on their own. A note about the word "disability": The words disability and disabled carry a great deal of stigma in our society, but they are neutral words associated with the rights and protections provided by laws such as the Americans with Disabilities Act (ADA) and the Individuals with Disabilities Education Act (IDEA). Disability is the term preferred by adults who are fighting for disability rights." (Lesson 14, Teacher Guide)

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

The materials explicitly clarify how they anticipate the needs of students who might struggle with any of the three dimensions in the assessment portion of the lesson. For example,

- Lesson 1, Lesson Assessment Guidance: "If a student is struggling to write a question, support them by using cause-and-effect question starters (found on slide Q), such as: How and why questions What happens if questions If we do ___, then does ____ happen?" (Lesson 1, Teacher Guide)
- Lesson 5, Lesson Assessment Guidance: "If a student struggles with this investigation, try the following:During Explore, if a student struggles to use the same total weight on each side to balance their sculpture, encourage them to weigh all the objects on each side, add up the total weight, and then compare the totals." (Lesson 5, Teacher Guide)
- Lesson 10, Synthesize Section, Step 3, "Consider using hand gestures to mime a push and pull. This is particularly important for multilingual students but will benefit all students." (Lesson 10, Teacher Guide)
- Lesson 11, Explore Section, Broadening Access Callout Box: "It may be helpful to use a scale and place heavier and lighter objects on it to remind students that scales are measuring a downward force (i.e., weight). Put a light object on the scale and read the number (in grams) out to the class. Then put a heavier object and read out the number (in grams). Ask students, Which force is greater? Why do we think that? Some students may benefit from holding the heavier and lighter object again to feel the greater downward force of the heavier object." (Lesson 11, Teacher Guide).

The "How Can I Use This Assessment Information?" section in the Lesson Assessment Guidance for each lesson includes tips to help students who are struggling to meet expectations. For example:

- Lesson 11 Lesson Assessment Guidance:" If a student needs extra support collecting data, consider having one set up for demonstration purposes. As you demonstrate the investigation, have the student watch closely how to hold the ruler, collect the data from the screen on the digital scale, and record the data on the handout. If a student needs extra support interpreting the data, ask questions such as: Is the force measured by the scale getting bigger or smaller? How would you describe a bigger force - as stronger or weaker?" (Lesson 11, Teacher Guide)
- Lesson 6 Lesson Assessment Guidance: "During the Synthesize moment, if a student says that no forces are acting on the still sculpture, revisit what they learned about forces in lessons 2-5. If students say the balance point causes motion, push them to think about what they did to get the sculpture to start moving. You may want to lean into structure and function at this moment to help students describe the structure of the balance points and the kind of movement that happens." (Lesson 6, 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.

There is evidence that differentiation strategies are explicitly called out for students who have already met the performance expectation. For example,

- Lesson 2, Lesson Materials and Preparation: "If your students are ready to begin tracking their ideas individually or in combination with a class-level chart, print My Growing Ideas for each student. Use this handout periodically throughout the unit to track the progress of student ideas over time. Consider adding the lesson question to the handout before making copies to reduce the writing burden for students. (Lesson 2, Teacher Guide)
- Lesson 5, Synthesize Section, Teaching Tip Callout Box:"Extension Opportunity (requires a spring scale): As a class, select one hanging sculpture, and calculate how much force must be pulled up on it by using a spring scale. First, use a spring scale to measure the force of each object pulling down. Then, add up all the forces due to the weights of each object. Use a spring scale to measure the upward pulling force." (Lesson 5, Teacher Guide)
- Lesson 8, Synthesize Section, Teaching Tip Callout Box: "For students with extra interest or in need of a challenge, consider giving them Sculpture Prediction as an extension opportunity to challenge their thinking." (Lesson 8, Teacher Guide)
- Lesson 12, Connect Section, Teaching Tip Callout Box: "Extension Opportunity: If there is a student with high interest or curiosity to know more about Surprising Magnets, encourage the student to explore for more examples of these magnets in the home, school or community space. Ask them to notice if there is anything different about these magnets compared to the ring magnets used in class. The student may notice that the devices in the book with Surprising Magnets are often "plugged" into the wall. They require electricity to turn on and off. Tell the student they will get to learn more about these amazing kinds of magnets in middle school (in OpenSciEd Unit 8.3: How can a magnet move another object without touching it? (Magnets Unit)." (Lesson 12, Teacher Guide)

Suggestions for Improvement

- Consider including additional extension opportunities such as "applying learning in new contexts (e.g., transfer phenomena) or through the lenses of different CCC elements or could include extending to learning from the next grade level, such as the next level SEP element in a learning progression (e.g., grade 5 students extending to prioritize criteria)." (EQuIP Detailed Guidance, p. 28)

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 providing sufficient support to facilitate coherent and explicit links between student sensemaking of phenomena and their learning in all three dimensions over time.

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.).
The materials provide guidance and support for teachers to recognize what students figure out in a lesson, what questions are left unanswered, and what new questions could be answered in the next investigation.
Each lesson begins and ends with a Navigate section that guides teachers in supporting students with engagement across lessons:

- Lesson 2, Navigate Section, Step 1: "Revisit the previous charts to elicit students' ideas again. Refer back to Our Initial Ideas: How They Work and the Ideas for Investigation charts from Lesson 1 and ask, What were some of our ideas for how we could build a Category A sculpture? What were our ideas to investigate them?" (Lesson 2, Teacher Guide)
- Lesson 2, Navigate Section, Step 7: "Use the Our Initial Ideas: How They Work chart and the Symmetry book to think about other designs. Ask students what they notice and wonder now about the Category A sculpture, especially when thinking about symmetry and asymmetry. Invite students to share their ideas with the class." (Lesson 2, Teacher Guide)
- Lesson 8, Navigate Section, Step 1: "Revisit the video from Lesson 1. Watch the full video, Balancing Act, by Walter Wick Studios - Full Video to see what happens after the sculpture is built. Facilitate a quick discussion to connect to ideas developed in lesson 7 to explain why the stack of blocks fell over." (Lesson 8, Teacher Guide)
- Lesson 8, Navigate Section, Step 5: "Celebrate all the questions and ideas students have figured out. Revisit the Initial Ideas chart from Lesson 1 along with the Our Growing Ideas chart to highlight for students how their ideas have grown and changed over the unit. Celebrate students' growth in developing new science ideas, and also how well they engaged in different science and engineering practices." (Lesson 8, Teacher Guide)

Throughout the unit, the "Our Growing Ideas" poster keeps track of the learning progression as one idea builds upon the next. Teachers are given tips for re-wording student questions to add to the poster or linking existing student questions.

- Lesson 6, Synthesize Section, Step 4: "Using the Our Growing Ideas chart, record the lesson question on the chart: How does the shape of the balance point and a force cause it to move? Move over any student questions from the Driving Question Board that might match this question. Read those questions aloud again as you move them. It is OK if there are none. Have students summarize what they figured out to the prompts on slide I. Encourage students to piggyback onto each other's ideas, especially when they have a similar idea. Likewise, encourage students to share new and different ideas." (Lesson 6, Teacher Guide)

ii. Providing strategies for ensuring student sense-making and/or problem-solving is linked to learning in all three dimensions.
Throughout the unit, lessons include Callout Boxes to highlight for teachers how students are using and developing SEPs and CCCs across the unit. These Callout Boxes guide teachers in supporting students as they progress. For example,

- Lesson 7, Synthesize Section, Patterns Callout Box: "Students develop this element of using patterns in changes in motion (across their trials) to consider how they can get predictable movements in their sculptures." (Lesson 7, Teacher Guide)
- Lesson 9, Synthesize Section, Asking Questions and Defining Problems Callout Box: "Throughout the unit students have been working on developing questions that can be investigated (i.e., testable questions), and in this moment, students are developing a new set of investigation questions about how magnets work

in these sculptures. They will continue to work on formulating testable questions to investigate cause-and-effect relationships in the subsequent lessons." (Lesson 9, Teacher Guide)

- Lesson 14, Synthesize Section, Cause and Effect Callout Box: "Where it makes sense, highlight cause-and-effect relationships between magnets and between magnets and other metal objects while students are developing their designs. Students identified and tested these relationships in previous lessons and are now applying these ideas to explain how the design works." (Lesson 14, Teacher Guide)

The Our Growing Ideas chart is not only for DCI-related content; teachers are also given prompts to use it to support student growth in related CCC and practices. For example,

- Lesson 11, Synthesize Section, Step 4 prompts encourage students to continue the work with the CCC of Cause and Effect. : "Update the Our Growing Ideas Chart with cause and effect statements. Ask students if they can change the wording in their evidence to explain a cause and effect relationship between strength and distances between magnets. First, have students talk with a partner about one thing they figured out in the labs. Then, have partners share an idea with the class. Once enough ideas are similar enough, develop a synthesis statement, such as the two suggested here: Using stronger magnets causes stronger forces between them (effect) and using weaker magnets causes weaker forces between them (effect). Changing the distance between magnets (cause) changes the strength of forces between them (effect). Shorten these ideas as you add them to the chart, if needed. Draw and write these words and ideas onto the class model as well." (Lesson 11, Teacher Guide).

The "A Successful Sculpture Will" poster connects student investigations to various types of sculptures. It gives teachers prompts to focus students on developing the Practice of Planning Investigations and Designing Solutions. For example,

- Lesson 8, Synthesize Section, Step 2, "Shift the discussion to recall how the focus on tracking needs and limitations on sculpture designs helps to improve designs over time. Refer to the A Successful Sculpture Will chart to discuss how the class sculptures changed as the needs of the sculpture and the limitations on designs changed each lesson." (Lesson 8, Teacher Guide). This instruction is accompanied by a discussion chart to support the teacher in eliciting ideas about criteria and constraints. The chart spells out what to look and listen for and gives follow-up responses that specifically talk about how the sculptures' needs changed (precursor to using the word "criteria") and how the limitations (precursor to "constraints") changed.

