EQuIP Rubric for Science

Sun, Moon, & Star Patterns

How and why does what I see in the sky change?

Curriculum Developer: OpenSciEd

GRADE 5 | DECEMBER 2025

nsta
National Science Teaching Association

Category I Rating

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

Score Category I: 3

Category II Rating

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

Score Category II: 3

Category III Rating

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

Score Category III: 3

UNIT 5.4

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

Overall Summary Comments

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

- The lessons work together around a central phenomenon (the observed pattern of the Moon being visible both during the day and at night, while the Sun and stars are visible only during the day and night, respectively) so that students can gain proficiency in all the targeted learning.
- Through the instructional routines in the materials, students have an opportunity in every lesson to build their understanding of grade-appropriate elements of the three dimensions.
- Students use grade-appropriate elements of the three dimensions simultaneously to develop a model to explain shadow directions and lengths, to construct an argument for when the Moon will set if it rises at the same time as the Sun on a given date, to critique arguments about the size and brightness of the Sun, to use patterns from data to support an argument about day and night length, and to evaluate a claim and evidence about patterns of constellations in the sky.
- Mathematical concepts are explicitly incorporated into lessons so that students use them to explain or help understand scientific concepts, phenomena, or results.
- Teachers are supported with strategies to help students make connections between the lessons to ensure sensemaking through integrated learning experiences.
- Student ideas are valued and drive the learning throughout the unit.
- Scaffolding is explicitly reduced over time for use of nearly all SEP elements stated as targeted learning objectives, supporting students to become more independent in their use of the SEP elements over the course of the learning experience. The narrative detailing the intentional reduction of support for the targeted elements of analyzing and interpreting data and arguing from evidence will be helpful for teachers in determining adjustments for their students.
- The unit has a strong, coherent assessment system with multiple opportunities and different types of assessments for students to demonstrate their understanding. Teachers are provided with clear guidance for formal and informal assessments.

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

Criterion II.C: Building Progressions

- Ensure teacher materials explain how prior learning will be built upon at the element level. Consider including a chart that explicitly details the prior learning, at the element level, for each of the dimensions.

Criterion II.E: Differentiated Instruction

- Ensure guidance for teachers to support differentiated instruction by including "[a]ppropriate reading, writing, listening, and/or speaking alternatives (e.g., translations, picture support, graphic organizers, etc.) for students who... read well below grade level." (EQuIP Detailed Guidance, p. 27)

Why are there two colors of text in this report?

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

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

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

CATEGORY I
NGSS 3D Design

I.A. Explaining Phenomena / Designing Solutions

EXTENSIVE

Making sense of phenomena and/or designing solutions to a problem drive student learning.

i. Student questions and prior experiences related to the phenomenon or problem motivate sense-making and/or problem solving.

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

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

The reviewers found **extensive** evidence that making sense of phenomena drives student learning. Materials are organized so that students are figuring out the central phenomenon: the observed pattern of the Moon being visible both during the day and at night, while the Sun and stars are visible only during the day and night, respectively. Student questions and prior experiences related to the phenomenon extensively motivate sensemaking. Students regularly return to the phenomena to add layers of explanation based on learning.

i. Student questions and prior experiences related to the phenomenon or problem motivate sense-making and/or problem-solving.

Student-centered focus on phenomena or problems

- Lesson 1, Connect, Step 1: "Connect to our past experiences skygazing. Display slide B and ask students to close their eyes and think back to a time when they looked up into the sky on a clear day and night. Ask students to recall: What objects did you see in the sky? Where in the sky did you see them?" (Lesson 1, Teacher Guide)
- Lesson 4, Navigate, Step 7: "Problematize the Moon sometimes being in the sky during the day. Display slide J. Point out that our work today has helped us to explain day and night as well as the shadow patterns. Ask students if our work today helps us to explain why the Moon is sometimes in the day sky and other times it is in the night sky. Accept all responses and look for students to suggest that we need to find out more about the Moon." (Lesson 4, Teacher Guide)
- Lesson 9, Connect, Step 2: "Connecting to our experiences. Display slide C. Showing the image of the night sky on the slide, ask students where the objects we just named on the Our Sky Observations chart would be in this image. Accept all answers, and if any students say that we need to know more about the objects to figure that out, use that comment to motivate research about the sky objects. If no students comment on the difficulty, note that it might be hard to tell what's what among all these things in the sky without more information about the objects." (Lesson 9, Teacher Guide)
- Lesson 11, Navigate, Step 5: "Identify star questions that we are still curious about. Display slide M. Celebrate the amount of thinking that students did today. Point to the two constellation cards on the slide that we know have made sense of why the stars are different from one another, but are there other star and constellation questions that we still need to investigate. Look for students to highlight that we still do not know why some stars and constellations are only viewable during certain times of year." (Lesson 11, Teacher Guide)
- Lesson 12, Navigate, Step 1: "Recall our past investigations. Display slide A and call back to the constellations students encountered in our last lesson. Ask students to think about the question on the slide: Why do you think we can only see some constellations during part of the year? Have students turn to a partner and have each person share their ideas. Let students know that it's ok if there are different ideas about why this happens and that we'll try out those ideas as we try to explain why this happens." (Lesson 12, Teacher Guide)

Consistent student-driven learning over time

- Lesson 3, Connect, Step 2: "Connect our experiences with the video observations to motivate the need for data. Display slide C. Ask students to compare the class' observations of the timelapse video and the experiences shared in the Navigate [1]. Then challenge students to use these observations to support predictions about how the sun and shadows will look different a few months from now. The goal of this conversation is to motivate the class' need to analyze shadow data from different times of year." (Lesson 3, Teacher Guide)
- Lesson 8, Navigate, Step 1: "Revisit Our Sky Observations chart to motivate an exploration of ancient observatories. Display slide A and bring students' attention toward the Our Sky Observations chart. Celebrate the amount of work that has gone in to not only identify, but even make sense of the observations." (Lesson 8, Teacher Guide)
- Lesson 9, Navigate, Step 1: "Revisit our Driving Question Board. Display slide A and let the class know we will look back at our Driving Question Board (DQB) to decide if we have answered any of our questions. Gather students around the DQB, and give students a moment to revisit the questions previously asked. Ask whether there are any groups we may want to look at more closely to decide if we have answered any of those questions." (Lesson 9, Teacher Guide)
- Lesson 13, Navigate, Step 1: "Look back on our DQB. Display slide B, read the remaining questions one by one. Ask students to think about if we can fully, partially, or not answer the question being read. If students feel that they can answer the question, place a dot sticker on that sticky note. Display slide C and ask students to record the answers to any of the questions with the dot sticker on them on a sticky note or index card. Place the answers on the DQB near the associated question." (Lesson 13, Teacher Guide)

When multiple phenomena and /or problems are used

- Lesson 1, Connect, Step 4: "Identify related phenomena through community connections. Use slide K to explain to students that we want to find examples of what else we could explain. Distribute the Related Phenomena handout to each student and prompt them to look for or think about sky-related phenomena. Encourage them to record words and/or pictures of the phenomenon that they observe or think about. Have them talk to family or friends about related phenomena and bring their handout back to school for the next lesson." (Lesson 1, Teacher Guide)
- Lesson 4, Connect, Step 4: "Watch the Foucault Pendulum Video. Display slide G. Share with students that there are hundreds of Foucault pendulums around the world. Allow them to watch the video Foucault Pendulum Timelapse of a Foucault pendulum." The Foucault pendulum is presented to support student understanding that the Earth is rotating. (Lesson 4, Teacher Guide)
- Lesson 9, Connect, Step 2: "Connect to our experiences with other space objects. Display slide B and remind students that we came up with a list of objects in the sky in Lesson 1. Display the *Our Sky Observations* chart. Ask students whether there are any objects they would like to add. After giving the class a minute to think individually, have students turn and talk with a partner about their objects. Once students have had the chance to share with a partner, invite participants to share. Follow-up by asking when they have seen it or when someone would see it (day, night, both) if it's an object they know about but have never seen. Capture these additional objects on the *Our Sky Observations* chart. Students may name objects others in the room may not be familiar with; if they do, ask questions like, "Can you tell us more about that?" so everyone in the room has a shared sense of what the object is." (Lesson 9, Teacher Guide)

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

Close match between the phenomena/problems and the student learning objectives throughout the materials

- 5.4 Unit Front Matter, "What is the anchoring phenomenon and why was it chosen? The anchoring phenomenon for this unit is the observed pattern of the Moon being visible both during the day and at night, while the Sun and stars are visible only during the day and night, respectively. Students observe and record additional sky patterns during the first lesson, which will inspire further exploration of night sky objects in the second lesson set." A sample of learning goals from lessons across the unit shows a close match between them and the stated phenomena.
- Lesson 1, Three-Dimensional Learning Goal: "1. Develop a model to describe why sometimes we see the Moon during the day and other times at night using patterns of motion of the Sun, Moon, and stars." (Lesson 1, Teacher Guide)
- Lesson 3, Three-Dimensional Learning Goal: "3. Represent daily changes in shadow data across a year graphically to reveal patterns that can be used to predict how the length of day and night changes, and that the Sun appears to move westward every day." (Lesson 3, Teacher Guide)
- Lesson 5, Three-Dimensional Learning Goal: "5. Analyze Sun and Moon location representations to reveal patterns in how much the Sun's and Moon's daily locations change over the course of a month." (Lesson 5, Teacher Guide)
- Lesson 7, Three-Dimensional Learning Goal: "7. Use evidence to construct an argument that uses observable Moon patterns to support a claim about different positions of the Sun and Moon at different times of the month." (Lesson 7, Teacher Guide)
- Lesson 12, Three-Dimensional Learning Goal: "Develop and use a model to explain patterns in star positions in the sky at different times of year, caused by Earth's orbit around the Sun." (Lesson 12, 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.

When students are designing solutions to problems (with or without connections to ETS DCIs)

- N/A. Engineering is not integrated in this unit.

Criterion-Based Suggestions for Improvement: N/A

I.B. Three Dimensions

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

EXTENSIVE

i. 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.*

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

iii. 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 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/or lesson-level phenomenon.

The unit centers on students using targeted elements from all three dimensions, clearly identified and addressed throughout the unit, to explain the observed pattern in which the Moon is visible both during the day and at night, while the Sun and stars are visible only during the day and night, respectively.

Rating for Criterion: SEP

EXTENSIVE

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

The reviewers found **extensive** evidence that the materials provide opportunities to develop and use specific elements of the SEPs:

- **AQDP-E3: Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. MOD-E1: Identify limitations of models.**
- **MOD-E2: Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.**
- **MOD-E3: Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.**
- **MOD-E4: Develop and/or use models to describe and/or predict phenomena.**
- **MOD-E6: Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.**
- **INV-E2: Evaluate appropriate methods and/or tools for collecting data.**
- **DATA-E1: Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.**

- **DATA-E2: Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.**
- **DATA-E3: Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.**
- **MATH-E1: Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success.**
- **MATH-E2: Organize simple data sets to reveal patterns that suggest relationships.**
- **MATH-E4: Create and/or use graphs and/or charts generated from simple algorithms to compare alternative solutions to an engineering problem.**
- **ARG-E1: Compare and refine arguments based on an evaluation of the evidence presented.**
- **ARG-E3: Respectfully provide and receive critiques from peers about a proposed procedure, explanation or model by citing relevant evidence and posing specific questions.**
- **ARG-E4: Construct and/or support an argument with evidence, data, and/or a model.**
- **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.**

The SEPs focus on grade-appropriate elements, and students are supported in developing deep competence in specific elements that can be applied across more than one context.

AQDP: Asking Questions and Defining Problems

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, 5, 9, and 13. Evidence was found in claimed lessons, examples include

- Lesson 1, Navigate, Step 6: "Write our questions about the sun, moon, and stars. Display slide T." (Lesson 1, Teacher Guide)
- Lesson 5, Navigate, Step 6: "Use our questions about the daily and monthly Moon patterns to motivate where to go next. Display slide N. Note that the class has made some initial observations about how the Moon seems to move differently than the Sun. Leverage the questions we have wondered about to "why the Moon's moving differently than the Sun?" and "why does the Moon have a monthly cycle?" Determining with students that we should figure out if there are other interactions happening that could help us explain how these phenomena happen." (Lesson 5, Teacher Guide)
- Lesson 9, Navigate, Step 1: "Ask whether there are any groups of questions we are still wondering about. Point out that we have questions still about some other objects in the sky. Refer to the Ideas for Investigation chart, and ask students to turn and talk about whether these types of investigations would help the class to answer these questions." (Lesson 9, Teacher Guide)
- Lesson 13, Explore, Slide D: "This bar graph shows the months when different constellations are visible. What patterns do you notice in this bar graph? What patterns make you curious to investigate further?" (Lesson 13, Teacher Guide)

MOD: Developing and Using Models

Claimed Element: **MOD-E1: Identify limitations of models.**

Claimed in Lessons 4. Evidence was found in claimed lesson, examples include

- Lesson 4, Explore, Step 3: "Motivate the need for more evidence. Display slide I and use the prompts to elevate the limitations of our model and help motivate looking for more evidence." (Teacher Guide)

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 13. Evidence was found in claimed lesson, examples include

- Lesson 13, Synthesize, Slide F: "Let's use our model to explain: Why is *First Slender One* and *Rabbit Tracks* seen during different times of year? Which type(s) of motion cause us to see these different constellations at different times of year?" (Lesson 13, Slides)

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

Claimed in Lesson 6. Evidence was found in claimed lesson, examples include

- Lesson 6, Explore, Step 2: "Develop a physical model for explaining the Moon's monthly patterns while in a Scientist's Circle. Invite the students to form a Scientist's Circle. Make sure they bring Sun and Moon Data Cards. Display slide C and start developing a physical model of the Sun-Earth-Moon for Day 0 using the following prompts:" (Lesson 6, Teacher Guide)

Claimed Element: **MOD-E4: Develop and/or use models to describe and/or predict phenomena.**

Claimed in Lesson 1. Evidence was found in claimed lessons, examples include

- Lesson 1, Synthesize, Step 5: "Model our initial ideas about the sun-moon-star system. Display slide O. Give students 10 minutes to create their initial model." (Lesson 1, Teacher Guide)

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 Lesson 12. Evidence was found in claimed lessons, examples include

- Lesson 12, Explore, Slide F: "Show how the parts of the system might interact causing us to only see some constellations during part of the year. In your small group, discuss: Where might each of the sky objects be? How would those position affect what could be seen in the sky?" (Lesson 12, Slides)