Suggestions for Improvement: NA

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 there was a change in how students independently use SEP elements from the beginning to the end of the unit. Reviewers found evidence of some of the practices gradually adjusting so that students are increasingly responsible for the three SEPs identified as the focus of the unit (Planning and

Carrying Out Investigations, Developing and Using Models, and Asking Questions and Defining Problems). Scaffolding is reduced over time for some of the SEP elements stated as targeted learning objectives. Supports are sometimes provided with guidance about adjustments for when and where to add/remove supports to move students toward independently knowing when to use and demonstrate proficiency with the SEP element. Support and scaffolds are aimed at all students, not customized to different student needs.

Three SEPs are the focus for this unit in the Unit Front Matter: Asking Questions and Defining Problems, Planning and Carrying Out Investigations, and Developing and Using Models. Elements for each SEP are identified in the Unit Front Matter document as well. These pieces of evidence were selected because they show how the class as a whole is progressing in steps from introduction to independent use of selected elements of the identified focal SEPs.

AQDP: Asking Questions and Defining Problems

AQDP:E1: Ask questions about what would happen if a variable is changed.

- Lesson 6, Explore Section, Step 2: "Work together to draft an investigation question similar to the lesson question, How does the shape of the balance point and a force cause it to move? Record the investigation question at the top of the chart." (Lesson 2, Teacher Guide)
- Lesson 7, Explore Section, Step 4: "Give students time to talk with their group about the investigation question and what they predict will happen when each size force is applied to their sculpture." (Lesson 7, Teacher Guide)
- Lesson 9, Synthesize Section, Step 5: "Remind students they will start by using the cause and effect question frames on slide J to write at least one question if they can. Tell students it is often helpful to pose cause and effect kinds of questions to help us investigate our ideas. To make cause-and-effect relationships more explicit, point to the examples on the slide. Say, Here are some question frames that we can use to ask about cause and effect." (Lesson 9, Teacher Guide)
- Lesson 10, Asking Investigation Question Student Handout walks students through changing yes/no questions to cause/effect related questions by asking students to use a sequence of increasingly open-ended sentence frames. "Test 1 (example)...New investigation question: If we put one magnet near another magnet, then will the other magnet move?...Test 2…New investigation question: If we ____, do we observe a push become a pull?...Test 3…New investigation question: If we ____ between the magnets, do we still observe a push or pull between them?...Test 4…Write a new cause-and-effect question to test two magnets:" (Lesson 10, Asking Investigation Questions Student Handout).
- Lesson 11 Investigating Magnets Further Student Handout: "Ask a question you can investigate. Either fill in the question provided below or create your own question for investigation…If the strength of a magnet __ (increases or decreases), how does this affect the size of the force between magnets?" (Lesson 11, Investigating Magnets Further Student Handout). Here, scaffolding is increased, as students can use a provided sentence frame or write their own variable-changing question.

AQDP:E2:Identify scientific (testable) and non-scientific (non-testable) questions.

- Lesson 6, Explore Section, Step 2, students are guided as a whole class by the teacher to turn questions about balance points and tools into a testable question: "what are some questions we can investigate using them? Accept all ideas for questions initially. As students share ideas for questions to test the shape of the balance point, place the dowel with the half circle on the sculpture base and have students observe it… Explain to students that their investigation question should include something about the shape of the balance point and the force to apply to make it start moving. Work together to draft an investigation

question similar to the lesson question, How does the shape of the balance point and an extra force cause it to move?" (Lesson 6, Teacher Guide)

- Lesson 10, Explore Section, Asking Questions and Defining Problems Callout Box:"Students are explicitly working on asking questions that can be investigated based on patterns, such as cause-and-effect relationships. In this lesson, and the next two lessons, students will practice asking questions as the basis for then investigating many types of interactions between magnets. This also gives them practice with asking more open-ended (how/why), testable questions as well. At any point, return to the scaffold provided in this lesson to support them to ask questions, or fade the scaffold as their questions improve over time." (Lesson 10, Teacher Guide)
- Lesson 12, Navigate Section, Step 1, "Introduce the lesson question or have students suggest one using a cause and effect framing." (Lesson 12, Teacher Guide). The accompanying AQDP Callout Box adds:" Articulate the change to make (replace 1 magnet with metal or other object) and the effect (see if there is still a push or pull). Then ask students to use the cause-and-effect question starters to suggest a question."(Lesson 12, Teacher Guide).

AQDP:E3: Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.

- Lesson 1, Synthesize Section, Step 6: "Now, they get to ask questions they want to investigate to understand these sculptures better. Explain that they are going to share all their questions to create the class's Driving Question Board. Introduce cause-and-effect question frames. Remind students that we have been talking about effects like staying balanced or falling over and we brainstormed initial ideas for causes of these effects. Tell students it may be helpful to pose cause-and-effect kinds of questions to help us investigate our ideas." (Lesson 1, Teacher Guide)
- Lesson 6, Explore Section, Step 2: "Explain that before applying force to the sculptures, students will make some predictions. Pause to discuss the term prediction. Ask students what they think of when they hear the word prediction. Elicit a few ideas, then share that prediction means to make a statement that something might happen or is expected to happen. Tell students to use their experiences and ideas to make predictions about how the sculptures might move based on the shape of the balance points." (Lesson 6 Teacher Guide). The accompanying handout, Balance Point Investigation, has a table for predictions and results: "A. Predict how the balance shape will affect the motion: We predict this sculpture will: __ Spin __ Rock (see-saw) __ Fall over __ No motion __ Other:" "We predicted that when we applied a force to the support bar with the (triangle / round) balance point, it would…When we applied a force to the support bar with the (triangle / round) balance point, we observed…This balance point (did / did not) help make a sculpture that moves and does not fall over because…"(Lesson 6 Student Handout Balance Point Investigation).
- Lesson 7, Making Sculptures Move Student Handout, students use a sentence frame rather than a check-off box to make predictions about motion: " Our Predictions: If we apply a weak force, our sculpture will… If we apply a medium force, our sculpture will…If we apply a strong force, our sculpture will…"(Lesson 7, Making Sculptures Move Student Handout)
- Lesson 9, Synthesize Section, Step 5: "Explain that they will get to add questions to the Driving Question Board. Remind students they will start by using the cause and effect question frames on slide J to write at least one question if they can. Tell students it is often helpful to pose cause and effect kinds of questions to help us investigate our ideas. To make cause-and-effect relationships more explicit, point to the examples on the slide. Say, Here are some question frames that we can use to ask about cause and effect." (Lesson 9, Teacher Guide) However, the students are writing these questions with question frames, which is the same support they had in the previous lessons.

- Lesson 10, Explore Section, Step 2: "Bring the class back together and display slide C. Say, Here are some question frames that we've been trying to use when we ask cause and effect questions. Notice how the questions have a fill-in-the-blank for the change you want to make and for the effect you are observing. Model and investigate the first question. Display slide D which is the same as the first question on the students' handout. Explain that this question has already been changed for us. Read the original question and connect it to similar ones on the DQB. Then read the new question: If we put one magnet near another magnet, then will the other magnet move?" (Lesson 10, Teacher Guide) Students use the question stems from Lesson 9, and the teacher models the way to create the questions. The reduction of scaffolding was not located in this lesson.
- Lesson 14, Navigate Section, Step 6: "But having more questions can also push us to do more. It's OK if not all our questions are answered now. We will have more investigations in science. Tell students that in the coming units, we may figure out more things that help us answer the questions we still have here and they will have new questions too." (Lesson 14, Teacher Guide)

AQDP:E5:Define a simple design problem that can be solved through the development of an object, tool, process, or system and include several criteria for success and constraints on materials, time, or cost.

- Lesson 2, Explore Section, Step 2: "The first step is to identify the goal of the design challenge. In this case, the design challenge is building an interesting and fun sculpture that balances. Use the slide to support students in stating the design goal. Record these ideas at the top of the "A Successful Sculpture Will…" chart." (Lesson 2, Teacher Guide)
- Lesson 4, Explore Section, Asking Questions and Defining Problems Callout Box:"This is an opportunity for students to practice modifying criteria for success and constraints on their designs as they learn new ideas about how to balance a sculpture." (Lesson 4, Teacher Guide)
- Lesson 13, Synthesize Section, Step 3: "Introduce the new design challenge. Transition from summarizing ideas figured out to applying these ideas to design and build a new sculpture. Say something like, Wow, we have made a lot of progress on understanding magnets and the forces between them. Now, let's use our new understanding to try to design and build magnetic sculptures. Remind students that when they designed Category A and B sculptures, they had to outline the goal. Add to the A Successful Sculpture Will chart or create a new one. Work together to outline a new goal." (Lesson 13, Teacher Guide)
- Lesson 14, Synthesize Section, Step 4:" Say something like, This is your final task for this unit! We are going to use our ideas to design something that solves a problem using magnets. It can be a design for something that we have a problem doing, such as putting on clothes, or it could solve another problem for ourselves, a friend, or a family member." (Lesson 14, Teacher Guide)

MOD: Developing and Using Models

MOD:E2: Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regularly occurring events.

- Lesson 5 "Handout Hanging Sculptures Part D "Create an individual model: Step 1. In the space below, draw a diagram of your final hanging sculpture. Step 2. Add arrows to show all forces pulling up and down on your sculpture. (Lesson 5 Handout Hanging Sculptures) Students begin to use symbols (arrows) to show relationships among forces acting on their sculpture.
- Lesson 7, the word "model" is being used with students as they create a class consensus model showing how a complex moving sculpture is affected by a range of forces. In slide D of the slide deck students see "Make A Model…What type of extra force do we need to get this sculpture to move?" (Lesson 7 Slide Deck, Slide D.)

- Lesson 8 students review before moving on to create their own sculptures and individual models in the Student Assessment Art Exhibit step 7: "Draw a sketch of your final sculpture and use arrows to show the strength and direction of forces that keep it balanced." (Lesson 8, Student Assessment Art Exhibit)

MOD:E3: Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.

- Lesson 3, Synthesize Section, Step 5: "Go back to science ideas and models for Lessons 2 and 3 and revise them using the new term "force" and the new symbol of an arrow." (Lesson 3, Teacher Guide)
- Lesson 5 Synthesize Step 5 Teaching Tip sidebar: "While you ask questions, it helps to demonstrate any movement due to pulling forces with a hanging sculpture. Be sure to have one model hanging sculpture ready for you to use during this activity. You might stand near a whiteboard and draw arrows upward and downward to capture the opposing forces that counterbalance each other. For a still sculpture, the arrows should be equal lengths in opposing directions." (Lesson 5 Teacher Guide). Students are introduced to the idea of using arrows to represent forces.
- Lesson 6, Synthesize Section, Step 4: "Then ask, Did someone else use a different way to cause the sculpture to move? Have another student demonstrate. As they demonstrate, point out the direction of the force (e.g., from the side or from the top) and how the force is being applied (e.g., light blowing or tapping)." (Lesson 6, Teacher Guide)
- Lesson 7, Synthesize Section, Step 5: "Then have students point to at least two places on the sculpture where two things are touching to apply a force. Remind students that before making their sculpture move, all the forces are balanced and the sculpture is at rest (or still). Support this idea by pointing out the arrows on the class model that show up and down forces of equal size acting on the sculpture at rest. Students can also look back at their handout (Step 3), where they drew the force arrows before starting a motion (excluding the extra force)." (Lesson 7, Teacher Guide)
- Lesson 8, Synthesize Section, Developing and Using Models Callout Box: "Emphasize how students tracked arrows to represent how the forces were acting on the sculptures to keep them still, or to start a specific motion. They will be asked to represent the forces again in an assessment task. They will also continue to develop this practice in subsequent lessons." (Lesson 8, Teacher Guide)

MOD:E4: Develop and/or use models to describe and/or predict phenomena.

- Lesson 1, Synthesize Section, Step 5: "Convene in a Scientists Circle to chart initial consensus ideas. Gather students around the Our Initial Ideas: How They Work chart that is placed near the Our Examples chart. This chart represents the class's initial consensus model." (Lesson 1, Teacher Guide)
- Lesson 9, Synthesize Section, Step 4:" Tell the students that they have been making models all along to plan and explain their sculptures. Point to the diagrammatic models on Our Growing Ideas chart from Lessons 2-8. Use these as examples of models that students have been making together as a class. Tell students they will make a model to answer the question, How do the magnets and other parts in the sculpture interact to cause movement? Pause and check for understanding of the word 'interact'. You can offer that the word interact means to affect each other." (Lesson 9, Teacher Guide)
- Lesson 10 Handout Asking Investigation Questions: "Observations. Use the image below to describe your observations in words and pictures."(Lesson 10 Handout Asking Investigation Questions). Students use the image to help them draw their own model in words and pictures.
- Lesson 12, Explore Section, Step 3:"Create models in small groups.When students are finished with their observations, direct them to keep the paper clip ready for testing, but set aside the magnet for now. Focus their attention on creating a model to explain how the paper clip hovered in some situations, and did not hover in other situations. Encourage them to use ideas from the Our Growing Ideas chart." (Lesson 12,

Teacher Guide) Students are encouraged to use the Our Growing Ideas chart to assist them in creating a model, just like in Lesson 9.

MOD:E5: Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.

- Lesson 1, Explore Section, Step 2: "As you circulate, pay attention to if a student is only drawing their sculpture on Group Sculpture: Build an Example. If you notice this, prompt the student to label their diagram with words and symbols to explain what causes it to balance or fall over. Explain to the student that there are two results, or effects: either their sculpture balances and/or moves or it falls over. Cue them to think about different causes for the result they got and to represent those causes on their diagrams." (Lesson 1, Teacher Guide)
- Lesson 5, Synthesize Section, Step 6:" Update the Our Growing Ideas chart with the new ideas students have where the arrows should be placed on the diagram.Prompt each student to draw a diagram of their final hanging sculpture on Hanging sculptures. Then have students show their drawings in their group and share ideas about how to add arrows to their diagram to show all forces pulling up and down on their sculpture." (Lesson 5, Teacher Guide)
- Lesson 7, Synthesize Section, Step 5: "First, use a sculpture with a triangle point to construct a diagram on chart paper for the class. Students should follow along on Step 1 of the handout. Once each group completes their spinning sculpture diagram, point to slide G and ask, How can we explain in one sentence what we did to the spinning sculpture, and what type of movement happened afterward." (Lesson 7, Teacher Guide) Students are given an example from the teacher before developing their diagram, just as in Lesson 5.
- Lesson 14, Student Assessment Using Magnets to Solve a Problem, students define their problem and then use a diagram to convey their solution: "Step 3. In the box below, use words and pictures to sketch and describe your design. Consider these questions as you design. Where will you place the magnets in this new device? Why is that location important? How will someone use this device? What makes your design unique?" (Lesson 14, Student Assessment Using Magnets to Solve a Problem)

MOD:E6: Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

- Lesson 5, Synthesize Section, Developing and Using Models Callout Box: "This is an opportunity to intentionally develop this practice by having students develop a diagrammatic model to explain how their hanging sculpture remains balanced and does not fall, with equal and opposite upwards and downward forces applied at specific locations. This pushes students to use ideas across several lessons to represent the multiple acting forces on a sculpture." (Lesson 5, Teacher Guide) However, students do not use this model to test cause and effect relationships.
- Lesson 6, Synthesize Section, Step 4: "Continue the Building Understandings Discussion to include force. Have a set of demonstration materials available throughout the discussion, particularly when students demonstrate the extra force they applied to start the sculpture's motion and the direction it moved. Ask, Can someone come up here and show the class how you caused the sculpture to move?" (Lesson 6, Teacher Guide)
- Lesson 14, Student Assessment Using Magnets to Solve a Problem, students define their own problem then use a diagram to convey their solution: "Step 3. In the box below, use words and pictures to sketch and describe your design. Consider these questions as you design. Where will you place the magnets in this new device? Why is that location important? How will someone use this device? What makes your design unique?" (Lesson 14, Student Assessment Using Magnets to Solve a Problem)

INV: Planning and Carrying Out Investigations

INV:E1: Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

- Lesson 4, Explore Section, Step 3: "Tell students that they are going to do three investigations to see what works best for making our new type of sculpture. The first two investigations are set up so that they will adjust only one thing at a time. As a class, read aloud the investigation question and investigation procedures (Steps 1-3)." (Lesson 4, Teacher Guide)
- Lesson 5, Explore Section, Step 4: "Plan and draw the asymmetrical balanced hanging sculpture. Pass out the materials to each group, along with Hanging sculptures Read aloud the Investigation Question." (Lesson 5, Teacher Guide)
- Lesson 6, Explore Section, Step 2:" Display a plain piece of chart paper or whiteboard with "Investigation Plan" as the title. Explain to students that their investigation question should include something about the shape of the balance point and the force to apply to make it start moving. Work together to draft an investigation question similar to the lesson question, How does the shape of the balance point and a force cause it to move? Record the investigation question at the top of the chart. Draft a plan to change only 1 thing." (Lesson 6, Teacher Guide)
- Lesson 7, Explore Section, Step 4: "Remind students that we are working on fair tests and in this investigation, they will only change the force they apply to the sculpture. Give students time to talk with their group about the investigation question and what they predict will happen when each size force is applied to their sculpture." (Lesson 7, Teacher Guide)
- Lesson 8, Synthesize Section, Step 3: "Apply ideas about force and motion to show learning. Display slide D and handout either Art Exhibit or Game Play. Use the introduction on the slide and handout to prepare students to complete the task. Additional slides are provided to support the art exhibit task."
- Lesson 11, Explore Section, Step 2: "Plan Investigation. Tell students that they will need to test two different situations with magnets to see what affects the size of a force between them. The first fair test will investigate stronger and weaker magnets and the second fair test will investigate the distance between magnets. Both tests will use a scale to measure the size of the force between the magnets as they push away from one another." (Lesson 11, Teacher Guide)

INV:E3: Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.