INV: Planning and Carrying Out Investigations

Claimed Element: **INV-E2: Evaluate appropriate methods and/or tools for collecting data.**

Claimed in Lesson 2. Evidence was found in claimed lesson, examples include

- Lesson 2, Explore, Step 3: "Display slide E and pair up groups that will be evaluating each other's investigation designs. Inform groups that they can present their drawings or the actual device. As groups describe their design, the evaluating

group should think about the following questions: What is similar and different between the two procedures? How well does the other procedure address our Sun Tracking Considerations?" (Lesson 2, 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 Lessons 3, 8, 9, and 11. Evidence was found in claimed lessons, examples include

- Lesson 3, Explore, Step 3: "After the class has had a chance to share out some of the patterns that were revealed in the data, ask students to consider how the process of identifying patterns went and problematize new ways of representing the data that might help reveal patterns in shadow length." (Lesson 3, Teacher Guide)
- Lesson 8, Student Materials, Handout 2: "Use CODAP: Lesson 8 Link, to build a line graph comparing all three locations' hours of sunlight over a single year. Draw and label what you and your partner's graph in the space provided." (Lesson 8, 5.4 Lesson 8 Handout 2 Hours of Daylight)
- Lesson 9, Synthesize, Step 4: "Set a timer or announce time remaining occasionally as groups work. As groups create their line plots, circulate and ask them clarifying questions about their scales and how they're making decisions about where to place different objects." (Lesson 9, Teacher Guide)
- Lesson 11, Explore, Step 3: "Option 1 - Revealing patterns in star data using a data table. Display slide G and distribute Star Size, Distance and Brightness Data Table to each student. Have partners analyze parts of the data table by circling the largest and smallest values in different columns. After students have done the analysis, they should discuss whether any of the patterns might help us figure out how the Sun compares to other stars. Option 2 - Revealing patterns in star data using a line plot. Display slide H and distribute Star Line Plots and an internet-connected device to each student. Have partners analyze parts of the data table by circling the largest and smallest values in different columns. After students have done the analysis, they should discuss whether any of the patterns might help us figure out how the Sun compares to other stars." (Lesson 11, Teacher Guide)

Claimed Element: **DATA-E2: Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.**

Claimed in Lessons 5, 8, 10, and 13. Evidence was found in claimed lessons, examples include

- Lesson 5, Explore, Step 4: "Carry out Sun and Moon Tracking Investigation. Display slide K and distribute Tracking the Sun and Moon. Have students record the example algorithm (or other chosen subtraction method) on Page 1. Then distribute Sun and Moon Data Cards to each group. You can also provide scratch paper or grid paper for students to complete their calculations. Give groups enough time to calculate and organize their data using the data table on Page 2. After groups have finished organizing their distance data, have them analyze their data by discussing the prompt on the slide and at the bottom of Page 2 of Tracking the Sun and Moon." (Lesson 5, Teacher Guide)
- Lesson 8, Explore, Step 3: "Make observations and analyze day and night data for one location. Display slide D and divide the class into groups of four students. Assign each group by distributing enough copies of Bighorn Mountains Medicine Wheel, Chaco Canyon Kivas, or Uaxactun E-Groups to each member of the group. Guide students to examine both the site description and the local day-and-night data. Encourage them to look for patterns connecting what the observatory tracks to concepts explored earlier in the unit. For the data table, suggest that each group member focus on a single column. As they review, they should identify and circle the longest and shortest lengths or the earliest and latest times." (Lesson 8, Teacher Guide)

- Lesson 10, Explore, Step 2: "Facilitate a Building Understandings discussion of the line plot data. Bring students back together and display slide C. Guide students to discuss the patterns they recorded on their handouts using the following prompts. As students share, group sticky notes with the names of the space objects Space Object Classifications chart. See an example on slide C." (Lesson 10, Teacher Guide)
- Lesson 13, Explore, Step 2: "Describe the patterns that are revealed by analyzing a bar graph. Display slide D and ask students to discuss what they notice about the bar graph on the board. After a few moments, ask students to share what their partner said. As students share these patterns, add them to the Our Sky Observations chart." (Lesson 13, Teacher Guide)

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 2 and 10. Evidence was found in claimed lessons, examples include

- Lesson 2, Synthesize, Step 4: Analyzing and Interpreting Data callout: "This is an opportunity to intentionally develop the practice of Analyzing and Interpreting Data. Each group's Sun Tracker setup will have small differences, leading to variations in their measured shadow lengths. The goal of this discussion is to identify the similar patterns in each group's data, but acknowledging the differences is also an important moment. This type of analysis will help in Lessons 3 and 8, where data sets also show both similarities and differences. In all three of these lessons, the variations in data collection are acknowledged, but the sensemaking focuses on patterns that remain consistent across all locations, times, or setups." (Lesson 2, Teacher Guide).
- Lesson 10, Explore, Step 2: "Lead students in a gallery tour of the line plot data. Organize students into pairs and distribute Comparing Line Plot Data to each set of partners. Display slide B. Explain that students will be taking a tour of the line plots across the classroom. As they tour the data with a partner, they should use the prompts on the handout to help them to notice patterns and generate questions about their observations. Read the prompts aloud on slide B before having students begin. Explain that when students are finished with the tour, they will discuss their observations as a class. Provide students with time to make observations and complete the handout with a partner." (Lesson 10, Teacher Guide)

MATH: Using Mathematics and Computational Thinking

Claimed Element: **MATH-E1: Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success.**

Claimed in Lesson 11. Evidence was found in claimed lesson, examples include

- Lesson 11, Explore, Slide F: "Scientists have used different tools to measure the size, distance, and brightness of stars to compare them. Which would be better for seeing difference between stars: a data table or graph? Why?" (Lesson 11, Slides)

Claimed Element: **MATH-E2: Organize simple data sets to reveal patterns that suggest relationships.**

Claimed in Lessons 2. Evidence was found in claimed lesson, examples include

- Lesson 2, Synthesize, Step 4: "As the class comes to consensus on how to organize and represent their data, record these entries on the Organized Shadow Data chart." (Lesson 2, Teacher Guide)

Claimed Element: **MATH-E4: Create and/or use graphs and/or charts generated from simple algorithms to compare alternative solutions to an engineering problem.**

Claimed in Lessons 5 and 11. Evidence was found in claimed lessons, examples include

- Lesson 5, Explore, Step 4: "Carry out Sun and Moon Tracking Investigation. Display slide K and distribute Tracking the Sun and Moon. Have students record the example algorithm (or other chosen subtraction method) on Page 1. Then distribute Sun and Moon Data Cards to each group. You can also provide scratch paper or grid paper for students to complete their calculations. Give groups enough time to calculate and organize their data using the data table on Page 2. After groups have finished organizing their distance data, have them analyze their data by discussing the prompt on the slide and at the bottom of Page 2 of Tracking the Sun and Moon." (Lesson 5, Teacher Guide)
- Lesson 11, Explore, Step 2: "Option 2 - Revealing patterns in star data using a line plot. Display slide H and distribute Star Line Plots and an internet-connected device to each student. Have partners analyze parts of the data table by circling the largest and smallest values in different columns. After students have done the analysis, they should discuss whether any of the patterns might help us figure out how the Sun compares to other stars." (Lesson 11, Teacher Guide)

ARG: Engaging in Argument from Evidence

Claimed Element: **ARG-E1: Compare and refine arguments based on an evaluation of the evidence presented.**

Claimed in Lessons 7 and 11. Evidence was found in claimed lessons, examples include

- Lesson 7, Student Materials, Handout 2: "Part 1: Compare Argument Claims What is similar and different between your group's argument claim and your partner group's argument claim?" (Lesson 7, 5.4 Lesson 7 Handout 2 Peer Review and)
- Lesson 11, Student Materials, Handout 4: "Revise one of the arguments above to make the argument and evidence more accurate and connected." (Lesson 11. 5.4 Lesson 11 Handout 4 Critiquing Arguments about)

Claimed Element: **ARG-E3: Respectfully provide and receive critiques from peers about a proposed procedure, explanation or model by citing relevant evidence and posing specific questions.**

Claimed in Lessons 7, 10, 11. Evidence was found in claimed lessons, examples include

- Lesson 7, Student Materials, Handout 2: "Evaluate evidence for connectedness. Evaluate how well your partner group's evidence connects to their argument. Look to see that your partner group's evidence explains how or why it took so long for the Moon to set while the sun is rising. Use "I wonder" statements to explore anything that seems disconnected in the evidence." (Lesson 7, 5.4 Lesson 7 Handout 2 Peer Review)
- Lesson 10, Synthesize, Step 3: "Lead students in critiquing arguments using evidence. Recall that in Lesson 7, students wrote and evaluated arguments about the Moon's position in the sky. They evaluated arguments based on whether the argument was accurate, clear, and connected. They will use the same criteria to evaluate arguments about Jupiter that have already been written. Explain that by evaluating whether the argument is accurate, connected, and clear, they will be able to respectfully critique (or point out incorrect components) the arguments." (Lesson 10, Teacher Guide)

- Lesson 11, Synthesize, Step 5: "Give and receive peer feedback. After students complete their revised argument, display slide O and have students share their revised arguments with a partner. Remind students of the checklist on the slide: they should look for accurate and connected claims and evidence, and use questions and/or "I wonder..." statements to provide feedback based on evidence. After sharing feedback, provide students time to revise their own arguments using a different color so you can see the changes they chose to make." (Lesson 11, Teacher Guide)

Claimed Element: **ARG-E4: Construct and/or support an argument with evidence, data, and/or a model.**

Claimed in Lessons 4, 6, 7, 8, 10, 11, and 13. Evidence was found in claimed lessons, examples include

- Lesson 4, Synthesize, Step 5: "Share an explanation with a partner. Display slide O and have students turn and talk using the prompts on the slide, referring to their Earth-Sun Model Observations handout as needed. After 2-3 minutes, bring students together and use the prompts below to support students in using evidence to support claims about why the Sun appears to move westward every day. Have the materials from the investigation, including the globe, meeple, and flashlight, available in the middle of the Scientist's Circle for students to use as they share their ideas." (Lesson 4, Teacher Guide)
- Lesson 6, Student Materials, Handout 1: "Use evidence from our models to argue what time and day of the Moon's cycle you'd expect the sky to appear like it does in the image below." (Lesson 6, 5.4 Lesson 6 Handout 1 Sun-Earth-Moon Argument)
- Lesson 7, Student Materials, Handout 1: "Construct an argument. On October 30th, the Moon will rise in the East at the same time as the Sun. How long will it take before the Moon starts setting when the Sun is rising? How do you know? Use evidence from what you've learned about the Moon to explain your thinking. You may explain your thinking in words, drawings, tables, or another way." (Lesson 7, 5.4 Lesson 7 Handout 1 Arguing from Evidence)
- Lesson 8, Student Materials, Student Assessment: "Do the patterns show whether all these communities had the shortest or longest NIGHT on the same day? Support your argument with patterns revealed in the line graph and earlier data tables." (Lesson 8, 5.4 Lesson 8 Student Assessment 1 Day and Night)
- Lesson 10, Synthesize, Step 4: "Guide students in constructing arguments. Display slide H. Direct students to part 2 of Constructing Arguments about the Sun. Ask students to examine the evidence they wrote in part 1 of the handout to consider whether the Sun can be accurately classified as a star. Lead the class in a discussion using the following prompt." (Lesson 10, Teacher Guide)
- Lesson 11, Synthesize, Step 4: "Critique arguments for why the Sun looks different than other stars. Display slide L and distribute Critiquing Arguments about the Sun to each student. Ask the students to evaluate the two arguments for why the Sun looks different from the other stars. After critiquing the arguments, students should pick one to revise using the patterns they discussed today. Collecting this handout provides an opportunity to give students feedback on their scientific understanding of the differences in stars and their progress on arguing from evidence." (Lesson 11, Teacher Guide)
- Lesson 13, Synthesize, Slide H: "Construct and support arguments for the following questions: Which motion(s) lead to us seeing seasonal stars? Do people living closer to the North Pole see seasonal stars?" (Lesson 13, Slides)

INFO: Obtaining, Evaluating, and Communicating Information

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 9. Evidence was found in claimed lesson, examples include

- Lesson 9, Explore, Step 3: "Ask comparison questions about student-selected space objects. Display slide D. Tell the class that they will have the opportunity to investigate sky objects they are curious about. Let the class know before starting our research, we'll choose research questions to help us obtain the information we are investigating. Share that we have a website with reliable information we can use for our research and that this website has information about each of the objects on the slide. If students want to research objects from the Our Sky Observations chart that are not on the list, there will be an opportunity to research an object not on the list." (Lesson 9, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

Rating for Criterion: DCI — EXTENSIVE

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

The reviewers found **extensive** evidence that the materials provide opportunities to develop and use specific elements of the DCIs. Students use the DCI elements that are listed as key learning objectives in service of making sense of phenomena. There are sufficient DCI elements and time that students are engaged in the elements for the length of the materials. Students have multiple opportunities to build the following science ideas:

Claimed Elements:

- **ESS1.A The Sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.**
- **ESS1.B The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year.**

ESS1.A The Universe and Its Stars

Claimed Element: **ESS1.A The Sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (ESS1.A-E1)**

Claimed in Lessons 9, 10, and 11. Evidence was found in the claimed lessons. Examples include:

- Lesson 9, Synthesize, Step 4: "Share comparison research with groups…In particular, listen for questions that arise about the scale of the comparison or other questions that motivate a more systematic way to compare objects." (Lesson 9, Teacher Guide).

- Lesson 10, Synthesize, Step 4: "Guide students in constructing arguments. Display slide H. Direct students to part 2 of Constructing Arguments about the Sun. Ask students to examine the evidence they wrote in part 1 of the handout to consider whether the Sun can be accurately classified as a star. Lead the class in a discussion using the following prompt." (Lesson 10, Teacher Guide)
- Lesson 11, Synthesize, Step 4: "Discuss the relationships between distance and apparent size of light. While still displaying slide K and having the student volunteers return to their spots, have the class consider another perspective of the effect that distance has on light. This time if we are looking at a light that is further away. Connect back that the Sun appears brighter since it is close, but it also looks bigger than the other stars. Share with students that you have a video of cars moving closer to a camera at night. Invite students to make observations about how the light seems to change as the cars get closer." (Lesson 11, Teacher Guide)

ESS1.B Earth and the Solar System

Claimed Element: **ESS1.B The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year. (ESS1.B-E1)**

Claimed in Lessons 1, 2, 3, 4, 5, 6, 7, 8, 12, and 13. Evidence was found in the claimed lessons. Examples include:

- Lesson 1, Explore, Step 2: "Make observations of how the sun, moon, and stars apparently move across the sky. Display slide E and tell students that each of these videos was recorded for at least an hour and in some cases longer (but not longer than a single day)." (Lesson 1, Teacher Guide)
- Lesson 1, Handout 4: Initial Model: "If the Sun and Moon appeared in the sky above you at the same time (picture 1), what would you expect the sky to look like in a few hours (picture 2)? What about at the same time of day but later this week (picture 3)? Show where you would expect the Sun and Moon to be. Include any other sky objects you picture in the sky. Use any combination of words, pictures, and/or symbols to show your prediction for what the sky would look like." (Lesson 1, Handout 4 Initial Model)
- Lesson 2, Navigate, Step 5: "Make predictions about future sun patterns. Display slide M and ask students to make predictions about what they would expect the result of today's investigation would be tomorrow and for future dates. Be sure to ask students to justify their predictions using their past experiences." (Lesson 2, Teacher Guide)
- Lesson 3, Navigate, Step 7: "Consider why the sun always rises in the east. Display slide O to review with students how in Lesson 3 they figured out that the sun always rises in the east and sets in the west. Now that they have evidence that shows that, ask students to consider what might be causing this stable pattern." (Lesson 3, Teacher Guide)
- Lesson 4, Connect, Step 4: "Read a book to gather evidence-Display slide F. Identify that several students suggested that other people have likely collected evidence about the movement of the Earth and/or Sun. Introduce the book and use the following prompts to support students while reading the book." (Lesson 4, Teacher Guide)
- Lesson 5, Synthesize, Step 5: "Facilitate a discussion to have students consider why the Moon's movement is different from the Sun. While in a Scientist's Circle display slide L and facilitate a Consensus Discussion about the patterns revealed using the class' graphical representation. Start by building consensus around the data collected and the graphical representation representing this data. Then guide the analysis of the patterns revealed in this data." (Lesson 5, Teacher Guide)

- Lesson 6, Navigate, Step 6: "Why does the moon appear to be in different locations at the same time each day? How do we know?" (Lesson 6, Teacher Guide)
- Lesson 7, Navigate, Step 1: "Recall types of evidence for the Moon's movement patterns. Display slide B and prepare the Moon Evidence chart. Use the prompts below to support students in taking stock of the evidence they have figured out so far. Record student ideas on the Moon Evidence chart." (Lesson 7, Teacher Guide)
- Lesson 8, Synthesize, Step 5: "Revisit Our Sky Observations chart and update Consensus Model chart. Display slide I and have students form a Scientist's Circle. Post the Consensus Model chart where everyone in the Scientist's Circle can see. Continue the Consensus Building discussion to update and revise the class consensus model to include all of the patterns and explanations they have made sense of so far." (Lesson 8, Teacher Guide)
- Lesson 12, Synthesize, Step 4: "As students share their explanations using the Orbit Model, listen for evidence that students understand how the Earth's different positions around its orbit cause certain constellations to be visible at certain times of year. Be sure to press students on whether this would be a pattern every year and their evidence to support that claim" (Lesson 12, Teacher Guide)
- Lesson 13, Synthesize, Step 3: Teaching Tip: "To support students in their arguments in Arguments for Sky Patterns, it's important to use this moment to explicitly identify the role of Earth's orbit AND rotation in causing the seasonal viewing of certain constellations. Earth's rotation allows us to move away from the Sun and see constellations each night as the Earth orbits around the Sun. And it is this orbit that causes us to view a different part of the universe each time the Earth rotates." (Lesson 13, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

Rating for Criterion: CCC **EXTENSIVE**

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

The reviewers found **extensive** evidence that the materials provide opportunities to develop and use specific elements of the CCCs. Students use the CCC elements that are listed in the 5.4 Sun, Moon, & Star Patterns SEP-DCI-CCC-ELA-Math-Matrix in service of making sense of the Moon's visibility during the day phenomenon and other observations of objects in the sky. Students are supported to develop deep competence in specific elements such that they can be applied to more than one context. Students have multiple opportunities to build the claimed crosscutting concepts.

Students have multiple opportunities to build the following crosscutting concepts.

- **PAT-E1: Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena and designed products.**
- **PAT-E2: Patterns of change can be used to make predictions.**
- **PAT-E3: Patterns can be used as evidence to support an explanation.**
- **CE-E1: Cause-and-effect relationships are routinely identified, tested, and used to explain change.**
- **CE-E2: Events that occur together with regularity might or might not be a cause-and-effect relationship.**

- **SPQ-E1: Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods.**
- **SPQ-E2: Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.**
- **SC-E1: Change is measured in terms of differences over time and may occur at different rates.**

PAT: Patterns

Claimed Element: **PAT-E1: 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 3, 6, 8, and 12. Evidence was found in the claimed lessons. Examples include:

- Lesson 3, Explore, Step 3: "After the class has had a chance to share out some of the patterns that were revealed in the data, ask students to consider how the process of identifying patterns went and problematize new ways of representing the data that might help reveal patterns in shadow length." (Lesson 3, Teacher Guide)
- Lesson 6, Navigate, Step 1: "'What patterns can we add to our Consensus Model? What do these patterns make you wonder about our Consensus Model?'" (Lesson 6, Teacher Guide)
- Lesson 8, Connect, Step 2: "Connect our sensemaking with the knowledge of other communities. Display slide B and have students discuss the prompts on slide B with a partner to think about the observations made by other communities. After a few minutes, ask students to share their partner's responses." (Lesson 8, Teacher Guide)
- Lesson 12, Synthesize, Step 4: "Comparing models. Display slide H. Once the class has landed on the idea of the Earth needing to be on different sides of the Sun at different times of year, display the Orbit Model (made with the turntable, two foam balls as the Earth and Sun figurines, a binder clip, and a paperclip) in the center of the Scientist's Circle and offer the Rabbit Tracks and First Slender Seasonal Constellations cards." (Lesson 12, Teacher Guide)

Claimed Element: **PAT-E2: Patterns of change can be used to make predictions.**

Claimed in Lessons 2, 3, 5, 7, and 13. Evidence was found in the claimed lessons. Examples include:

- Lesson 2, Navigate, Step 5: "Make predictions about future sun patterns. Display slide M and ask students to make predictions about what they would expect the result of today's investigation would be tomorrow and for future dates. Be sure to ask students to justify their predictions using their past experiences." (Lesson 2, Teacher Guide)
- Lesson 3, Synthesize, Step 6: "Make predictions about expected observable sun patterns throughout the year. Display slide L and hold a Building Understanding Discussion where the class uses their ideas from Lesson 2 and the revealed yearly shadow patterns recorded on How do shadows change throughout the year chart to make predictions as to the sun's apparent motion and how the length of day and night change seasonally. As students generate these predictions, record them next to the shadow patterns that are used as support." (Lesson 3, Teacher Guide)
- Lesson 5, Synthesize, Step 5: "Consider why the Moon's movement is different from the Sun's. While in a Scientist's Circle, display slide L and facilitate a Consensus Discussion about the patterns revealed using the class's graphical representation. Start by building consensus around the data collected and the graphical representation representing this data. Then, guide the analysis of the patterns revealed in this data." (Lesson 5, Teacher Guide)
- Lesson 7, Navigate, Step 1: "If we wanted to predict where the Sun or the Moon might be in the sky at a certain time and day, what types of evidence do you think would be most useful?" (Lesson 7, Teacher Guide)

- Lesson 13, Synthesize, Step 4: "Introduce the transfer task. Display Slide H, and explain to students that, now that we have figured out why the constellations of the southern and northern sky appear to move differently, we are going to use what we know about the seasonality of constellations to make an argument for what we would expect to see at a different location on Earth. Distribute the Arguments for Sky Patterns assessment to each student." (Lesson 13, Teacher Guide)

Claimed Element: **PAT-E3: Patterns can be used as evidence to support an explanation.**

Claimed in Lessons 1, 4, and 10. Evidence was found in the claimed lessons. Examples include:

- Lesson 1, Synthesize, Step 5: "Form a Scientist's Circle...This will allow more students to express their ideas and to listen to classmates' ideas as they consider the range of initial ideas within the class, as well as patterns among their ideas." (Lesson 1, Teacher Guide)
- Lesson 4, Explore, Step 2: "Plan an investigation. Display slide C and show students the physical items that each group will have available to them. Allow partners 2-3 minutes to develop ideas on how we could investigate our ideas related to the cause of the shadow patterns." (Lesson 4, Teacher Guide)
- Lesson 10, Synthesize, Step 4: "Guide students in constructing arguments. Display slide H. Direct students to part 2 of Constructing Arguments about the Sun. Ask students to examine the evidence they wrote in part 1 of the handout to consider whether the Sun can be accurately classified as a star. Lead the class in a discussion using the following prompt." (Lesson 10, Teacher Guide)

CE: Cause and Effect

Claimed Element: **CE-E1: Cause and effect relationships are routinely identified, tested, and used to explain change.**

Claimed in Lessons 1, 2, 4, 6, and 7. Evidence was found in the claimed lessons. Examples include:

- Lesson 1, Navigate, Step 6: "Direct students to look back at the work we have done thinking about why the moon can sometimes be seen in the day and other times at night." (Lesson 1, Teacher Guide)
- Lesson 2, Explore, Step 3: "Throughout the day, use recess and/or send supervised pairs outside. Show slide H. Ideally, additional observations happen every hour. In a way that aligns with your classroom and school expectations, use additional outside time (such as at recess) and/or send supervised pairs outside to trace the shadow using their Sun Tracking Device." (Lesson 2, Teacher Guide)
- Lesson 4, Explore, Step 3: "Motivate the need for more evidence. Bring students back together. Say something like, At this point we have tested the Earth spinning, but we had other ideas that the Sun (flashlight) could be moving. Use a group's model to demonstrate moving the flashlight around the globe. Use the prompts below to help students share what they notice about the shadows of the figure." (Lesson 4, Teacher Guide)
- Lesson 6, Synthesize, Step 3: "Have a discussion to figure out how the Moon's orbit causes some of the observed patterns. Display slide K and lead a discussion to make sense of the relative position of the Sun-Earth-Moon for the days when the Moon is seen in the night sky." (Lesson 6, Teacher Guide)
- Lesson 7, Synthesize, Step 3: Cause and Effect callout: "This is an opportunity to have students use the previously identified cause and effect relationships of the Earth's rotation causing the apparent movement of the Sun across the sky and Moon's orbit around Earth causing the Moon's movement across the sky to make predictions about the Sun's and Moon's location on a given time and date. Students can draw upon the physical model they developed using people in Lesson 6 to support their sensemaking or materials from the Lesson 4 investigation including the inflatable globe, turntable, and a physical representation of the Moon." (Lesson 7, Teacher Guide)

Claimed Element: **CE-E2: Events that occur together with regularity might or might not be a cause and effect relationship.**

Claimed in Lesson 11. Evidence was found in the claimed lesson. Examples include:

- Lesson 11, Synthesize, Step 4: Cause and Effect callout: "This is an opportunity to help students practice seeing that not all data connections necessarily mean causal relationships. Taking a moment to surface whether we have evidence to support that distance has an effect on brightness helps to support future middle and high school development." (Lesson 11, Teacher Guide)

SPQ: Scale, Proportion, and Quantity

Claimed Element: **SPQ-E1: Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods.**

Claimed in Lessons 10 and 11. Evidence was found in the claimed lessons. Examples include:

- Lesson 10, Explore, Slide B: "Which space objects tend to appear in the same category or close together in the data? Which space objects tend to appear in separate categories or far apart in the data? What else do you notice about this data?" (Lesson 10, Slides)
- Lesson 11, Synthesize, Step 4: "Discuss the relationship between brightness and distance. Display slide K and ask for two volunteers to hold two different flashlights. Once the students have been selected, have them stand close to the board with a clear path to back up. Turn the lights off in the room and have the students slowly back up. As they do this, students share what they notice about the brightness of the light on the wall." (Lesson 11, Teacher Guide

Claimed Element: **SPQ-E2: Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.**

Claimed in Lessons 2, 5, 8, 9, and 10. Evidence was found in the claimed lessons. Examples include:

- Lesson 2, Explore, Step 3: "What units should we use to measure the length of shadows? What units would make sense? What units would we use for time?" (Lesson 2, Teacher Guide)
- Lesson 5, Explore, Step 4: "Using student contributions, elevate that we are noticing the Moon traveling less than the Sun over 24 hours. Tell students to be sure let's compare the measurements for how far the Sun and Moon travel each day by noon. Scientists can measure this distance by determining the angle between the object and one of the directions (North, South, East and West). Use both of your arms to gesture the formation of an angle." (Lesson 5, Teacher Guide)
- Lesson 8, Student Materials, Handouts 1-3: "Circling the longest and shortest lengths or earliest and latest times." Students are analyzing data tables of each community noting sunrise, sunset, length of day and night in hours. (Lesson 8, Teacher Guide)
- Lesson 9, Student Materials, Handout 1: "Read the digital articles for the three objects you are comparing. Take notes on your Comparison Research handout. If one of your objects is from our class chart, use the "More Resources" page to find information about that object." (Lesson 9, 5.4 Lesson 9 Handout 1 Comparison Research)
- Lesson 9, Synthesize, Step 4: "Comparing and evaluating data organizations. Display slide G and ask students to think about which categories or measurements were easier to decide if they were similar or different and which were harder. Ask students to share their thinking and as they share, ask others to show thumbs up or down to indicate

whether they agreed about whether something was easier or harder to decide. Chart students ideas on the Harder and Easier to Decide chart as you lead a brief discussion using the prompts below." (Lesson 9, Teacher Guide)

- Lesson 10, Navigate, Slide A: "What do you notice about the different line plots? What were the categories or measurements that groups used? As you were sorting the sky objects onto your line plots, was there anything that surprised you?" (Lesson 10, Slides)

SC: Stability and Change

Claimed Element: **SC-E1: Change is measured in terms of differences over time and may occur at different rates.**

Claimed in Lessons 5 and 8. Evidence was found in the claimed lessons. Examples include:

- Lesson 5, Synthesize, Step 5: "Update our Growing Ideas charts. Conclude the discussion by pointing out that even with our questions, we have still figured a lot out about the Moon's changes in location over days and months." (Lesson 5, Teacher Guide)
- Lesson 5, Explore, Step 2: "Using student noticings, elevate that when the Moon crosses our sky seems to change differently than how and when the Sun does. Ask students to consider if we watched the sky several days later, what might they expect to see? Accept all responses." (Lesson 5, Teacher Guide)
- Lesson 8, Explore, Step 3: Stability and Change callout: "This is an opportunity to look at differences over time, change, when looking for patterns in day and night throughout the year. Students will need to make sense of what changes in numbers mean and tell us about the observable patterns. This is an opportunity to connect back to Lesson 3 and the patterns students observed in terms of shadow lengths and the Sun's position throughout the year." (Lesson 8, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

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 requires student performances that integrate elements of the SEPs, CCCs, and DCIs. In the unit, students are expected to **use the patterns revealed in graphical displays to argue whether different locations experience the longest and shortest days and nights at the same time of year** and to **support an argument** that the **seasonality of stars is the** result of the **Earth's motion and the stars' relative position to Earth's poles** as observed by their position in our sky, which requires students to use grade-appropriate elements of the three dimensions simultaneously. This integrated learning supports student sensemaking over time. The three dimensions are not used in isolation, as there are several tasks in which students are expected to figure something out (a phenomenon) in a way that requires a grade-appropriate element of each of the three dimensions working together. 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.