- Lesson 2, Explore Section, Initial Sculpture Design:Category A Student Handout, students work in a group to figure out that the same objects with equal distance from the balance point make a symmetrical design.
- Lesson 3, Explore Section, Sculptures with Different Objects Student Handout: "Step 2: Use the box on the handout to draw and label your sculpture and record the number of objects…Step 4: Figure out the total weight of the objects on each side of the ruler." In Synthesize Section, Step 5, "Summarize ideas developed throughout the lesson and write them onto the class chart: Different objects can be used, but weight and distance must be equal on both sides." (Lesson 3, Teacher Guide)
- Lesson 6, Synthesize Section, Step 4: "Looking at the results you recorded on the handout, was there a pattern of movement across the trials for one shape?... How predictable was the motion for each shape?" Here, students make observations of the motion of a variety of support bar shapes (Student Handout Balance Point Investigation) and then use their observations as evidence for how each support bar changes the sculpture's motion. (Lesson 6, Teacher Guide)
- Lesson 8, Synthesize Section, Planning and Carrying Out Investigations Callout Box: "Students have progressively practiced collaboratively planning and carrying out investigations using procedures, making observations, and producing data for evidence. This is an assessment opportunity for students to engage

in this practice independently as they build their sculptures and/or apply ideas to the game play task." (Lesson 8, Teacher Guide)

- Lesson 11, Explore Section, Investigating Magnets Further Student Handout: "Measure the amount of force between the magnet when there is 1 only one magnet. Repeat the measurements when using 2 test magnets and then three test magnets. Record your data below… Based on the data in the chart, what can you say about the size of the force between magnets as the strength of the magnet increases?" They then collect data about the effect of varying distances on magnetic field strength, and use their data as evidence to explain the relationship between magnetic field force and distance: "Measure the amount of force between the magnets when they are 1 inch apart. Repeat the measurements when the magnets are held 2 and 3 inches apart. Record your data below…Based on the data in the chart, what can you say about the size of the force between magnets as the distance gets further apart?" (Lesson 11, Investigating Magnets Further Student Handout)
- Lesson 12, Explore Section Step 4: "If time allows, use this final investigation to explore another noncontact force – electric forces. Display slide G and pass out Moving objects without touching to each student. Read the introduction aloud as a class, or have small groups read it together. Test our ideas. Once students have made connections between magnetic and electric forces, have them test their ideas with some items in the classroom. First, watch the video at Move objects without touching them. Play the video more than once so that students can observe different things happening in the video each time." (Lesson 12, Teacher Guide) However, this is an extension opportunity; therefore, teachers may not complete this part of the lesson.

INV:E4:Make predictions about what would happen if a variable changes.

- Lesson 4, Explore Section, Step 3:"Tell students that they are going to do three investigations to see what works best for making our new type of sculpture. The first two investigations are set up so that they will adjust only one thing at a time." (Lesson 4, Teacher Guide)
- Lesson 4, Synthesize Section, Step 6: "How did using the procedures help us test distance and weight? It helped us change just one thing and record what happened.What if we had changed both distance and weight at the same time? We wouldn't know which one to move or add weight to. It would be confusing." (Lesson 4, Teacher Guide) In Lesson 4, students are told which variable to change.
- Lesson 6, Explore Section, Step 2:"Remind students that to carry out a careful investigation, they want to change only one thing at a time. Everything else should be kept the same. Elicit suggestions for the one thing to change. Students should recommend the balance point shapes. Record on the chart paper the one thing they want to change: the shape of the balance points." (Lesson 6, Teacher Guide) Students can choose their independent variable.
- Lesson 10, Explore Section, Step 2: "Go back to the investigation question. Have students flip or "change the side" of the top magnet and repeat. Like sides will cause the top magnet to hover. Unlike sides will cause the magnets to snap together." Students may miss that the only thing that is changing here is the side of the magnet. It is not explicit that they are only changing one variable in this investigation.

Suggestions for Improvement

- Consider using a variety of scaffolding techniques to ensure students change in how independently they use SEP elements that are targeted as learning objectives.
- As students advance in their independent use of the element ADQP-E3, consider offering them additional scaffolds in addition to using sentence stems.

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 student artifacts show direct, observable evidence of using all three dimensions at a grade-appropriate level. Tasks require students to integrate all three dimensions as part of the learning performance, applying them to explain the balancing sculptures phenomenon. Assessments are similar in style and context to student learning activities. The focus is on using student sensemaking of the phenomenon to uncover student understanding of all three dimensions.

Lessons 8 and 14 contain summative assessments that are transfer tasks where students must use their existing knowledge to construct new understanding of the scenario presented. Students complete these tasks independently, and these artifacts can be collected and evaluated to determine student mastery of the learning objectives.

- Lesson 8, Synthesize Section, Art Exhibit Student Assessment: "You will make a sculpture on your own. You will: plan what type of sculpture you will make, test your sculpture to make sure it is successful, explain the forces acting on your sculpture." (Lesson 8, Art Exhibit Student Assessment) This assessment does not ask students to use their previous knowledge to construct a new understanding of the given scenario; it is the same type of scenario students have been engaging with in lessons 1-7.
- Lesson 8, Synthesize Section, Game Play Student Assessment: "Game #1: Your class is playing a few games to figure out how they work. You test one game, and observe another. You will use what you figured out in science class to: Use your observations to notice patterns, Make predictions about the best way to play each game, Explain the forces that make the games work. The next game your group visits is indoor putt-putt golf. The goal of this game is to use the club to tap the golf ball into a hole 6 feet away on a flat surface. You watch Marcus and Kyla play." (Lesson 8, Game Play Student Assessment)
- The Forces and Interactions Assessment Overview document states: "In lesson 14, students apply their ideas about magnetic forces to solve a problem. This is an opportunity to summatively assess Assessment Statement 4."
- Lesson 14, Synthesize Section, Step 4: "Introduce the Magnet Design Task. Display slide F and pass out Using Magnets to Solve a Problem. Use the written assessment to assess whether students can apply their knowledge of magnets and forces to another context. Say something like, This is your final task for this unit! We are going to use our ideas to design something that solves a problem using magnets. It can be a design for something that we have a problem doing, such as putting on clothes, or it could solve another problem for ourselves, a friend, or a family member." (Lesson 14, Teacher Guide)

Throughout the unit, several student performances produce artifacts that integrate the three dimensions in service of sense-making or problem-solving.

- Following Student Sensemaking Lessons 2 - 5 gives teachers a format to collect informal evidence about students using 3 integrated dimensions in service of their sculpture building: "Checklist of Listen/Look-Fors (*see examples below the table). Use handouts, small group discussions, and whole class discussions: Uses a series of steps, including fair tests with more than one try, to build, test, and explain a balanced sculpture. Measures and represents data for objects added to the sculpture, including whether it created a balanced effect or not. Includes an accurate representation of forces acting on the sculpture to achieve

the desired effect, including arrows showing opposing forces equal in strength. Your Notes About What a Student Says, Does, Writes, Draws, Gestures, Manipulates" (Following Student Sensemaking Lessons 2-5)

- Following Student Sensemaking Lessons 10 - 12 gives teachers a format to collect informal evidence about students using 3 integrated dimensions in service of their magnetic field investigations: "Checklist of Listen/Look-Fors (*see examples below the table). Use handouts, small group discussions, and whole class discussions. Ask questions to investigate how A. like sides cause pushing apart, unlike sides cause pulling together. (Lesson 10) B. magnet strength causes different-size forces. (Lesson 11) C. distances between magnets cause different size forces. (Lesson 11) D. some (pattern) metal objects have pulling forces with magnets. (Lesson 12) Circle the letters below to show that students have demonstrated evidence of learning toward that idea. Then track notes in the right column about their learning." (Following Student Sensemaking Lessons 10 - 12)

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

- Lesson 5, Explore Section, Step 3: "Tell students that, in groups, their design goal is to build a balanced hanging sculpture that is playful and puzzling. Review what our sculpture needs to do by telling students that the sculpture must hang, and the balance point must be at the center of the support bar." (Lesson 5, Teacher Guide)
- Lesson 7, Explore Section, Step 4: "During Making Sculptures Move, students plan and conduct an investigation to uncover the patterns in an object's motion (effect) caused by unbalanced forces, and predict future movement based on patterns of change (effect)." (Lesson 7, Teacher Guide)
- Lesson 8 Student Assessment Game Play, Step 3: "After a few plays, this is what your game looks like. On the image below, add words and symbols to explain what causes the rods to stay balanced and helps the game not fall over. Use your new understanding of forces to help explain how this game works." (Lesson 8 Student Assessment Game Design Transfer), and step 4:" On the very next play, a player places a new rod and the game falls over. Use the lines below, to write and how forces caused the game to fall over." (Lesson 8 Student Assessment Game Play). Students use their understanding of the DCIs about balanced and unbalanced forces.
- Lesson 8, Student Assessment Game Play, Step 4: Students use their skill in the Practice of Planning and Carrying Out Investigations: "Based on your prediction for what will happen when the first rod is added, use the lines and box below to write and draw a plan for how your group will add another rod to balance the game. Explain why you think this will work. Tip - use this example to write your ideas: We will place another rod _____ because _____." (Lesson 8 Student Assessment Game Play). They use their skill in the Practice of Developing and Using Models: "On the image below, add words and symbols to explain what causes the rods to stay balanced and helps the game not fall over. Use your new understanding of forces to help explain how this game works." (Lesson 8 Student Assessment Game Play).
- Lesson 11, Explore Section, Step 2: "Students complete the investigation using the Investigating Magnets Further handout. They plan and conduct an investigation collaboratively to produce data to serve as evidence that the properties of magnets and the distance between them causes different sizes of forces (effect)." (Lesson 11, Teacher Guide)
- Lesson 12, Explore Section, Step 2: "Students make observations that pull forces exist between magnets and some (patterns) metals, and they can hover when equal forces are pulling up and down on the metal as they complete Magnets and Metals Investigation." (Lesson 12, Teacher Guide)

Suggestions for Improvement: NA

III.B. Formative	Extensive
Embeds formative assessment processes throughout that evaluate student learning to inform instruction.	

The reviewers found extensive evidence that the materials provided opportunities that were labeled as formative assessment. Most of those opportunities include support for the teacher in the next steps of instruction. There is varied support for student thinking across the three dimensions, and most of the formative assessment processes attend to multiple aspects of student equity.

Materials explicitly, frequently, and variedly support formative assessment processes. Formative assessment opportunities are called out for each lesson, with connections to all 3 dimensions highlighted in separate colors. The assessment instructions at the beginning of each lesson include a "How can I use the information I gather from this assessment?" section, often in a clear, if-then format.