Learning is integrated and supports student sense-making over time

The learning objectives below show a natural flow in sense-making using patterns to explain the apparent movements of celestial bodies in the night sky. Students are given opportunities that integrate elements of the three dimensions on several tasks used as formal formative assessments, with opportunities for peer and teacher feedback before they complete each integrated summative task in Lessons 8 and 13.

- Lesson 1, Synthesize, Step 5: Introduce modeling our initial ideas about the sun-moon-star system. Students integrate elements of **MOD-E4 Develop and/or use models to describe and/or predict phenomena**, **CE-E1 Cause and effect relationships are routinely identified, tested, and used to explain change**, and **ESS1.B-E1 The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year** when they create models to explain "why the Moon sometimes appears with the Sun during the day, and other times with the stars at night?"
- Lesson 4, Explore, Step 3: Students integrate the elements o**f MOD-E6 Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system**, **PAT-E3 Patterns can be used as evidence to support an explanation**, and **ESS1.B-E1 The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year** when they complete the Earth-Sun Model Observations handout to provide evidence for the rotation of the Earth as a cause for changes in shadows throughout the day.
- Lesson 8, Student Materials, Student Assessment 1: Students integrate the elements of **ARG-E4 Construct and/or support an argument with evidence, data, and/or a model**, **PAT-E1 Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products,** and **ESS1.B-E1 The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year,** when they use patterns in data to support whether all these communities had the shortest or longest night on the same day using the Earth-Sun-Moon system.
- Lesson 10, Student Materials, Handout 2: Students integrate the elements of **DATA-E3 Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings**, **PAT-E3 Patterns can be used as evidence to support an explanation**, and **ESS1.A-E1 The Sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth** when they construct an argument using patterns from data to support a claim that the Sun is or is not a star.

Criterion-Based Suggestions for Improvement: N/A

I.D. Unit Coherence

EXTENSIVE

Lessons fit together to target a set of performance expectations.

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

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

The reviewers found **extensive** evidence that the lessons form a coherent sequence targeting a focused set of performance expectations. Each lesson builds directly on the previous one, making the connections and purpose clear from the student's perspective. Together, the lessons provide ample opportunities for students to develop proficiency across all three dimensions and to understand how each step contributes to the unit's larger goals. The DQB and navigation routines further support this coherence and seamlessly connect the two lesson sets.

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

- 5-ESS1-1: Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.
- 5-ESS1-2: Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

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.

- Lesson 3, Navigate, Step 1: "Revisit ideas from the Sun Tracking investigation. Display slide A. While pointing towards the Organized Shadow Data chart, support students in returning to the ideas we investigated and the questions that were raised in the previous lesson. Use this discussion to navigate to students sharing the patterns they've noticed about how shadows, the sun, or daylight change throughout the year. Record these new observations on the Our Sky Observation chart started in Lesson 1." (Lesson 3, Teacher Guide)
- Lesson 4, Navigate, Step 7: "Problematize the Moon sometimes being in the sky during the day. Display slide J. Point out that our work today has helped us to explain day and night as well as the shadow patterns. Ask students if our work today helps us to explain why the Moon is sometimes in the day sky and other times it is in the night sky. Accept all responses and look for students to suggest that we need to find out more about the Moon." (Lesson 4, Teacher Guide)
- Lesson 9, Navigate, Step 1: "Ask whether there are any groups of questions we are still wondering about. Point out that we have questions still about some other objects in the sky. Refer to the Ideas for Investigation chart, and ask students to turn and talk about whether these types of investigations would help the class to answer these questions." (Lesson 9, Teacher Guide)
- Lesson 12, Navigate, Step 1: "Recall our past investigations. Display slide A and call back to the constellations students encountered in our last lesson. Ask students to think about the question on the slide: Why do you think we can only see some constellations during part of the year? Have students turn to a partner and have each person share their ideas. Let students know that it's ok if there are different ideas about why this happens and that we'll try out those ideas as we try to explain why this happens." (Lesson 12, Teacher Guide)

- Lesson 13, Navigate, Step 1: "Sort DQB questions we haven't yet answered. Celebrate the fact that we have figured out a lot in our unit, and we are ready for a final check-in on our DQB. Remove any questions from the DQB that have not yet been answered and checked off in previous lessons. Evenly distribute the questions among groups of about 4 students and display slide A. Ask students to work in groups and as they read each question, think about if we can fully, partially, or not answer it." (Lesson 13, Teacher Guide)

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

The lessons help students develop toward proficiency in a targeted set of performance expectations. The two target Performance Expectations are:

ESS1.A The Universe and its Stars: The sun is a star that appears larger and brighter than other stars because it's closer. Stars range greatly in their distance from Earth.

- Lesson 9, Synthesize, Step 4: "Share comparison research with groups. Split the class into groups of four making sure students who were partnered for the research are in different groups. Display slide F. Distribute a set of Object Cards to each group, and let the class know each person will take about 2 minutes to share their results using the steps on the slide. There is a blank card in the set in case students researched additional objects. Circulate and listen to the small groups as students share. In particular, listen for questions that arise about the scale of the comparison or other questions that motivate a more systematic way to compare objects. After about 8 minutes, bring the class back together." (Lesson 9, Teacher Guide)
- Lesson 10, Synthesize, Step 4: "Share comparison research with groups. Split the class into groups of four making sure students who were partnered for the research are in different groups. Display slide F. Distribute a set of Object Cards to each group, and let the class know each person will take about 2 minutes to share their results using the steps on the slide. There is a blank card in the set in case students researched additional objects. Circulate and listen to the small groups as students share. In particular, listen for questions that arise about the scale of the comparison or other questions that motivate a more systematic way to compare objects. After about 8 minutes, bring the class back together." (Lesson 10, Teacher Guide)
- Lesson 11, Synthesize, Step 4: "Facilitate a discussion to have students consider why the Sun is so different from other stars. While in a Scientist's Circle with the *Sun Claims* chart posted and slide J displayed, facilitate a Building Understandings Discussion about the patterns revealed using the data representations. Encourage students to refer to the Star Size, Distance, and Brightness handout (provide additional copies if needed) so they can make calculations to support their comparisons of the stars." (Lesson 11, Teacher Guide)

ESS1.B Earth and the Solar System: The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of day, month, and year.

- Lesson 1, Explore, Step 2: "Make observations of how the sun, moon, and stars apparently move across the sky. Display slide E and tell students that each of these videos was recorded for at least an hour and in some cases longer (but not longer than a single day)." (Lesson 1, Teacher Guide)
- Lesson 2, Synthesize, Step 5: "Discuss how our data help us understand the Sun's position in the sky. Display slide M. Have students turn and talk with their elbow partner about each of the questions on the slide." (Lesson 2, Teacher Guide)
- Lesson 3, Synthesize, Step 6: "Make predictions about expected observable Sun patterns throughout the year. Display slide L and hold a Building Understandings Discussion where the class uses their ideas from Lesson 2 and the yearly

shadow patterns recorded on the How do shadows change throughout the year? chart to make predictions as to the Sun's apparent motion and how the length of day and night change seasonally." (Lesson 3, Teacher Guide)

- Lesson 4, Synthesize, Step 5: "Share an explanation with a partner. Display slide O and have students turn and talk using the prompts on the slide, referring to their Earth-Sun Model Observations handout as needed. After 2-3 minutes, bring students together and use the prompts below to support students in using evidence to support claims about why the Sun appears to move westward every day." (Lesson 4, Teacher Guide)
- Lesson 5, Synthesize, Step 5: "Consider why the Moon's movement is different from the Sun's. While in a Scientist's Circle, display slide L and facilitate a Consensus Discussion about the patterns revealed using the class's graphical representation. Start by building consensus around the data collected and the graphical representation representing this data. Then, guide the analysis of the patterns revealed in this data." (Lesson 5, Teacher Guide)
- Lesson 6, Synthesize, Step 3: "Have a discussion to figure out how the Moon's orbit causes some of the observed patterns. Display slide K and lead a discussion to make sense of the relative position of the Sun, Earth, and Moon for the days when the Moon is seen in the night sky." (Lesson 6, Teacher Guide)
- Lesson 7, Navigate, Step 1: "Recall types of evidence for the Moon's movement patterns. Display slide B and prepare the Moon Evidence chart. Use the prompts below to support students in taking stock of the evidence they have figured out so far. Record student ideas on the Moon Evidence chart." (Lesson 7, Teacher Guide)
- Lesson 13, Synthesize, Step 4: "Introduce the transfer task. Display Slide H, and explain to students that, now that we have figured out why the constellations of the southern and northern sky appear to move differently, we are going to use what we know about the seasonality of constellations to make an argument for what we would expect to see at a different location on Earth. Distribute the Arguments for Sky Patterns assessment to each student." (Lesson 13, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

I.E. Multiple Science Domains

EXTENSIVE

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

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

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

The reviewers found **extensive** evidence that links are made across the science domains when appropriate because the phenomenon of the Moon sometimes appearing with the Sun during the day and other times with the stars at night can be fully addressed within the Earth and space science domain (ESS1.A and ESS1.B). The CCC elements of PAT-E1, PAT-E2, PAT-E3, SPQ-E1, and SPQ-E2 are used effectively within the ESS1 domain to support students in figuring out the phenomenon. The phenomenon driving the unit can be fully addressed within ESS1.A and ESS1.B domain.

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

- Students use elements of **ESS1.A The Universe and its Stars** and **ESS1.B Earth and the Solar System** for sensemaking. In Lessons 1-13, only the earth science domain is necessary to explain the phenomenon presented in the unit.

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

- In Lessons 1-13, students use elements of the crosscutting concepts to make sense of phenomena related to the earth science domain. See I.C for evidence of the use of the intentionally developed CCC elements: PAT-E1, PAT-E2, PAT-E3, CE-E1, CE-E2, SC-E1, SC-E2, SPQ-E1, and SPQ-E2.

Criterion-Based Suggestions for Improvement: N/A

I.F. Math and ELA

EXTENSIVE

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

The reviewers found **extensive** evidence that the materials provide grade-appropriate connections to the Common Core State Standards in Mathematics and/or English Language Arts & 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. Mathematical concepts are explicitly incorporated into lessons so that students use them to explain or help understand scientific concepts, phenomena, and results. Students use reading skills at a grade-appropriate level to develop an understanding of scientific concepts and results, supporting their sensemaking. Reading materials include news articles, websites of scientific entries, and informational texts. Students use writing skills to explain and communicate their understanding of the scientific concepts, results, and phenomena. Students have multiple opportunities to speak and listen to peers in a variety of formats and scenarios (e.g., diverse partners, small groups, Scientist's Circle).

ELA - Reading: Informational Text

CCSS.ELA-LITERACY.RI.5.2 Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.

Claimed in Lesson 4. Evidence found in the claimed lesson. Examples include:

- Lesson 4, Connect, Step 4: Literacy Supports Callout: "Students will ask and answer questions after reading to ensure that they understand the main idea and key details of the text. Students will use these ideas to support their thinking later during their Building Understandings Discussion (RI.5.2)." (Lesson 4, Teacher Guide)

CCSS-ELA-LITERACY.RI.5.3 Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.

Claimed in Lessons 6 and 7. Evidence found in the claimed lessons. Examples include:

- Lesson 6, Connect, Slide M: "Read an article. How is Comet 24P's movement similar to the Moon's? How is it different from the Moon's? The moon and comet both orbit another space object. What does this type of movement look like?" (Lesson 6, Slides)
- Lesson 7, Connect, Step 2: "Connect to our Moon evidence. Show slide D. Have students connect the different types of evidence that scientists use to support their arguments with the types of evidence we've collected. Encourage both scientific and everyday language, as well as gestures, for students to express their ideas." (Lesson 7, Teacher Guide)

CCSS-ELA-LITERACY.RI.5.6 Analyze multiple accounts of the same event or topic, noting important similarities and differences in the point of view they represent.

Claimed in Lessons 1 and 5. Evidence found in the claimed lessons. Examples include:

- Lesson 1, Connect, Step 3: "Read Skywatchers in Our Communities to observe new patterns." (Lesson 1, Teacher Guide)
- Lesson 5, Connect, Step 3: "Connect to skywatchers from different communities. Display slide F and distribute a Navajo Skywatching handout to each student. Direct students to read and analyze their handout by discussing the following prompts: What patterns did this community notice when they watched the Moon? What patterns have you noticed looking at the Moon?" (Lesson 5, Teacher Guide)

CCSS-ELA-LITERACY.RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

Claimed in Lesson 9. Evidence found in the claimed lesson. Examples include:

- Lesson 9, Navigate, Step 1: "Read through the individual questions in the identified groups and ask for them to indicate whether we've answered the question using thumbs up, down, or sideways, indicating a partial answer. For those questions the class agrees we've fully answered, ask for a volunteer to summarize how we would answer that question. If the class agrees we've answered the question, add a checkmark to the sticky note." (Lesson 9, Teacher Guide)

CCSS-ELA-LITERACY.RI.5.8 Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s).

Claimed in Lesson 11. Evidence found in the claimed lesson. Examples include:

- Lesson 11, Synthesize, Step 4: "Critique arguments for why the Sun looks different than other stars. Display slide L and distribute Critiquing Arguments about the Sun to each student. Ask the students to evaluate the two arguments for why the Sun looks different from the other stars. After critiquing the arguments, students should pick one to revise using the patterns they discussed today. Collecting this handout provides an opportunity to give students feedback on their scientific understanding of the differences in stars and their progress on arguing from evidence." (Lesson 11, Teacher Guide)

CCSS-ELA-LITERACY.RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

Claimed in Lesson 8. Evidence found in the claimed lesson. Examples include:

- Lesson 8, Connect, Step 2: "Connect our sensemaking with the knowledge of other communities. Display slide B and have students discuss the prompts on slide B with a partner to think about the observations made by other communities. After a few minutes, ask students to share their partner's responses." (Lesson 8, Teacher Guide)

ELA - Writing

CCSS-ELA-LITERACY.W.5.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

Claimed in Lesson 13. Evidence found in the claimed lesson. Examples include:

- Lesson 13, Synthesize, Step 4: "Introduce the transfer task. Display Slide H, and explain to students that, now that we have figured out why the constellations of the southern and northern sky appear to move differently, we are going to use what we know about the seasonality of constellations to make an argument for what we would expect to see at a different location on Earth. Distribute the Arguments for Sky Patterns assessment to each student." (Lesson 13, Teacher Guide)

CCSS-ELA-LITERACY.W.5.2D Use precise language and domain-specific vocabulary to inform about or explain the topic.

Claimed in Lessons 7 and 10. Evidence found in the claimed lessons. Examples include:

- Lesson 7, Synthesize, Step 3: Literacy Supports callout: "As students complete My Growing Ideas remind them to use precise and domain-specific vocabulary or drawings that refer to precise and domain-specific vocabulary to explain their science ideas in their explanation. This supports W.5.2D and encourages the use of sophisticated science vocabulary in students' writing." (Lesson 7, Teacher Guide)
- Lesson 10, Synthesize, Step 3: Literacy Supports callout: "As students evaluate and critique arguments, remind them to use precise and domain-specific vocabulary or drawings to explain their science ideas in their critique and arguments. This will prepare them for using sophisticated science vocabulary in their arguments now and later in the lesson (W.5.2D)." (Lesson 10, Teacher Guide)

CCSS-ELA-LITERACY.W.5.5 With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.

Claimed in Lessons 7, 10, and 11. Evidence found in the claimed lesson. Examples include:

- Lesson 7, Student Materials, Handout 3: "Evaluate evidence for connectedness. Evaluate how well your partner group's evidence connects to their claim. Look to see that your partner group's evidence explains how or why it took so long for the Moon to set while the sun is rising. Use "I wonder" statements to explore anything that seems disconnected in the evidence." (Lesson 7, 5.4 Lesson 7 Handout Argument Peer Review)
- Lesson 10, Synthesize, Step 4: "Guide students in constructing arguments. Display slide H. Direct students to part 2 of Constructing Arguments about the Sun. Ask students to examine the evidence they wrote in part 1 of the handout to consider whether the Sun can be accurately classified as a star. Lead the class in a discussion using the following prompt." (Lesson 10, Teacher Guide)
- Lesson 11, Synthesize, Step 4: "Critique arguments for why the Sun looks different than other stars. Display slide L and distribute Critiquing Arguments about the Sun to each student. Ask the students to evaluate the two arguments for why the Sun looks different from the other stars. After critiquing the arguments, students should pick one to revise using the patterns they discussed today. Collecting this handout provides an opportunity to give students feedback on their scientific understanding of the differences in stars and their progress on arguing from evidence." (Lesson 11, Teacher Guide)

CCSS-ELA-LITERACY.W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

Claimed in Lesson 9. Evidence found in the claimed lesson. Examples include:

- Lesson 9, Student Materials, Handout 1: "Read the digital articles for the three objects you are comparing. Take notes on your Comparison Research handout. If one of your objects is from our class chart, use the "More Resources" page to find information about that object." (Lesson 9, 5.4 Lesson 9 Handout 1 Comparison Research)

ELA - Speaking and Listening

CCSS-ELA-LITERACY.SL.5.1B Follow agreed-upon rules for discussions and carry out assigned roles.

Claimed in Lessons 2 and 12. Evidence found in the claimed lessons. Examples include:

- Lesson 2, Explore, Step 3: "Remind learners that our classroom agreements guide how we communicate with each other. In our roles as peers in a scientific community, it is our responsibility to show each other respect and to help each other grow." (Lesson 2, Teacher Guide)
- Lesson 12, Synthesize, Step 4: "Participate in a discussion to debrief our small group modeling experiences. Display slide G and have students arrange their chairs in a circle to form a Scientist's Circle. Have students bring their copy of the Seasonal Constellation Model handout and My Night Sky handout. Take a moment to reflect on the Community Agreements. Ask students to each pick one they want to focus on during the Scientist's Circle." (Lesson 12, Teacher Guide)

CCSS-ELA-LITERACY.SL.5.2 Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

Claimed in Lesson 3. Evidence found in the claimed lesson. Examples include:

- Lesson 3, Connect, Slide F: "Which ways did they organize their data? How did they decide which way to use? How did each way help scientists see patterns?" (Lesson 3, Slides)

CCSS-ELA-LITERACY.SL.5.3 Summarize the points a speaker makes and explain how each claim is supported by reasons and evidence.

Claimed in Lesson 12. Evidence found in the claimed lesson. Examples include:

- Lesson 12, Synthesize, Step 4: "Ask students to turn to a partner and explain why Earth's orbit makes some constellations visible at certain times of year. Invite a couple students to share their explanation. Ask if students would like to add on to the explanation. If it's easiest for students to explain their idea while using the Orbit Model or Seasonal Constellations cards, let them know the models are available to support their explanation." (Lesson 12, Teacher Guide)

Mathematics Practices

CCSS-MATH-Practice.MP1 Make sense of problems and persevere in solving them.

Claimed in Lesson 11. Evidence found in the claimed lesson. Examples include:

- Lesson 11, Synthesize, Step 4: "Facilitate a discussion to have students consider why the Sun is so different from other stars. While in a Scientist's Circle with the Sun Claims chart posted and slide J displayed, facilitate a Building Understandings Discussion about the patterns revealed using the data representations. Encourage students to

refer to the Star Size, Distance, and Brightness handout (provide additional copies if needed) so they can make calculations to support their comparisons of the stars. A sample chart is shown here; keep in mind that your class may have expressed their ideas differently." (Lesson 11, Teacher Guide)

CCSS-MATH-Practice.MP2 Reason abstractly and quantitatively.

Claimed in Lessons 1, 3, 4, and 8. Evidence found in the claimed lessons. Examples include:

- Lesson 1, Connect, Step 3: Math Supports callout: "As you read the book, help students to read and interpret the data represented in the table by asking students to identify different features, like the labels for the columns and rows and the bolded information. Ask students "What similarities and differences do you see in how and when the sun and moon rise?" and "What similarities and differences do you see in how and when the sun and moon set?" Connect back to the book by asking, "Do we see the same patterns as the people of Oahu?"" (Lesson 1, Teacher Guide)
- Lesson 3, Connect, Step 4: "Gather students in a Scientist's Circle for a read-aloud of the Scientists Represent Data book. Use the following discussion prompts (also found on the last page of the book) to lead a brief class discussion in which students identify the different ways scientists can represent data." (Lesson 3, Teacher Guide)
- Lesson 4, Explore, Step 3: "Motivate the need for more evidence. Bring students back together. Say something like, At this point we have tested the Earth spinning, but we had other ideas that the Sun (flashlight) could be moving. Use a group's model to demonstrate moving the flashlight around the globe. Use the prompts below to help students share what they notice about the shadows of the figure." (Lesson 4, Teacher Guide)
- Lesson 8, Explore, Step 3: "Once students have analyzed both, the group should discuss and record their responses to prompts on slide D. What do you notice about the observatory's structure and use? What patterns do you notice in the day and night data at the observatory's location? What do those noticings make you wonder about?" (Lesson 8, Teacher Guide)

CCSS-MATH-Practice.MP3 Construct viable arguments and critique the reasoning of others.

Claimed in Lessons 5, 7, 10, and 13. Evidence found in the claimed lessons. Examples include:

- Lesson 5, Synthesize, Step 5: "Facilitate a discussion to have students consider why the Moon's movement is different from the Sun. While in a Scientist's Circle display slide L and facilitate a Consensus Discussion about the patterns revealed using the class' graphical representation. Start by building consensus around the data collected and the graphical representation representing this data. Then guide the analysis of the patterns revealed in this data." (Lesson 5, Teacher Guide)
- Lesson 7, Student Materials, Handout 2: "Evaluate evidence for connectedness. Evaluate how well your partner group's evidence connects to their argument. Look to see that your partner group's evidence explains how or why it took so long for the Moon to set while the sun is rising. Use "I wonder" statements to explore anything that seems disconnected in the evidence." (Lesson 7, 5.4 Lesson 7 Handout 2 Peer Review)
- Lesson 7, Student Materials, Handout 2: "Evaluate evidence for clarity. What is clear and what is unclear about your partner group's evidence? Look to see that your partner group's evidence is explained with pictures, symbols and/or words and is clearly labeled or explained. Use "I wonder" statements to explore anything that is unclear about the evidence. Then complete the table below." (Lesson 7, 5.4 Lesson 7 Handout 2 Peer Review)
- Lesson 10, Synthesize, Step 4: "Guide students in constructing arguments. Display slide H. Direct students to part 2 of Constructing Arguments about the Sun. Ask students to examine the evidence they wrote in part 1 of the handout to consider whether the Sun can be accurately classified as a star. Lead the class in a discussion using the following prompt." (Lesson 10, Teacher Guide)

- Lesson 13, Explore, Step 2: Math Supports callout "As students analyze the graph, have them explain their observations, support their claims with evidence from the bar graph, and critique the claims of others (MP3)."

CCSS-MATH-Practice.MP4 Model with mathematics.

Claimed in Lesson 3. Evidence found in the claimed lesson. Examples include:

- Lesson 3, Explore, Step 5: "Use an online graphing tool to represent shadow length data for different months. Display slide J. Guide students to the CODAP link CODAP: Lesson 3 Link. Direct students to work in pairs to create at least three different line graph combinations. They should write, draw, or describe the patterns revealed in these graphs on "Representing Shadow Data from One Year." (Lesson 3, Teacher Guide)

CCSS-MATH-Practice.MP5 Use appropriate tools strategically.

Claimed in Lessons 2, 3, and 11. Evidence found in the claimed lessons. Examples include:

- Lesson 2, Connect, Step 2: "After students share their similarities about tracking the movement of different objects, have the class consider how we might apply these to tracking the movement and position of the sun across our sky. Say something like, So it sounds like to keep track of how something is moving we need some way to describe its current location and some way to mark the time when it's at that location. So let's take a moment to brainstorm more things we will need to consider when tracking the sun's movement." (Lesson 2, Teacher Guide)
- Lesson 3, Explore, Step 3: "Begin to look for patterns in a large dataset. Display slide D and distribute the One Year Shadow Data handout to each group. Tell students that this shadow data was collected using a Sun Tracking Device that was 1 meter in height --Place your hand on your hip to show a rough estimate of how tall the device was. Also, tell students that the times are being reported using the 24-hour clock notation. A key has been included on slide D to support sensemaking." (Lesson 3, Teacher Guide)
- Lesson 11, Explore, Step 3: "Plan to explore differences in star characteristics. Display slide F and share with students that scientists have been able to use tools to measure different characteristics of stars. Ask the class to consider the method of organizing the measurements that would be most helpful in seeing if there are any meaningful patterns that could help us argue why the Sun looks so different." (Lesson 11, Teacher Guide)

CCSS-MATH-Practice.MP7 Look for and make use of structure.

Claimed in Lessons 4 and 10. Evidence found in the claimed lesson. Examples include:

- Lesson 4, Navigate, Step 1: "Revisit the shadow patterns collected from last class. Display slide A and have students turn and talk about the prompts on the slide. After 1-2 minutes have students share what their partner said. Guide students to recall that shadows appear to change direction (move from west to east) and change length (start out long, then get smaller, and then grow again) during the course of the day or year." (Lesson 4, Teacher Guide)
- Lesson 10, Explore, Slide B: "Which space objects tend to appear in the same category or close together in the data? Which space objects tend to appear in separate categories or far apart in the data? What else do you notice about this data?" (Lesson 10, Slides)
- Lesson 10, Explore, Step 2: "Take a gallery tour of the number line data. Organize students into pairs and distribute Comparing Number Line Data to each set of partners. Explain that students will be taking a tour of the number lines around the classroom. Display slide B and read the prompts aloud. As students tour the data with a partner, they should use the prompts on the handout to help them to notice patterns and generate questions about their observations." (Lesson 10, Teacher Guide)

Mathematics - Number and Operations in Base Ten

CCSS-MATH-5.NBT.A.1 Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.

Claimed in Lesson 9. Evidence found in the claimed lesson. Examples include:

- Lesson 9, Explore, Step 3: "Navigate students to the place value chart and explain how they can use the chart as a tool to make sense of larger numbers in different forms. For example, show how 1.43 million can be written as a number using the place value chart by placing a one in the millions place, a 4 in the hundred thousands place, a 3 in the ten thousands place, and zeros as place holders in the remaining place to the right of ten thousands." (Lesson 9, Teacher Guide) Students can answer the follow-up questions without referring to place value or what the digits represent.

CCSS-MATH-5.NBT.B.7 Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

Claimed in Lesson 5. Evidence found in the claimed lesson. Examples include:

- Lesson 5, Explore, Step 4: "Using a whiteboard, chalkboard, or smartboard, support students in co-developing a method for subtracting the Sun and Moon angles to find how different the locations are. A larger difference means their location changed more. See the sample of the subtraction algorithm below- the Sun moved 0.4 degrees, while the Moon moved 18.8 degrees in the same amount of time. You may also decide to use a different method for subtraction." (Lesson 5, Teacher Guide)

Mathematics - Geometry

CCSS-MATH-5.G.A.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

Claimed in Lesson 8. Evidence found in the claimed lesson. Examples include:

- Lesson 8, Student Materials, Handout 2: "Use CODAP: Lesson 8 Link, to build a line graph comparing all three locations' hours of sunlight over a single year. Draw and label what you and your partner's graph in the space provided." (Lesson 8, 5.4 Lesson 8 Handout 2 Hours of Daylight)

Criterion-Based Suggestions for Improvement

- Consider including prompts in the follow-up questions in Lesson 9 to guide students in using place value and understanding the meaning of each digit.