- Lesson 3, Teacher Guide Assessment Guidance: "If a student is struggling with this idea of weight as a force, revisit the demonstration using the mini plastic springs to revisit the idea that weight is a force pulling down. Test two different objects again and show how one object pulls more to the ground than another object. Then place those same objects onto a support bar (ruler) and show how the same heavier object pulls the support bar down and causes the sculpture to fall." (Lesson 3, Teacher Guide)
- Lesson 7, Teacher Guide Assessment Guidance: "If a student struggles with the idea of contact forces (i.e., touching, blowing on objects), have the student place an object in their hand and describe if they can "feel" the weight of the object against their hand. They can also blow on their hand or push two fingers together. When they feel an object touching another object, it is making contact." (Lesson 7, Teacher Guide)

Key formative assessments are labeled separately from other formative assessment opportunities and include more specific support in the 3.1 Forces & Interactions Assessment Overview document, the Teacher Guide for that lesson, and the associated Following Student Sensemaking documents.

- Lesson 5, Explore Section, Step 4: "Key formative assessment: This is a moment to formatively assess progress toward learning goal **5** with the purpose of determining how well a student understands how to balance the downward forces of the hanging mobile. If a student struggles to balance the mobile (by keeping the support bar mostly level), ask the student how they could balance the previous sculptures using rulers and blocks. Encourage the student to consider how they might add the total weight on either side of the balance point to cause the sculpture to balance. Use Following Student Sensemaking (Lessons 2-5) to track evidence of student ideas. Refer to the Assessment Guidance at the beginning of the lesson." (Lesson 5, Teacher Guide)
- Following Student Sensemaking, Lessons 2-5 support the teacher with possible student work showing appropriate responses to the key formative goals, organized into a table with the following headings: "Students might say…Students might gesture/manipulate…Students might write/draw" (Following Student Sensemaking, Lessons 2-5)
- 3.1 Forces & Interactions Assessment Overview: "It will be important here to look for student ideas about the forces pulling down on the hanging mobile (i.e., the weight of the objects) and the upward force holding the mobile up. This is a key idea for students to understand that when these forces up and down forces are equal (i.e., net force is zero), then the sculpture is not moving up and down. Pay attention to see if students understand that even a non-moving object has forces acting on it to keep it stable. Use the ideas students share on Hanging sculptures and evidence you have gathered on Following Student

Sensemaking (Lessons 2-5) from lessons 2-5 to evaluate students' progress in understanding these ideas, to provide feedback to students, and to plan your upcoming instruction." (3.1 Forces & Interactions Assessment Overview)

Following Student Sensemaking, Lessons 2-5, Following Student Sensemaking, Lessons 6-7, and Following Student Sensemaking, Lessons 10-12 offer check sheets to help teachers keep track of individual students' progress toward key formative learning goals. These are 3-dimensional, as shown through color-coding of the checklist:

- Following Student Sensemaking Lessons 6-7: "A. Explains a predictable pattern of future motion based on past motions using evidence produced through testing sculptures. B. Includes an accurate representation of forces acting on the sculpture to achieve the desired effect, including arrows to show an extra force that changes motion in the sculpture." (Following Student Sensemaking, Lessons 6-7)
- The What To Look and Listen For column of each lesson's Lesson Assessment Guidance is also color-coded to emphasize elements from each dimension. Lesson 4 Where Can I Check For Understanding: "What to look and listen for: Ideas from the fair tests about how moving the balance point away from the center (cause) means that more weight must be added to the shorter side (effect) to balance the sculpture. Ideas about changing one thing at a time (fair test) to identify what is causing it to balance or fall over. Ideas about accurate measurement and multiple trials across groups: If you don't get the exact distance or weight, the sculpture may fall over (effect), or it might take multiple trials of the same test to see patterns in results. Individual student ratings on how confident they feel in carrying out fair tests to see what can cause an off-centered sculpture to balance." (Lesson 4 Teacher Guide)

Teacher action steps correspond to elements from all three dimensions over time, for example:

- Lesson 6, How Can I Use This Assessment Information: "If students say the balance point causes motion, push them to think about what they did to get the sculpture to start moving. You may want to lean into structure and function at this moment to help students describe the structure of the balance points and the kind of movement that happens." Support here is given for two CCC (Cause and effect and Structure and Function) and a DCI about unbalanced forces changing motion.
- Lesson 10, How Can I Use This Assessment Information: "If a student needs extra support interpreting the data, ask questions such as: Is the force measured by the scale getting bigger or smaller? How would you describe a bigger force - as stronger or weaker?" Support here is given for a Practice element about data and a DCI element about strengths of forces.

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

- Lesson 2, Lesson Assessment Guidance: "Students may verbally express ideas, gestures, or written notes indicating ideas they figured out through investigating how the objects and distances must be equal or the same on both sides of the balance point to cause the sculpture to balance." (Lesson 2, Teacher Guide)
- Lesson 5, Explore Section, Broadening Access Callout Box: "Invite students to share their learning across multiple modalities. They can write and/or draw on the handout, verbally share, and/or use gestures and materials to show how they were able to balance the hanging sculpture. This allows students to share the full range of their thinking and will provide more rich information for their peers to build on, as well as for teacher feedback and adjusting instruction." (Lesson 5, Teacher Guide)
- Lesson 9, Connect Section, Broadening Access Callout Box: Provide multiple means of engagement by asking students how they have used magnets in their lives to solve a problem or create something. This helps optimize the relevance, value, and authenticity of the focal science idea for students." (Lesson 9, Teacher Guide)

- Lesson 10, Teacher Assessment Tool Following Student Sensemaking: "Remember students are often using multiple means of communication to express their sensemaking. Recall that what you aim to identify here is the extent to which students are figuring out and demonstrating an understanding of the focal performance assessment across lessons. In this space, it is important that you identify evidence of this understanding, regardless of how students express their ideas. Use the following ideas below as evidence that students have a secure grasp of the assessment statement."

Following Student Sensemaking check sheets for Lessons 2-5, 6-7, and 10-12 allow teachers to track individual students' progress toward learning goals more easily. The check sheets also remind teachers in several locations about different methods that individual students might use to communicate understanding:

- Following Student Sensemaking, Lessons 10-12: "Throughout each lesson, keep track of students' sensemaking, remembering that students often use multiple means of communication at the same time to express their sensemaking. Given this unit's topic, it is likely students manipulate magnets and other objects while expressing their ideas so it is important to notice that throughout the lessons…Your Notes About What a Student Says, Does, Writes, Draws, Gestures, Manipulates… Remember students are often using multiple means of communication to express their sensemaking. Recall that what you aim to identify here is the extent to which students are figuring out and demonstrating an understanding of the focal performance assessment across lessons. In this space, it is important that you identify evidence of this understanding, regardless of *how* students express their ideas. Use the following ideas below as evidence that students have a secure grasp of the assessment statement…Students might say or ask…Students might gesture/manipulate…Students might write/draw…" (Following Student Sensemaking, Lessons 10-12).

Suggestions for Improvement: NA

III.C. Scoring Guidance	Adequate

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 adequate evidence that the materials include scoring guidance that consistently supports the learning process. The materials provided some tools that can assist teachers in monitoring student progress along a continuum toward the ultimate learning goals of the materials. Assessment materials include limited ways for students to interpret their own progress and make sure they understand their learning targets.

- The Teacher Assessment Tool documents clearly state learning targets and incorporate scoring guidance, except for the extension activity Sculpture Prediction in Lesson 8. The other Teacher Assessment Tools list the Performance Expectations addressed in the assessment at the top of the page and include learning targets in a table correlating them to elements of each dimension and to specific questions on the assessment.

- The rubric tables for each summative assessment in Lessons 8, 13, and 14 provide guidance for teachers on interpreting progress, except for the extension activity Sculpture Prediction in Lesson 8. Column labels of "Beginning," "Developing," and "Secure" for each question or step in the assessment indicate what a teacher should look for to tell which level best fits a student's work.
- Lesson 8 has two options for the summative assessment. Both Assessment Statements are the same: 3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. 3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. The materials do not specify whether the students can choose which assessment to complete or if the teacher chooses which assessment the students complete.
    - Lesson 8 Option 1, Art Exhibit, is an embedded assessment where each student creates their own sculptures and explains how it works using ideas developed across Lessons 2-7. The Teacher Assessment Tool, Art Exhibit Rubric, contains a color-coded, three-dimensional rubric for teachers to assess students' understanding during this individual performance assessment. Each element that is used on this assessment is identified in the NGSS Reference Table, and the guidance for how to interpret student progress is included. There are row labels (learning targets) and column labels (Beginning, Developing, Secure Feedback) that contain detailed descriptions of what the students should include for different questions on the assessment. There are also sample drawings and possible student responses included on the key.
    - Lesson 8, Option 2, Game Play, is a transfer task that requires students to transfer the ideas developed about balance sculptures and apply them to a new context – game play. The Teacher Assessment Tool, Game Play Rubric, contains a color-coded, three-dimensional rubric for teachers to assess students' understanding during this individual performance assessment. Each element that is used on this assessment is identified in the NGSS Reference Table and the guidance for how to interpret student progress is included. There are row labels (learning targets) and column labels (Beginning, Developing, Secure, Feedback) that contain detailed descriptions of what the students should include for different questions on the assessment. There are also sample drawings and possible student responses included on the key.
    - The materials include information to support teachers in providing feedback to students in Lesson 8. The Forces and Interactions Assessment System Overview: "Also, use the evidence you have gathered on the Following Student Sensemaking (Lessons 2-5) and Following Student Sensemaking (Lessons 6-7) tools from lessons 2-7 to make summative claims about students' understanding of Assessment Statements 1 and 2. If you have not yet checked off both boxes for certain students, make sure to talk individually with those students about either their art exhibit design or their explanations of how the games work so they have an opportunity to explain their thinking and inform your summative assessment of their progress. See the example student samples shown in the tools, and use the suggestions of what to look for and ask about as you provide feedback and evaluate the ideas students communicate in words, gestures, drawings, and symbols." (Lesson 8, Teacher Guide)
    - Students have the opportunity to receive feedback from their peers in Lesson 8, Synthesize Section, Step 3: "Provide peer feedback and update ideas. As students finish either task, use this as an opportunity for students to practice giving and receiving feedback on either their sculptures or their ideas for how the games work. Pass out Giving and Receiving Feedback and read aloud as a class the suggestions for how to give and receive feedback. Then, in partners, let students practice giving feedback to one another and then revising their own thinking based on the feedback." (Lesson 8, Teacher Guide)