CATEGORY II

NGSS Instructional Supports

II.A. Relevance and Authenticity

EXTENSIVE

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

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

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

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

The reviewers found **extensive** evidence that the materials engage students in authentic and meaningful scenarios that reflect the practice of science and engineering as experienced in the real world. This is because students experience the phenomenon as directly as possible—firsthand or through media representations—and have multiple opportunities to connect the phenomena they figure out to their own prior experiences, community, or culture. The materials provide support to teachers for connecting instruction to all students' homes, neighborhoods, communities, and cultures as appropriate, with a particular emphasis on making connections for students from underserved communities, including reminders to seek out and make use of the funds of knowledge that students bring to school from their homes and communities throughout the learning process. The phenomena and classroom activities used are engaging to students and reflect grade-appropriate, realistic scenarios that students are authentically motivated to figure out. Students can relate to the phenomenon, and materials provide opportunities for students to reflect on how figuring out the phenomenon is important to someone—whether themselves or someone they can relate to. Students experience phenomena as directly as possible when they go outside and make morning observations and record shadow data, recall past observations of the sky during the day and at night, use Stellarium to observe constellations during self-selected dates, and go outside to observe the Moon during the day.

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

- Lesson 1, Connect, Step 1: "Connect to our past experiences observing the moon during the day. Display slide A. Say something like, *I was out for a walk the other day and I saw something that I thought was pretty odd. I looked up in the sky and saw the moon!* Ask the students to take a moment and consider whether they have ever seen the moon during the day. Connect to our past experiences skygazing. Display slide B and ask students to close their eyes and think back to a time when they looked up into the sky on a clear day and night. Ask students to recall: What objects did you see in the sky? Where in the sky did you see them?" (Lesson 1, Teacher Guide)
- Lesson 2, Connect, Step 2: "Connect to our experiences tracking an object's motion. Display slide B and have the class consider times in their past where they tracked an object's motion. Remind students that these experiences are not limited to those they had in past science classes, but can come from any lived experience." (Lesson 2, Teacher Guide)
- Lesson 2, Explore, Step 4: "Go outside and make morning observations. Once groups have revised their procedures, display slide I and head outside to set up and record their first shadow data point using their Sun Tracking Devices. Support students in using compasses to find north, so groups can be sure their paper is oriented correctly." (Lesson 2, Teacher Guide)

- Lesson 3, Connect, Step 2: "Make noticings and wonderings about the sun at different times of year. Display slide B and tell students that these videos were taken at the same location, but at different times of year (June and December). As you start the video, tell students that the left side of the video was taken in December while the right was taken in June. After the video finishes, have students share the observations they noticed and record these on the *Our Sky Observation* chart." (Lesson 3, Teacher Guide)
- Lesson 5, Navigate, Step 1: "Invite the class to travel outside to possibly observe the Moon. Elevate student contributions about needing to investigate the Moon's movements across the sky. If your school allows and the weather is nice, invite the students to step outside to look for the Moon. While they are outside, remind them to observe the Moon safely and not to look directly at the Sun." (Lesson 5, Teacher Guide)
- Lesson 5, Navigate, Step 1: "Alternative Activity: If students are unable to go outside due to poor weather or school procedures, consider using a location in your classroom or school with large windows that provide a view of the sky. The goal of this activity is to highlight that tracking the Moon's movements is more challenging than tracking the Sun's." (Lesson 5, Teacher Guide)
- Lesson 11, Navigate, Step 1: Broadening Access: "Students will have varying experiences observing the stars in the night sky, especially those who live in, or near cities. Providing a common experience observing a night sky will help to make this lesson accessible to these students. At this point, surfacing the need for a common experience for all students to draw upon is imperative." (Lesson 11, Teacher Guide)
- Lesson 12, Connect, Step 2: "Connect to our experiences by looking at the night sky on dates that are meaningful to us. Display slide B and let students know that to look at the night sky at different points of the year, we will use Stellarium. Share that each person can pick their birthday or another date that is meaningful to them and that each person will sketch what the night sky looks like at midnight on that date." (Lesson 12, Teacher Guide)

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

- Lesson 1, Connect, Step 1: Broadening Access: "To optimize relevance, value, and authenticity, it is important that students have their ideas recorded in alignment with the ways they share them (e.g., using their own words, capturing gestures they might have used, etc.) when recording students' ideas in the Sky Observations chart. Doing so not only helps students understand what is recorded in the chart, but also sends the message that their language resources and practices are valuable for the classroom community's sensemaking work." (Lesson 1, Teacher Guide)
- Lesson 5, Connect, Step 3: Community Connections: "Lunar calendars guide the cultural, religious, and agricultural practices of many communities around the world, including those represented in the handouts and many others. Inviting students to share their own community knowledge of Moon patterns and experiences with lunar calendars can enhance this discussion and help connect students' at-home and in-school communities in ways that build science identities and value." (Lesson 5, Teacher Guide)
- Lesson 1 Book: Skywatchers in Our Communities highlights two groups of people who have historically used the night sky to guide celebrations or planting (Lesson 1, Book Skywatchers in Our Communities).
- Lesson 5 Teacher Guide, Connect 3: Connect to skywatchers, Community Connection callout: "Lunar calendars guide the cultural, religious, and agricultural practices of many communities around the world, including those represented in the handouts and many others. Inviting students to share their own community knowledge of Moon patterns and experiences with lunar calendars can enhance this discussion and help connect students' at-home and in-school communities in ways that build science identities and value." (Lesson 5, Teacher Guide)

- Lesson 9, Connect, Step 2: "Connecting to our experiences. Display slide C. Showing the image of the night sky on the slide, ask students where the objects we just named on the Our Sky Observations chart would be in this image. Accept all answers, and if any students say that we need to know more about the objects to figure that out, use that comment to motivate research about the sky objects. If no students comment on the difficulty, note that it might be hard to tell what's what among all these things in the sky without more information about the objects." (Lesson 9, Teacher Guide)
- Lesson 9, Connect, Step 2: Community Connections: "Use students' words they use when naming objects in the sky. If they use names of objects in languages other than English or name objects you are not familiar with, ask follow-up questions to understand more about the object they are describing." (Lesson 9, Teacher Guide)
- Lesson 12, Connect, Step 2: "Connect to our experiences. Display slide B and let students know that to look at the night sky at different points of the year, we will use Stellarium. Share that each person can pick their birthday or another date that is meaningful to them and that each person will sketch what the night sky looks like at midnight on that date. Distribute internet-connected devices to each student and guide them to Stellarium." (Lesson 12, Teacher Guide)
- Lesson 12, Connect, Step 2: Broadening Access: "Some religious or cultural groups don't celebrate birthdays or follow a different calendar (e.g., lunar calendar), so students could always choose a different day of the year for this chart." (Lesson 12, Teacher Guide)

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

- Lesson 1, Connect 4: Connect to our communities: "Use slide K to explain to students that we want to find examples of what else we could explain. Distribute the Related Phenomena handout to each student and prompt them to look for or think about sky-related phenomena. Encourage them to record words and/or pictures of the phenomenon that they observe or think about. Have them talk to family or friends about related phenomena and bring their handout back to school for the next lesson." (Lesson 1, Teacher Guide)
- Lesson 9, Explore, Step 3: "Ask comparison questions about student-selected space objects. Display slide D. Tell the class that they will have the opportunity to investigate sky objects they are curious about. Let the class know before starting our research, we'll choose research questions to help us obtain the information we are investigating. Share that we have a website with reliable information we can use for our research and that this website has information about each of the objects on the slide. If students want to research objects from the *Our Sky Observations* chart that are not on the list, there will be an opportunity to research an object not on the list." (Lesson 9, Teacher Guide)
- Lesson 11, Navigate, Step 1: "Revisit the previous investigation. Display slide A and invite students to recall what they were wondering following their arguments...Generate new ideas to explain the differences between the Sun and other stars. Display slide B to support students in beginning to consider how we could figure out why the sun looks so different from the other stars in the sky." (Lesson 11, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

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 express, clarify, justify, interpret, and represent their ideas and to respond to peer and teacher feedback orally and/or in written form as appropriate. Students share ideas with peers directly to elicit ideas from others, and to use others' ideas to improve or change their own thinking. The students are supported to communicate their ideas in ways that are meaningful to them and respectful of their cultures. This can include multiple modes of discourse and the initial expression of ideas in vernacular language or students' home languages. Student artifacts include elaborations, reasoning, and reflection and show how students' reflective thinking has changed over time. Descriptions of student thinking may be written, oral, pictorial, kinesthetic, or models. Supports are provided to guide constructive feedback to students from both the teacher and peers. The feedback is based on displayed student thinking related to the classroom task and is framed to support improvement in how students reason about the phenomenon or problem. Students have opportunities to reflect on and respond to the feedback they receive, when appropriate, using multiple modalities of expression. The teacher has enough support to act as an expert facilitator, drawing out individual student ideas and multiple perspectives in an identity-affirming way. The support is specifically customized to the lesson materials. The classroom discourse includes explicitly expressing, clarifying, and justifying student reasoning. There are teacher-to-student and peer-to-peer feedback loops to help students improve their arguments from evidence using written and verbal feedback.

Student ideas are clarified, justified, and built upon

- Lesson 1, Explore, Step 2: "Broadening Access: The Our Sky Observations chart should capture not only students' ideas, but also the rich ways that students express their ideas. This is especially important for multilingual students because their language resources and practices are not always noticed or valued in school spaces. If a student shares an idea using words or phrases in a named language other than English (e.g., in Spanish, Arabic, Mandarin) or using informal/nonscientific language, record their idea exactly as they shared it and then, if needed, add a translation in English next to it. If possible, have students record ideas onto the chart themselves." (Lesson 1, Teacher Guide)
- Lesson 3, Synthesize, Step 6: "Make predictions about expected observable sun patterns throughout the year. Display slide L and hold a Building Understanding Discussion where the class uses their ideas from Lesson 2 and the revealed yearly shadow patterns recorded on How do shadows change throughout the year chart to make predictions as to the sun's apparent motion and how the length of day and night change seasonally. As students generate these predictions, record them next to the shadow patterns that are used as support." (Lesson 3, Teacher Guide)
- Lesson 6, Navigate, Step 6: "Revisit the Driving Question Board. Display slide P. Direct students to the DQB and consider saying something like, We have figured out a lot of important ideas! Let's see if we can check off any of our questions from the beginning of the unit. Either lead the class or invite students to come up to the DQB and select questions that they think we have answered. Add check marks to those sticky notes. As time allows, have students add new questions to the DQB." (Lesson 6, Teacher Guide)
- Lesson 10, Synthesize, Step 3: "Lead students in critiquing arguments using evidence. Recall that in lesson 7, students wrote and evaluated arguments about the Moon's position in the sky. They evaluated arguments based on whether the argument was accurate, clear, and connected. They will use the same criteria to evaluate arguments about Jupiter that have already been written. Explain that by evaluating whether the argument is accurate, connected, and clear, they will be able to respectfully critique (or point out incorrect components) the arguments." (Lesson 10, Teacher Guide)

- Lesson 13, Synthesize, Step 4: "Build Gotta-Have-It Checklist for arguing from evidence. Display slide G and have a discussion using all of the experiences from the unit to build the aspects of strong argumentation. Record these student contributions on the Gotta-Have-It Checklist." (Lesson 13, Teacher Guide)

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

- Lesson 1, Synthesize, Step 5: "Introduce modeling our initial ideas about the sun-moon-star system. Display slide M. Distribute Initial Model handout to each student. Explain that this handout is what students will use to create their initial model...The prompts on the *Initial Model* handout ask students to consider why the sun and moon appear together. You may need to reassure students that it's okay to not be able to explain exactly what is going on right now–scientists often model to help them understand what they haven't figured out yet.
- One way to reassure students about their uncertainty is to prompt them to add question marks to the places in their model where they're not sure how/whether something happens." (Lesson 1, Teacher Guide)
- Lesson 4, Synthesize, Step 6: "Update the Class Consensus Model. Display slide I and the class consensus model from lesson 1 and use a chart marker with a color that is new to the model. Facilitate a discussion with students about what new ideas should be added to the model based on the evidence that was collected. Use the prompts below to help guide students in updating the class consensus model." (Lesson 4, Teacher Guide)
- Lesson 5, Synthesize, Step 5: "Update our Growing Ideas charts. Conclude the discussion by pointing out that even with our questions, we have still figured a lot out about the Moon's changes in location over days and months." (Lesson 5, Teacher Guide)
- Lesson 7, Synthesize, Step 4: "Refine arguments after evaluating the evidence. Distribute Sun and Moon Data Cards and display slide I. Direct students to part 1 of the handout. Provide students time to discuss revisions they need to make with their small group. Students should refine their argument using another color. Encourage students not to erase anything that they wrote or drew because we want to see how our ideas improve when we evaluate them. They should use the checklist on Sun and Moon Data Cards and the Peer Review feedback they received to improve their arguments. Encourage students to keep the Peer Review handout out on their workspace and refer to the feedback they received as they revise." (Lesson 7, Teacher Guide)
- Lesson 10, Synthesize, Step 4: "Guide students in self reflection of their arguments. Display slide I. Direct students to part 3 of Constructing Arguments about the Sun, where they have an opportunity to reflect on their argument to ensure that it is accurate, clear, and connected. Explain that an accurate claim should come from evaluation of accurate evidence and that the evidence they wrote should be connected to whether the sun can be classified as a star. Once students finish their self reflection, collect students' arguments to assess." (Lesson 10, Teacher Guide)
- Lesson 12, Explore, Step 3: "Develop an individual initial model. Display slide D and distribute the Seasonal Constellation Model handout. Let students know they'll create an initial model to show their ideas about why we can see some constellations only at some times of the year. Point out that they can use the combination of pictures, words, and symbols that works best for them. The lines on the paper are optional in case they want to write any part of their explanation. Refer to the Classroom Agreement that "We share ideas even when we're not sure" and remind students that it's OK to be unsure, but sharing the ideas we have can help us all figure things out together." (Lesson 12, Teacher Guide)
- Lesson 12, Synthesize, Step 4: "Participate in a discussion to debrief our small group modeling experiences. Display slide G and have students arrange their chairs in a circle to form a Scientist's Circle. Have students bring their copy of the Seasonal Constellation Model handout and My Night Sky handout. Take a moment to reflect on the Community Agreements. Ask students to each pick one they want to focus on during the Scientist's Circle." (Lesson 12, Teacher Guide)

Students receive feedback and revise their thinking accordingly.

- Lesson 2, Explore, Step 3: "Display slide G and pair up groups that will be evaluating each other's investigation designs. Inform groups that they can present their drawings or the actual device. As groups describe their design, the evaluating group should think about the following questions: What is similar and different between the two procedures? How well does the other procedure address our *Sun Tracking Considerations*? When one group is done presenting their design, have the evaluating group share a piece of feedback using the following sentence stem: I wonder if you thought about doing _____ to address _____. Give time for the groups to switch roles and repeat the process...Debrief the group evaluations to identify appropriate methods of tracking daily shadow changes. Have students return to their seats and display slide H. Ask the class to debrief the peer evaluations by discussing the following prompts:...Give groups a minute or two to revise their procedures before heading outside." (Lesson 2, Teacher Guide)
- Lesson 6, Synthesize, Step 5: "After students finish this task, collect the handouts to review and provide students with feedback on their progress in evidence-based argumentation. Be sure to offer time for students to read/hear that feedback prior to Lessons 7 and/or 8 so they can take it up during additional argumentation opportunities in those lessons." (Lesson 6, Teacher Guide)
- Lesson 7, Synthesize, Step 4: "Prepare students for peer review. Explain that students will be reviewing each other's arguments so that they can revise them to make them more trustworthy. You may add that scientists often review each other's work and that peer-reviewed work is more widely-accepted as true. Encourage students to provide feedback using "I wonder" statements. If applicable, you may direct students back to the Community Agreements they constructed in Lesson 1. Explain that "I wonder" statements are a respectful way to explore differences in scientific ideas. Instead of assuming that one group is right or wrong, get curious and explore why the difference might have happened. For example, students might start by asking something like "I wonder what happened in our 'figuring out' process that caused us to find different answers here," and that could lead their groups to start explaining the steps they took to get that answer and realize that something unexpected happened along the way. While students provide each other feedback today, students should practice using these statements." (Lesson 7, Teacher Guide)
- Lesson 7, Synthesize, Step 4: "Refine arguments after evaluating the evidence. Distribute Refine Arguments and Self Assessment and display slide H. Direct students to part 1 of the handout. Provide students time with their group to discuss revisions they could make to their original argument. Small groups should refine their argument using another color. Encourage students not to erase anything that they wrote or drew because we want to see how our ideas improve when we get feedback on them. They should use the checklist on the Refine Arguments and Self Assessment handout; encourage students to keep the Argument Peer Review handout out on their workspace and refer to the feedback they received as they revise." (Lesson 7, Teacher Guide)
- Lesson 10, Synthesize, Step 4: "Guide students in self reflection of their arguments. Display slide I. Direct students to part 3 of the Constructing Arguments about the Sun handout, where they have an opportunity to reflect on their argument to ensure that it is accurate, clear, and connected. Explain that an accurate claim should be based on accurate evidence and that the evidence they wrote should be connected to whether the Sun can be classified as a star. Provide time for students to complete the self-reflection...After students finish their self reflection, remind them to go back and revise their arguments if they found they were missing anything from the evaluation checklist...Collect student arguments to assess. Plan to provide written feedback and/or set up conferences to provide oral feedback before Lesson 11 so students can revise their work as needed before their next opportunities to construct arguments from evidence." (Lesson 10, Teacher Guide)

- Lesson 11, Synthesize, Step 4: "Critique and revise arguments for why the Sun looks different than other stars. Display slide N and distribute Critique Arguments About the Sun to each student. Ask the students to evaluate the two arguments for why the Sun looks different from the other stars. After critiquing the arguments, students should choose one to revise using the patterns they discussed today, and construct their revised argument on the handout." (Lesson 11, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

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 learning students are expected to come in with for all three dimensions, and how this learning will be added to during instruction, is explicitly stated. The materials do explicitly identify prior learning expected for all three dimensions, but not at the element level. The supports to teachers clearly explain how the prior learning will be built upon. Learning progresses logically throughout the unit. The materials provide explicit support for teachers to clarify adult understanding of potential alternate conceptions they or their students may have during the unit.

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

Disciplinary Core Ideas:

- 5.4 Sun, Moon, & Star Patterns Unit Front Matter: What ideas and experiences will students bring that can help them in this unit?:
- Apparent Motion of the Sun
  - Students come to school with many experiences of observing changes in the Sun's apparent motion over a day and year, and they will have started explored this idea in 1.3: How do patterns of the Sun, Moon, and stars affect what we see in the sky?. Students often notice that the Sun appears higher or lower in the sky or up for longer or less of a day at different times of year. In this unit, students use their eyesight, as well as data analysis, to observe how the Sun moves across the sky. This provides many opportunities to build on the experiences that students have prior to entering fifth grade. Though students have observed changes in how the Sun seems to move, they may not know why this happens. In Lesson 1, students learn about and make observations of different Sun patterns. They can then connect this learning with their many experiences of observing the Sun while in school, home, and their community.
- Apparent Motion of the Moon
  - Students come to school with varying levels of experience observing the Moon's apparent motion, often noting how its position and phase change from night to night or throughout a month. In 1.3: How do patterns

of the Sun, Moon, and stars affect what we see in the sky?, students noticed the pattern of how the Moon appears to move across the sky. In their own experiences, they may have noticed the Moon rising and setting at different times or its shifting location in the sky. In this unit, students build on their observations, using their eyesight and data analysis to explore the Moon's apparent motion across the sky and its connection to its orbit. This provides opportunities to deepen their understanding of the patterns they may have noticed at home, in their community, or during past learning experiences. In Lesson 1, students observe and analyze Moon patterns, connecting these findings with their prior experiences and laying a foundation for understanding the causes behind the Moon's apparent motion.

- Stars and Constellations
  - For some students, stargazing and watching for constellations may be part of their community and/or family traditions and they will have rich experiences to build from when exploring patterns of stars in this unit. For some students, light pollution, safety concerns, and other factors may have limited their experiences with stars to books and media rather than direct observation. In Unit 1.3: What patterns of the Sun, Moon, and stars can we observe, describe, and predict?, students identify stars as evidence that it is nighttime, but since it is difficult to organize time to observe stars as a school-related event, even students who experienced that unit may not have seen stars at night themselves. Leverage the ideas students do bring, from their own experiences, stories, videos/movies, etc to help them ask questions they want to explore about the patterns of stars and constellations.

- 5.4 Sun, Moon, & Star Patterns Unit Front Matter, Disciplinary Core Ideas Developed in this Unit, ESS1.B Earth and the Solar System: "Students begin by observing and tracking the Sun, a readily visible object during school hours, and revisiting shadow investigations from previous units (1.3: How do patterns of the Sun, Moon, and stars affect what we see in the sky?). They use the length and direction of shadows to determine how the Sun's position changes throughout the day. In Lesson 3, they explore whether these patterns remain consistent year-round. Building on this work, in Lesson 4, students use a model for Earth's rotation to explain the repeating shadow patterns." (5.4 Sun, Moon, & Star Patterns Unit Front Matter)
- Lesson 4, Connect, Step 4: Teaching Tip callout: "The descriptions of Foucault's pendulum used in this lesson are simplified to help students understand the basic idea of his investigations. Complex mathematics can be used to explain why the various Foucault pendulums all over the world have different timings; if you are curious to learn more about these details and others, see the resources in this unit's About the Science document." (Lesson 4, Teacher Guide)
- Lesson 11, Lesson Materials and Preparation: "IMPORTANT LESSON GUIDANCE: As students make sense of stars and why they appear less bright than the Sun, students may raise questions or experiences about stars being hard to observe when there are more lights in the area. The effect of lights on apparent brightness will be explored in 6th grade during OpenSciEd Unit 6.1: Why do we sometimes see different things when looking at the same object? (One-way Mirror Unit). If students bring these questions up, it is ok for you to add them to the DQB, but further exploration into the interaction of different light sources is beyond the scope of this unit." (Lesson 11, Teacher Guide)
- 5.4 Sun, Moon, and Star Patterns, About the Science, provides an overview of what students will figure out in this unit, as well as the boundaries of the science ideas. To support teacher understanding, adult-level recommendations for the key concepts are provided.
- Although prior learning opportunities are provided for the disciplinary core ideas, they are not at the element level.

Science and Engineering Practices:

- 5.4 Sun, Moon, & Star Patterns Unit Front Matter, Intentionally Developed Science and Engineering Practices: "Analyzing and Interpreting Data is also practiced in the first unit in the suggested sequence for fifth grade, Unit 5.1: How does a nurse log help other things live and grow?. In that unit, students are guided in representing data through graphs related to plant growth. As the unit progresses, students apply mathematical and logical reasoning to analyze data on the weight of a termite colony over time and compare it to data collected on mushroom growth, allowing them to explore and contrast different growth patterns." (5.4 Sun, Moon, & Star Patterns Unit Front Matter)
- 5.4 Sun, Moon, & Star Patterns Unit Front Matter, Intentionally Developed Science and Engineering Practices: "Engaging in Argument from Evidence is also developed in Unit 5.1: How does a nurse log help other things live and grow? when students argue about how matter is measured and the factors that plants need to grow. Students also have the opportunity to construct arguments for freshwater accessibility solutions that best meet the criteria and constraints in Unit 5.3: How does changing the flow of water impact Earth's systems, and how can humans help?" (5.4 Sun, Moon, & Star Patterns Unit Front Matter)
- Lesson 4, Explore, Step 3: Developing and Using Models callout: "Building on their prior identification of model limitations in Unit 4.3: What causes Earth's landscape to change and how do the changes impact humans? (Islands Unit) and Unit 5.3: How does changing the flow of water impact Earth's systems, and how can humans help?, students now practice identifying the limitations of our Earth model. These limitations are then used to help motivate the need for additional evidence." (Lesson 4, Teacher Guide)
- Lesson 5, Navigate, Step 1: Asking Questions and Defining Problems callout: "This is an opportunity to practice Asking Questions and Defining Problems. Taking time for the class to ask questions that can be investigated will help to motivate future discussions about how to investigate the Moon's differences in how it appears to travel across the sky. Asking questions was previously intentionally developed in Unit 4.1: Why does an object's motion change? and Unit 4.2: How do we power clocks and other devices?" (Lesson 5, Teacher Guide)
- Lesson 6, Explore, Step 2: Developing and Using Models callout: "This is an opportunity for students to practice developing and using models. By collaboratively analyzing the Sun and Moon Data Cards to co-construct the locations the Moon needs to be in order to recreate the apparent location of the Moon and Sun, students can co-construct a model for the Moon's monthly patterns. Students previously intentionally developed modeling in Unit 5.1: How does a nurse log help other things live and grow? and Unit 5.3: How does changing the flow of water impact Earth's systems, and how can humans help?" (Lesson 6, Teacher Guide)
- Although prior learning opportunities are provided for the science and engineering practices, they are not at the element level.

Crosscutting Concepts:

- 5.4 Sun, Moon, & Star Patterns Unit Front Matter, Intentionally Developed Crosscutting Concepts: "Students bring a wealth of experience to this unit with the crosscutting concept of patterns. Every unit in third grade and fourth grade develops or practices this concept, so students can build on those experiences here as they identify and use patterns to help them make sense of science ideas in the vast and possibly more unfamiliar context of space. In *Unit 1.3: What patterns of the Sun, Moon, and stars can we observe, describe, and predict?*, students observed, described, and predicted patterns of motion of the Sun, Moon, and stars, including seasonal differences in sunrise and sunset, and they likely have noticed some of these patterns in their everyday lives, as well. If they have experienced *Unit 5.1: How does a nurse log help other things live and grow?*, students focused on using patterns in the growth of termite colonies and mushrooms as evidence to support explanations about how organisms get energy and matter to grow. Students have used similarities and differences in patterns to sort and classify and communicate about phenomena throughout

third grade and more recently in *Unit 4.2: How do we power clocks and other devices?*. However this unit includes their first opportunity to use similarities and differences in patterns in regard to rates of change when they communicate how the differences in rates of changes in the Moon's and Sun's locations can be used to support arguments." (5.4 Sun, Moon, & Star Patterns Unit Front Matter)

- 5.4 Sun, Moon, & Star Patterns Unit Front Matter, Intentionally Developed Crosscutting Concepts: "Students will bring ideas about this crosscutting concept from their everyday lives, other school experiences, and prior science units. Students have used standard units to measure and describe qualities such as time (e.g., in their school days, family schedules, and community histories), temperature (e.g. when considering the weather forecast or when helping in the kitchen), and distance (e.g. measuring lengths in math classes, talking about how far they go to get home or go visit relatives). Students also used standard units (centimeters, angles in degrees) to be sure their kick system investigations were fair tests in *Unit 4.1: Why does an object's motion change?*. If students have already experienced *Unit 5.2: How can we make water healthy for all living things?*, they used standard units (grams/kilograms) to measure weights of their water samples before and after filtering and to determine if the amount of matter in a system stayed the same or changed. Students have also had prior experiences considering how natural objects and observable phenomena exist at vastly different scales. In *Unit 5.1: How does a nurse log help other things live and grow?* and Unit 5.2, students make sense of the idea that matter is made of particles so small we cannot see them. However this unit will not address phenomena that are very small or that span short times or distances. In *Unit 3.3: Why do animals look and act the way they do?*, students use physical timelines to help them comprehend the immense scale of relative ages of fossils. That timeline work will be helpful to students as they create number lines in this unit to help them compare the incredible sizes of celestial objects and make sense of the immense scale of distances in space." (5.4 Sun, Moon, & Star Patterns Unit Front Matter)
- Lesson 4, Explore, Step 2: Patterns callout: "Students previously used patterns to support an explanation in Unit 4.3: What causes land and things on it to change? How can we reduce the impacts on humans? and Unit 5.1: How does a nurse log help other things live and grow?. Students also practiced using patterns to make predictions in Lessons 2 and 3 of this unit. Here, students are practicing the use of patterns to support both predictions and possible explanations for the shadow patterns observed in Lessons 2 and 3, as well as motivate the need for further investigation." (Lesson 4, Teacher Guide)
- Lesson 5, Explore, Step 2: Patterns callout: "Students continue developing this crosscutting concept to help them make predictions about what they would expect to see. Students used patterns to help them make predictions in the context of when we see objects in the sky in Unit 1.3: What patterns of the Sun, Moon, and stars can we observe, describe, and predict?, but since then they have had numerous other experiences using patterns to make predictions in more recent OpenSciEd units." (Lesson 5, Teacher Guide)
- Lesson 5, Explore, Step 4: Scale, Proportion, and Quantity callout: "Students use standard units for measuring the apparent distance the Sun and Moon seem to travel by noon on different days. Traditionally, scientists have used a measure called azimuth, which is the angle a sky object is from true north. To keep everything in view of the image, the angle is measured from the eastward direction in this lesson. Thinking about Scale, Proportion, and Quantity was previously intentionally developed in *Unit 5.1: How does a nurse log help other things live and grow?*, *Unit 5.2: How can we make water healthy for all living things?*, and *Unit 5.3: How does changing the flow of water impact Earth's systems, and how can humans help?*. Students build on that foundational work in this lesson as they figure out the differences between 2 angle measurements to make sense of how the Moon appears to move through the sky differently than the Sun." (Lesson 5, Teacher Guide)
- Lesson 6, Synthesize, Step 3: Cause and Effect callout: "This is an opportunity for students to practice using cause and effect relationships to explain change. By identifying the cause (the Moon's orbit) of the Moon appearing in different locations at the same time each day, students will be able to support an argument for the time and day for a

new moment. To construct and support this argument, students will need to use the Moon's orbit to figure out where in the Moon's orbit would produce the given image. Students previously developed their cause and effect thinking in Unit 5.2: How can we make water healthy for all living things? and Unit 5.3: How does changing the flow of water impact Earth's systems, and how can humans help?" (Lesson 6, Teacher Guide)

- Although prior learning opportunities are provided for the crosscutting concepts, they are not at the element level.