- The Lessons 10-12 Following Student Sensemaking Assessment Tool is included as a summative assessment. The Forces and Interactions Assessment System Overview states: "Evidence gathered across lessons 10-12 are an opportunity to summatively assess students asking questions about cause-and-effect relationships between magnets and magnets and other objects (Assessment Statement 3). Use Following Student Sensemaking (Lessons 10-12) to gather this evidence of student learning." This tool includes guidance for teachers to interpret and track students' progress in relation to the instructional materials as well as the standards, elements, and learning performances that are targeted learning objectives.
- The Forces and Interactions Assessment System Overview includes Lesson 13 as a summative assessment: "Lesson 13 offers an opportunity for students to apply their ideas about magnetic forces developed in lessons 10-12 to build a magnetic sculpture similar to the ones seen in lesson 9. Use Magnetic Sculpture Rubric for guidance on assessing student ideas toward Assessment Statement 4. Consider combining this evidence with additional evidence gathered on Following Student Sensemaking (Lessons 10-12) across lessons 10-12 to make summative claims about students' understanding of Assessment Statements 3 and 4. Similar to lesson 8, talk with students who may not have fully demonstrated their understanding so that they have a chance to explain their thinking and inform your summative assessment of their progress. Use this as an opportunity to provide feedback to students about their ideas to then apply them again on a new task in lesson 14."
- The Lesson 13 Teacher Assessment Tool, Magnetic Sculpture Rubric, contains a color-coded, three-dimensional rubric for teachers to assess students' understanding during this individual performance assessment. Each element that is used on this assessment is identified in the NGSS Reference Table, and the guidance for how to interpret student progress is included. There are row labels (learning targets), and column labels (Beginning, Developing, Secure, Feedback), that contain detailed descriptions of what the students should include for different questions on the assessment.
- Suggestions for feedback are in the Lesson Assessment Guidance section of the Teacher Guides for each lesson. This guidance includes feedback for summative assessments, as seen in Lesson 13 Lesson Assessment Guidance: "If a student needs additional scaffolds to apply the science ideas about magnetic forces, review the Our Growing Ideas chart and use magnets again to review pushing and pulling forces. There are also sentence frames on Explaining My Sculpture that might be helpful for a student as they construct an explanation. If explanations are short or unclear, probe students' thinking further with questions like: How did you know they would pull together? Do you think the side of the magnet matters? How close did the magnet have to be? Is it a pushing or pulling force that is causing that to move? Can you show me with your hands (or a magnet) how that works?" (Lesson 13 Teacher Guide)
- Lesson 14, Forces and Interactions Assessment System Overview: "In Lesson 14, students apply their ideas about magnetic forces to solve a problem. This is an opportunity to summatively assess Assessment Statement 4. Use KEY: Using Magnets to Solve a Problem for guidance on assessing student ideas. Combine this evidence with additional evidence gathered on Following Student Sensemaking (Lessons 10-12) across lessons 10-12 to make summative claims about students' understanding of Assessment Statement 4. Talk individually with any students who have not fully demonstrated their thinking for the Assessment Statement."
- Lesson 14 Teacher Assessment Tool, Key: Using Magnets to Solve a Problem, contains a color- coded, three-dimensional rubric for teachers to assess students' understanding during this individual performance assessment. Each element that is used on this assessment is identified in the NGSS Reference Table and the guidance for how to interpret student progress is included. There are row labels (learning targets), and column labels (Beginning, Developing, Secure, Feedback), that contain detailed descriptions of what the students should include for different questions on the assessment.
- Teachers are given the option to have students to track their own progress on a personal Our Growing Ideas chart, or use the class chart. Lesson 2, Materials and Preparation: "In 3rd grade OpenSciEd, the units

include a class-level Our Growing Ideas chart similar to the units in K-2. However, if your students are ready to begin tracking their ideas individually or in combination with a class-level chart, print My Growing Ideas for each student. Use this handout periodically throughout the unit to track the progress of student ideas over time. Consider adding the lesson question to the handout before making copies to reduce the writing burden for students." (Lesson 2, Teacher Guide) Because this can be done by individual students or as a class, students may not have enough guidance to interpret their own progress in relation to both the instructional materials (e.g., the activity) or understand the learning objectives in a grade-appropriate way.

Suggestions for Improvement

- Consider scoring guidance for the optional extension summative assessment, Sculpture Prediction.
- Consider additional ways for students to interpret their progress and ensure they understand their learning targets.

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 the materials containing the tasks or items for measuring student learning are sensitive to the variety of students in the nation's classrooms. The materials provide ways for students to understand the phenomena involved in the transfer tasks, regardless of prior knowledge/experience. Most formative tasks have more than one option for showing understanding, or may include scaffolding, such as sentence starters to help students for whom written or oral language is a barrier. In most formative tasks, there are instructions for allowing multiple modalities of student work.

The summative assessments contain grade-appropriate text volume and vocabulary. These tasks are also frequently accompanied by graphics or videos to help students express their understanding of the content.

- Lesson 8, Synthesize Section, Step 3:" Apply ideas about force and motion to show learning. Display slide D and handout either Art Exhibit or Game Play. Use the introduction on the slide and handout to prepare students to complete the task. Additional slides are provided to support the art exhibit task." (Lesson 8, Teacher Guide) A visual is provided to students before they begin the assessment task.
- Lesson 8, Game Play Student Assessment, contains several graphics to assist students in applying their knowledge in a different scenario.
- Class informational texts are read aloud, ensuring reading level is not a barrier. The books also include both text and photos.
- Lesson 10, Connect Step 4: "Display slide O to introduce students to a new artist the class will read about (pp. 19-22). Introduce Panayiotis Vassilakis, also known as Takis. Prepare students to listen for evidence of how Takis used science ideas in his art. As you read, ask students to share ideas about what they are noticing and wondering about the magnetic art. Use the prompts in the book to guide the discussion. Probe students for their ideas about how Takis uses science in the art." (Lesson 10, Teacher Guide)

- Lesson 14, Connect Section, Step 2 includes a video and newspaper article to introduce the task: "Introduce adaptive clothing. Motivate this assessment by reading aloud the newspaper article, Adaptive Clothing is Fashion Forward, to elicit student ideas for how a design solution like adaptive clothing may make getting dressed easier for a wide range of people.Read aloud the newspaper article to introduce how magnets are used in adaptive clothing to help people get dressed and in tools to reach objects. Use the prompts to draw out ideas for how magnets can be used in place of buttons or zipper enclosures to help keep something closed or put it on more easily. After reading the article, use slide C to show videos of how magnets are used in clothing or navigate to a clothing website to look at different clothes that use magnets." (Lesson 14, Teacher Guide)

The materials support success for all students.

- Lesson 2, Explore Section, Broadening Access Callout Box: "For a student who might be struggling to get a balanced sculpture after several attempts, suggest: Since there are several of you, you might try to work together to either hold the ruler on the center point or to place the objects on each side at the same time. Or consider giving the student(s) a larger block to balance with or change the positioning of the block to be lower to the ground. For a student who might master the two-level sculpture quickly, add an additional challenge to try to add more levels to the sculpture similar to the anchoring phenomenon sculpture from lesson 1. Encourage the student to observe and write down what is challenging about building an even taller sculpture" (Lesson 2, Teacher Guide).
- Lesson 3, Explore Section, Step 3: "Pass out Sculptures with Different Objects and display slide D. Read aloud the Investigation Procedures on the slide. Then, as a class, identify the class object in each of the bins and find its weight using a digital scale. Have the class write down the weight on their handout." Reading aloud the investigation procedures supports students' success (Lesson 3, Teacher Guide)
- Lesson 7, Navigate Section, Community Connections Callout Box: "Consider letting students bring some of their own materials for their design in the next lesson. This can allow students to design unique and interesting balance sculptures that may have culturally- or locally-relevant themes. In the interest of access and equity, ask them to bring materials they could share with 3-4 other students if available." (Lesson 7, Teacher Guide)
- Lesson 12, Navigate Section, Step 7: "If you decide to let students bring some of their own materials for their design in the next lesson, be sure to remind them now... In the interest of equity, ask them to bring materials that they could share with 3-4 other students if possible." (Lesson 12, Teacher Guide).
- Lesson 14, Connect Section, Broadening Access Callout Box: "Adaptive clothing is designed for many people, such as people with disabilities, the elderly, someone with limb differences or limb injury, or anyone who might struggle to get dressed on their own. Some students might recall experiences with this as their caregivers helped them button, zip, or snap their clothes until they were able to do it on their own. Some students might have disabilities or other circumstances that currently affect their ability to get dressed on their own. A note about the word "disability": The words disability and disabled carry a great deal of stigma in our society, but they are neutral words associated with the rights and protections provided by laws such as the Americans with Disabilities Act (ADA) and the Individuals with Disabilities Education Act (IDEA). Disability is the term preferred by adults who are fighting for disability rights." (Lesson 14, Teacher Guide)

The expectations for formative and summative tasks are communicated and the formative tasks have a structured variety in the modalities expected for student response. The summative task materials do not explicitly provide students with a choice of responses across multiple modalities. It is implied that the teacher will offer students a choice of modalities. Examples include,

- Lesson 3, Explore Section, Broadening Access Callout Box: "In small groups and one-on-one, encourage students to also communicate their observations and ideas using words and gestures. A student might be able to show you how they add multiple objects to one side to balance the sculpture and/or they can place the objects onto the scale to demonstrate how they found equal weight." (Lesson 3, Teacher Guide)
- Lesson 5, Explore Section, Broadening Access Callout Box: "Invite students to share their learning across multiple modalities. They can write and/or draw on the handout, verbally share, and/or use gestures and materials to show how they were able to balance the hanging sculpture. This allows students to share the full range of their thinking and will provide more rich information for their peers to build on, as well as for teacher feedback and adjusting instruction." (Lesson 5, Teacher Guide)
- Lesson 8, Synthesize Section, Broadening Access Callout Box: "Provide opportunities, as needed, for students to communicate their ideas through words, pictures, verbally, or using gestures. Consider alternative formats, such as creating a short video to demonstrate learning about forces and motions. These options allow for multiple means of action or expression. Encourage students to use the Our Growing Ideas chart to help them think about questions on the assessments. Additionally consider alternate formats for the art gallery, such as a virtual gallery with videos of each artist talking about how their sculpture works. Or, give "art gallery" visitors a series of questions to ask the artists as they visit the art exhibit. Students can prepare answers ahead of time with teacher support or answer the questions using a modality that is most comfortable to them." (Lesson 8, Teacher Guide) While this suggestion gives students the opportunity to choose their responses across modalities, if students complete the Game Play assessment, teachers are not given any suggestions for students' choice of responses across modalities.
- Lesson 13, Connect Section, Broadening Access Callout Box: "Provide opportunities, as needed, for students to communicate their ideas through words, pictures, verbally, or using gestures. Consider alternative formats, such as creating a short video to demonstrate learning about forces and motions using noncontact forces (e.g., magnets). These options allow for multiple means of action or expression. Encourage students to use the Our Growing Ideas chart to help them think about questions on the assessments. Additionally consider alternate formats for the art gallery, such as a virtual gallery with videos of each artist talking about how their sculpture works. Or, give "art gallery" visitors a series of questions to ask the artists as they visit the art exhibit. Students can prepare answers ahead of time with teacher support or answer the questions using a modality that is most comfortable to them." (Lesson 13, Teacher Guide). Although there are suggestions for student choice of responses across multiple modalities, the "art gallery" is a suggestion as an alternate format. If teachers do not set up the art gallery, students are more limited across multiple modalities for this summative assessment.
- Lesson 14, Synthesize Section, Broadening Access Callout Box:" Provide opportunities, as needed, for students to communicate their ideas through words, pictures, verbally, or using gestures. Have magnets available for students who may need to check their thinking about how it could work in their design. Or, a student may want to show how their design works using magnets. Encourage students to use the Our Growing Ideas chart and the A Successful Sculpture Will chart to help them think about the steps in the transfer task." (Lesson 14, Teacher Guide)

Suggestions for Improvement: NA

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 assessments within the unit, including pre-, formative, summative, and self-assessments that create a system that works together to measure the intended student learning across the materials. The unit assessments are designed to lead from one to the next, culminating in assessment of a performance expectation.

Each lesson has an identified Three-Dimensional Learning Goal that is explicitly aligned with the Lesson Assessment Guidance. For example:

- Lesson 3, the three-dimensional learning objective is to make observations and measurements to find the weight of an object or group of objects (cause) that will balance a sculpture with a centered balance point (effect).
- Lesson 3, Lesson Assessment Guidance: "Where to check for understanding: As students build and capture their thinking on Sculptures with Different Objects and during the whole class Synthesize as new ideas are added to Our Growing Ideas chart. What to look and listen for: Observations and measurements that equal weight (a force) must be on either side of the sculpture to cause it to balance. Observations and measurements that objects of different sizes, shapes, and weights can be used as long as the objects on either side add up to the same weight. Weight is the pull on an object to the ground. Heavier objects weigh more and have a stronger pull; lighter objects weigh less and have less pull. When a sculpture is heavier on one side, it causes it to fall over (effect)." (Lesson 3, Teacher Guide)
- Lesson 5, the three-dimensional learning objective is to design and build a hanging sculpture to test and explain how it can remain balanced even with multiple forces acting on it.
- Lesson 5, Lesson Assessment Guidance: "Where to check for understanding: During the Explore as students plan, build, and test their hanging sculpture using Hanging sculptures. During the Synthesize when individuals use a model to show multiple forces acting upon their hanging sculpture. What to look and listen for: When building and testing design, the total weight on either side of the balanced hanging sculpture must be equal to cause it to balance. A model of multiple forces acting on the hanging balanced sculpture including a force pulling upward at the balance point. The upward force is just as strong as the total weight pulling down, which causes the sculpture to stay up and not fall down." (Lesson 5, Teacher Guide)

The materials contain pre-, formative, summative, and self-assessments.

Pre-Assessment

- The Forces and Interactions Assessment System Overview document: "As students engage in these lessons, there are multiple opportunities to gather pre-assessment evidence. This evidence can be used to determine what incoming ideas, experiences, and sensemaking strategies students bring to the unit. All ideas and experiences should be invited into the classroom and be considered as resources to support students' ongoing sensemaking. These opportunities should not be used to assign a score or a grade."
- Pre-assessment opportunities are included in Lessons 1 and 9.
- Lesson 1 Lesson Assessment Guidance reminds teachers what 3-dimensional task students will do ("1.A Develop a diagram and simple sculpture to share initial ideas for what causes the sculpture to balance or balance and move.), gives suggestions about what to look and listen for (Assessment type: Pre-assessment

Where to check for understanding: As small groups diagram their initial sculpture using Group Sculpture: Build an Example and share Initial Ideas aloud. What to look and listen for: Accept all student ideas, but the following are examples of ones that may be shared."), and offers ideas for following up ("This is a pre-assessment opportunity (aligned to 3-PS2-1 and 3-PS2-2). Do not take a grade or score. Use this information in subsequent lessons to build upon students' incoming ideas about balance, movement, weight, and other factors that might help the sculptures balance and/or move. Encourage students to add symbols and words so their diagram explains the sculpture to others (not simply drawing it). This is students' first attempt to develop a model. Focus on helping them practice modeling before labeling it with a term. If a student needs support using cause-and-effect ideas, demonstrate how to reframe an idea by revoicing it in the following way, "If we did _____, then ____ was the result." When a student uses terms or ideas, like 'stable', "unstable", "weight", or "equal distance," probe what they mean by the words or ideas. There is no need to define terms or come to a consensus on ideas in this first lesson. However, it is helpful to gauge their initial understanding of these terms to build on those ideas in subsequent lessons.")

Formative Assessment

Formative Assessment opportunities are called out in yellow boxes in each lesson at the point in the lesson where they occur.

- Lesson 6, Explore Section, Step 3: "Small group discussions provide an opportunity to collect evidence toward learning goal 6 with the purpose of supporting how students are thinking about predictable types of motion. Circulate among groups as they carry out the investigations and observe how they are controlling their investigations and describing their observations of motion. Listen to how they are talking about the forces in a still sculpture, forces that cause movement, and whether they claim that the balance point causes movement. Use Following Student Sensemaking (Lessons 6-7) to record evidence of student thinking. Refer to the Assessment Guidance at the beginning of the lesson." (Lesson 6, Teacher Guide)
- Following Student Sensemaking Lessons 2 - 5, and Following Student Sensemaking Lessons 10-12, offer teachers a way to record informal noticings about each individual student's performance on lesson-level three dimensional learning goals. For example, Lesson 10's learning goal is "10 Ask questions to investigate cause and effect relationships related to forces between two magnets." and the Following Student Sensemaking Lesson 10-12 sheet has an entry for "Ask questions to investigate how A. like sides cause pushing apart, unlike sides cause pulling together." (Lesson 10)

Summative Assessment

Summative assessment opportunities are identified in lessons 8, 10-12, 13, and 14.

- The summative assessments in Lessons 8, 13, and 14 are related to the lesson progression Learning Goals and to grade-level Performance Indicators. For example, Lesson 13's Learning Goal is "13 Define a simple design challenge that can be solved by applying scientific ideas about magnets to cause balance and/or movement." which relates directly to 3-PS2-4, "Define a simple design problem that can be solved by applying scientific ideas about magnets. 3-PS2-4". In Student Assessment Explaining My Sculpture, student apply science ideas about magnets to define and solve a design problem involving balance and/or movement of a hovering sculpture: "How do magnetic forces interact on your sculpture to cause it to stay still and not fall over or move in an interesting way?"

Self Assessment

Self-Reflection opportunities are identified in lessons 4, 6, 8, 10, and 14.

- The Forces and Interactions Assessment Overview: "These lessons provide opportunities to support students in reflecting on their own learning and sensemaking. These opportunities allow students to take ownership of their learning and use their reflections to guide future sensemaking. There are embedded

self-reflections in lessons 4, 6, 8, 10, and 14 to offer an opportunity for students to consider their own progress in planning and carrying out investigations, asking questions, working as a group, and engaging in engineering design, with the purpose of helping them celebrate what went well and communicate when they need help or more practice."

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

- The "Forces and Interactions Assessment System Overview" describes the rationale and flow of the assessment system. It also describes the lesson learning goals, assessment types, purposes, and locations for each assessment throughout the unit. The document also contains information on what to look and listen for with each assessment.
- Each lesson plan includes a "Lesson Assessment Guidance" section, which echoes the information from the Overview about the Learning Goal, type and location of assessment, and what to look and listen for. This section also adds a "How Can I Use This Assessment Information?" column to help the teacher know how they might use their collected data to inform or change instruction for individuals or the whole class.
    - Lesson 11 Teacher Guide, Assessment Guidance, "How can I use this assessment information?... If a student needs extra support collecting data, consider having one set up for demonstration purposes. As you demonstrate the investigation, have the student watch closely how to hold the ruler, collect the data from the screen on the digital scale, and record the data on the handout. If a student needs extra support interpreting the data, ask questions such as: Is the force measured by the scale getting bigger or smaller? How would you describe a bigger force - as stronger or weaker? Encourage students to use ideas about stronger and weaker forces from earlier in the unit as they consider the stronger and weaker forces here. For example, students may want to represent stronger forces with longer arrows and weaker forces with shorter arrows. If students do not readily come up with this idea, remind them of how they used arrows earlier in the unit to represent different sizes of force." (Lesson 11, Lesson Assessment Guidance)

Suggestions for Improvement: NA

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 unit has multiple opportunities for students to demonstrate increased proficiency in practices related to targeted learning objectives. Assessment opportunities are coherent and interconnected. However, evidence of students having opportunities to receive peer feedback focused on improving their performance for all key claimed learning in each of the three dimensions was not present.

The materials have multiple, interconnected opportunities for students to demonstrate their progress to proficiency over time. For example, students build toward 3-PS2-1 "Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object." as seen in:

Lesson 3, Learning Goal 2: "Make observations and measurements to find the weight of an object or group of objects (cause) that will balance a sculpture with a centered balance point (effect)." (Lesson 3, Teacher Guide)

- Lesson 3, Explore Section, Formative Assessment Opportunity: "This is the first opportunity to formatively assess learning goal 3 with the purpose of determining how students are able to make observations and measurements related to their sculpture designs and/or how they are thinking about weight as a force on either side of their sculpture. Use the small group, one-on-one discussions, and Sculptures with Different Objects to collectively and individually assess students' ideas about the cause-and-effect relationship between weight and whether the sculpture balances or not." (Lesson 3, Teacher Guide)

Lesson 5, Learning Goal 5:"Design and build a hanging sculpture to test and explain how it can remain balanced even with multiple forces acting on it." (Lesson 5, Teacher Guide)

- Lesson 5, Explore Section, Formative Assessment Opportunity: "This is a moment to formatively assess progress toward learning goal 5 with the purpose of determining how well a student understands how to balance the downward forces of the hanging mobile. If a student struggles to balance the mobile (by keeping the support bar mostly level), ask the student how they could balance the previous sculptures using rulers and blocks. Encourage the student to consider how they might add the total weight on either side of the balance point to cause the sculpture to balance. Use Following Student Sensemaking (Lessons 2-5) to track evidence of student ideas. Refer to the Assessment Guidance at the beginning of the lesson." (Lesson 5, Teacher Guide)

Lesson 7, Learning Goal 7:"Plan and conduct an investigation to uncover the patterns in an object's motion (effect) caused by unbalanced forces, and predict future movement based on patterns of change (effect)." (Lesson 7, Teacher Guide)

- Lesson 7, Synthesize Section, Formative Assessment Opportunity:" This individual work is your first assessment opportunity for learning goal 7 with the purpose of determining how well students understand the forces acting on the sculpture at both rest and with a change in motion. Walk around and check to see whether students are including the balance point shape, arrows to show upward and downward forces, and an arrow to show the extra force direction and strength. Collect these handouts at the end of class to check for student understanding and use Following Student Sensemaking (Lessons 6-7) to track additional evidence of student learning for the unit. Encourage students to use words and symbols on the handout, and also offer up the option to verbally and with gestures provide an if/then statement. Refer to the Assessment Guidance at the beginning of the lesson." (Lesson 7, Teacher Guide)

Lesson 9, Learning Goal 9.B: "Ask questions that can be investigated about what causes sculptures to balance and move with magnets and metals." (Lesson 9, Teacher Guide)

- Lesson 9, Synthesize Section, Formative Assessment Opportunity: "Adding to the Driving Question Board is your assessment moment for learning goal 9.B with the purpose of gauging student progress on asking testable questions or questions that can be investigated to explore cause and effect relationships. Accept all questions, but look to see if a student is using the cause and effect question frames or asking other kinds of open-ended, investigable questions. Do not make students change their questions. Instead, pay attention to the patterns in the kinds of questions they ask. Identify 1-2 questions that are not testable questions or perhaps are testable, but would lead to a close-ended yes/no answer." (Lesson 9, Teacher Guide)

Lesson 12, Learning Goal 12: "Make observations that pull forces exist between magnets and some (patterns) metals, and they can hover when equal forces are pulling up and down on the metal." (Lesson 12, Teacher Guide)

- Lesson 12, Explore Section, Formative Assessment Opportunity: "Use Magnets and Metals and the small group discussions to assess progress toward learning goal 12 with the purpose of providing feedback to students about their thinking in regards to how magnets interact with other objects. Review students' ideas on Magnets and Metals to see if they are finding evidence that magnets attract some metals. Look for how students are representing forces in their models to help you follow up on ideas during the discussion." (Lesson 12, Teacher Guide)

Students have multiple interconnected opportunities over time. They create the class "A successful sculpture Will…" chart, which they revisit in many lessons and revise multiple times to track their learning over time.

- Lesson 4, Navigate Section, Step 1: "Ask students how they would modify the A Successful Sculpture Will chart to have a new need to make a sculpture balance like the image on slide A. Students might say to make it oddly balanced, off-centered and balanced, or asymmetrical. Add a new sub-criteria idea to the A Successful Sculpture Will chart to capture an off-centered design as a way to make it more playful or puzzling." (Lesson 4, Teacher Edition)
- Lesson 7, Explore Section, Step 4: "Update the A Successful Sculpture Will chart to include any new ideas. Ask students what the sculpture would need to do to work and what their designs are limited by. Encourage students to consider the materials available as they consider the new limitations. Record any new student ideas on the A Successful Sculpture Will chart." (Lesson 7, Teacher Edition)
- Lesson 13, Synthesize Section, Step 3:" Remind students that when they designed Category A and B sculptures, they had to outline the goal. Add to the A Successful Sculpture Will chart or create a new one." (Lesson 13, Teacher Edition)

The materials contain opportunities for teacher and peer feedback. Peer feedback is claimed in Lessons 8, 13, and 14. While the materials provide a "Giving and Receiving Feedback" guide document for students, the feedback document is not lesson-specific. While this document includes a generic format for giving and receiving feedback, it does not guide students about what they are looking for or how to tell if their peer's work is related to the learning targets.

- Lesson 8 Synthesize step 3: "As students finish either task, use this as an opportunity for students to practice giving and receiving feedback on either their sculptures or their ideas for how the games work. Pass out Giving and Receiving Feedback and read aloud as a class the suggestions for how to give and receive feedback. Then, in partners, let students practice giving feedback to one another and then revising their own thinking based on the feedback." The Community Connections Callout Box in that section offers a purpose for peer feedback: "Connect back to the Classroom Agreements and emphasize "we let our ideas change and grow." Tell students that peer feedback is a way to get some extra help on our work and improve what we have figured out." (Lesson 8, Teacher Guide) The peer feedback statements are general and students are not prompted to provide feedback on the learning targets.
- Lesson 13 Synthesize step 4: "Students' use of the Peer Feedback with the purpose of supporting them in giving and receiving feedback on their sculptures and the models to explain them. Remind students to use the class's Our Growing Ideas chart to support the feedback they give. Students will have an opportunity to use the feedback to clarify their ideas as they write an explanation using "Explaining My Sculpture." (Lesson 13, Teacher Guide) The peer feedback statements are general and students are not prompted to provide feedback on the learning targets.
- Lesson 14 Synthesize step 4: "Optional: Students can create a public service announcement, advertisement, or poster to communicate about their design using science ideas they figured out about magnets. Have students present their designs to one another using Peer Feedback to give and receive feedback on their design." (Lesson 14, Teacher Guide) This peer feedback is optional.

In each lesson, opportunities for teacher feedback are included in the "How can I use this assessment information?" section of the Lesson Assessment Guidance. For example,

- Lesson 10: "How can I use this assessment information?: "To support a student in writing questions, ask them first what effect they want to observe. For example, they may want to observe the magnets pushing apart or pulling together. Then have them identify a change they want to test, like putting their book between the two magnets. After they articulate these two parts, have them pick the question frame that best matches their thinking (e.g., If we put a book between the like sides of two magnets, can we still get a push?)." (Lesson 10, Teacher Guide)
- Lesson 5: "How can I use this assessment information?: "During Explore, if a student struggles to use the same total weight on each side to balance their sculpture, encourage them to weigh all the objects on each side, add up the total weight, and then compare the totals. During Synthesize, if a student misses the upward force in their model, repeat the demonstration with a mobile to think about the force holding it up. Draw arrows to show the force of the weight downward and the force holding the sculpture upward as the students hold the sculptures. Have each student hold the sculpture so that they can feel the upward force from their arm holding up the downward force from the weight of the sculpture. Demonstrate what happens to a hanging sculpture if the string holding it up lets go, and what it takes to get it back up to where it was hanging." (Lesson 5, Teacher Guide)

Suggestions for Improvement

- Consider modifying the Peer Feedback handout to focus on helping students engage with the peer feedback process: specifically, supporting students in giving feedback to their peers to improve student performance for all claimed learning in each of the three dimensions.

CATEGORY RATINGS			Total Score
CATEGORY I: NGSS 3D Design	CATEGORY II: NGSS Instructional Supports	CATEGORY III: Monitoring NGSS Student Progress	
0 1 2 (3)	0 1 2 (3)	0 1 2 (3)	9

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**