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

- Lesson 2, Synthesize, Step 4: Analyzing and Interpreting Data callout: "This is an opportunity to intentionally develop the practice of Analyzing and Interpreting Data. Each group's Sun Tracker setup will have small differences, leading to variations in their measured shadow lengths. The goal of this discussion is to identify the similar patterns in each group's data, but acknowledging the differences is also an important moment. This type of analysis will help in Lessons 3 and 8, where data sets also show both similarities and differences. In all three of these lessons, the variations in data collection are acknowledged, but the sensemaking focuses on patterns that remain consistent across all locations, times, or setups." (Lesson 2, Teacher Guide).
- Lesson 8, Explore, Step 3: Scale, Proportion, and Quantity callout: "This is an opportunity to have students make sense of observable phenomena using standard units that describe time. Students will use both the reported sunrise and sunset times, as well as the length of day and night described in total hours. Students will again use standard units of measure to make comparisons in Lessons 9 and 10." (Lesson 8, Teacher Guide)
- Lesson 9, Lesson Assessment Guidance: "This is an opportunity for students to reflect on one of the key SEPs for the unit: analyzing and interpreting data. They can consider the affordances and limitations of different data representations. Students will reflect on their initial ideas about similarities and differences and whether their ideas have changed based on the line graph of the data." (Lesson 9, Teacher Guide)
- 5.4 Sun, Moon, & Star Patterns Unit Front Matter: What ideas and experiences will students bring that can help them in this unit?:
  - Apparent Motion of the Sun
    - Students come to school with many experiences of observing changes in the Sun's apparent motion over a day and year, and they will have started explored this idea in 1.3: How do patterns of the Sun, Moon, and stars affect what we see in the sky?. Students often notice that the Sun appears higher or lower in the sky or up for longer or less of a day at different times of year. In this unit, students use their eyesight, as well as data analysis, to observe how the Sun moves across the sky. This provides many opportunities to build on the experiences that students have prior to entering fifth grade. Though students have observed changes in how the Sun seems to move, they may not know why this happens. In Lesson 1, students learn about and make observations of different Sun patterns. They can then connect this learning with their many experiences of observing the Sun while in school, home, and their community.
  - Apparent Motion of the Moon
    - Students come to school with varying levels of experience observing the Moon's apparent motion, often noting how its position and phase change from night to night or throughout a month. In 1.3: How do patterns of the Sun, Moon, and stars affect what we see in the sky?, students noticed the pattern of how the Moon appears to move across the sky. In their own experiences, they may have noticed the Moon rising and setting at different times or its shifting location in the sky. In this unit, students build on their observations, using their eyesight and data analysis to explore the Moon's

apparent motion across the sky and its connection to its orbit. This provides opportunities to deepen their understanding of the patterns they may have noticed at home, in their community, or during past learning experiences. In Lesson 1, students observe and analyze Moon patterns, connecting these findings with their prior experiences and laying a foundation for understanding the causes behind the Moon's apparent motion.

  - Argumentation
    - Students will have experiences arguing from evidence in several prior grade levels, and in Unit 5.1: How does a nurse log help other things live and grow? if they already completed that unit. However, students may still consider argumentation to be negative and bring ideas about everyday arguments to the classroom. The book Scientists Use Evidence in Lesson 7 will continue students' development in the idea of scientific argumentation and how scientists use evidence to try to reach agreement to help explain observations about the natural world. Students will have an opportunity to build on their ideas of everyday augmentation before they read the book, and then have multiple opportunities to practice scientific argumentation throughout the unit.

- The Unit Front Matter does not identify specific elements of the three dimensions.

Criterion-Based Suggestions for Improvement

- Ensure "[t]he materials explicitly state the expected level of prior proficiency students should have with individual elements of all three dimensions for the core learning of the materials." (EQuIP Detailed Guidance, p. 24)
- Ensure "[a]progression of learning toward the targeted elements of all three dimensions is clearly described for teachers for each section of the materials." (EQuIP Detailed Guidance, p. 25)

II.D. Scientific Accuracy

EXTENSIVE

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

The reviewers found **extensive** evidence that students do use scientifically accurate and grade-appropriate scientific information, phenomena, and representations to support students' three-dimensional learning. Teachers are provided guidance in how to support students in understanding the patterns occurring in the day and night sky and the effects that are visible to the observer. The science ideas and representations included in the materials are accurate.

- Lesson 4, Explore, Step 2: Teaching Tip: "At this point in the lesson students may still have differing ideas about the causes of the patterns. Some groups may suggest we investigate the Earth spinning with the flashlight held still. Other groups may suggest we investigate the Earth still with the flashlight moving. Do not correct students but allow them to share all possible causes. Later in the lesson students will read a book that helps to provide evidence of the Earth's rotation." (Lesson 4, Teacher Guide)

- Lesson 11, Synthesize, Step 4: "Discuss the relationship between brightness and distance. Display slide L and ask for two volunteers to hold two different flashlights. Have them stand close to the board or wall with a clear path to back up. Turn the lights off in the room and have the students slowly back up. As they do this, ask other students to share what they notice about the brightness of the light on the wall…Discuss the relationships between distance and apparent size of light. Have the student volunteers return to their spots in the circle. Invite the class to consider another perspective of the effect that distance has on light: if we are looking at a light that is further away. Remind students that we have noticed that the Sun appears brighter since it is close, but it also looks bigger than the other stars. Ask students to make observations about how the light seems to change in a video of cars moving closer to the camera at night. Play the video on slide M and discuss." (Lesson 11, Teacher Guide)
- Lesson 12, Synthesize, Step 4: Teaching Tip callout: "Students may bring up orbit. If they do, focus on asking them to demonstrate that with the model and asking what the effect of different locations would be on how the objects appear in the sky. The idea that the Earth orbits around the Sun will be formalized next, so supporting making sense of the effect of different relative positions is key for this discussion." (Lesson 12, Teacher Guide)
- Lesson 13, Synthesize, Step 3: Teaching Tip: "To support students in their arguments in Arguments for Sky Patterns, it's important to use this moment to explicitly identify the role of Earth's orbit AND rotation in causing the seasonal viewing of certain constellations. Earth's rotation allows us to move away from the Sun and see constellations each night as the Earth orbits around the Sun. And it is this orbit that causes us to view a different part of the universe each time the Earth rotates." (Lesson 13, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

II.E. Differentiated Instruction

EXTENSIVE

Provides guidance for teachers to support differentiated instruction by including:

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

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

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

The reviewers found **extensive** evidence for teachers to support differentiated instruction because the materials clarify how they anticipate the needs of students who might struggle with any of the three dimensions within a particular activity. The materials clarify how they anticipate the needs of students who might struggle with any of the three dimensions within a particular activity and provide multiple, varied, individualized learning strategies that support three-dimensional sensemaking throughout the unit, including specific guidance for key formative and summative assessments. Differentiation strategies clarify how they address the needs of multilingual learners and students who read below grade level. Not all groups are necessarily supported in every activity, but they are supported most of the time when an obvious need arises. Supports, such as multiple modalities, are provided throughout the materials for students who are struggling to meet performance

expectations or any of the three dimensions, with guidance on how to determine their understanding at that point in the lesson. Extensions are provided for students who have already met the performance expectation(s) or who have a high interest in the subject matter and are ready to develop a deeper understanding in any of the three dimensions.

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.

- Unit Front Matter, Unit Specific Strategies: "For this unit specifically, it is important to consider the following: Consider ways to engage all students in science talks through the Scientist's Circle. This is an opportunity for students to see and hear one another to build community learning across the class. During the Scientist's Circle discussions, it is important to look for *how* students are sharing their ideas in addition to *what* ideas and questions they might be sharing. Students might share ideas through talk, motions, gestures, facial expressions, etc. Young children have many rich ways of communicating, and it is important to welcome, recognize, and value all their ways of communicating. Throughout this unit, students will develop additional language resources and practices that will further support their scientific communication. For students who are unable to see the daily changes in shadows, consider having them feel the Sun's location by facing south and using the warmth of the Sun to determine its location. For students with visual impairments, consider using tactile models to support them in identifying and explaining changes in location of the Sun, Moon, and stars. This unit involves a great deal of text and graphical analysis. Be sure to use various tools as needed to help students access these texts, such as increasing font size, using screen readers, or turning on video captions." (5.4 Sun, Moon, & Star Patterns Unit Front Matter, pgs. 37-38)
- Lesson 1, Connect, Step 1: Broadening Access: "To optimize relevance, value, and authenticity, it is important that students have their ideas recorded in alignment with the ways they share them (e.g., using their own words, capturing gestures they might have used, etc.) when recording students' ideas in the Sky Observations chart. Doing so not only helps students understand what is recorded in the chart, but also sends the message that their language resources and practices are valuable for the classroom community's sensemaking work." (Lesson 1, Teacher Guide)
- Lesson 1, Explore, Step 2: Broadening Access: "The *Our Sky Observations* chart should capture not only students' ideas, but also the rich ways that students express their ideas. This is especially important for multilingual students because their language resources and practices are not always noticed or valued in school spaces. If a student shares an idea using words or phrases in a named language other than English (e.g., in Spanish, Arabic, Mandarin) or using informal/nonscientific language, record their idea exactly as they shared it and then, if needed, add a translation in English next to it. If possible, have students record ideas onto the chart themselves." (Lesson 1, Teacher Guide)
- Lesson 4, Explore, Step 2: "Broadening Access: You can provide multiple means of action and expression by varying response methods and navigation. For example, provide ample time for students to process their thinking before recording their answers, allow students to answer orally while you record on the Investigation Chart, allow students to discuss in pairs, or provide choices to write or draw their ideas." (Lesson 4, Teacher Guide)
- Lesson 6, Navigate, Step 1: "Once the class has established that the Moon is between the Sun and Earth, start building consensus around the fact that the Moon is moving as the Earth rotates." Teacher prompts include "Can you use your hands and body to show where the Earth, Moon, and Sun are on Day 3? Can anyone say that in a different way? Can you use your hands to show what you mean? What does your fist represent? So if the Moon is no longer in between the Sun and Earth after three days, what might be happening while the Earth rotates to cause the Moon's changing location? *Use your hands to gesture the Moon being out of line between the Sun and Earth.*" (Lesson 6, Teacher Guide)
- Lesson 6, Explore, Step 2: "Broadening Access: If there is a student(s) with a disability related to mobility in your class, it should not exclude them from participating in the physical model. Instead, you will need to adjust this

exploration to ensure their equitable participation. Work with the student's case manager as needed, but ideas for providing multiple means of engagement include using peer support to help facilitate movement and direction and having the actors sit instead of stand." (Lesson 6, Teacher Guide)

- Lesson 7, Synthesize, Step 3: "Broadening Access: Pairing students in groups of 3 or more will help support students who want to use their bodies to model the Earth's rotation and Moon's orbit, like they did in Lesson 5." (Lesson 7, Teacher Guide)
- Lesson 13, Navigate, Step 1: "Broadening Access: You can provide multiple means of action and expression by varying response methods and navigation. For example, provide ample time for students to process their thinking before recording their answers, allow students to answer orally while you record on the DQB, allow students to work in pairs, or provide choices for paper or writing tools to accommodate writing needs." (Lesson 13, Teacher Guide)
- Lesson 13, Synthesize, Step 4: Broadening Access: "Consider providing students, especially multilingual students and students with accommodations that call for a variety of options in demonstrating understanding, options other than writing or drawing to share their ideas on the Star Patterns Assessment. For example, you could conference with students or allow them to record a video of their responses, both of which would invite students to use gestures and talk to help them communicate their ideas." (Lesson 13, Teacher Guide)
- Lesson 13, Synthesize, Step 4: "Literacy Supports: Students practice writing arguments to support a claim. This is a form of informative or explanatory text writing, in which students should use data and evidence, along with science ideas to make a convincing argument. You might remind students that a strong argument conveys ideas and information clearly (W.5.2)." (Lesson 13, Teacher Guide)

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

Emerging multilingual students learning English:

- Lesson 1, Explore, Step 2: Broadening Access: "The Our Sky Observations chart should capture not only students' ideas, but also the rich ways that students express their ideas. This is especially important for multilingual students because their language resources and practices are not always noticed or valued in school spaces. If a student shares an idea using words or phrases in a named language other than English (e.g., in Spanish, Arabic, Mandarin) or using informal/nonscientific language, record their idea exactly as they shared it and then, if needed, add a translation in English next to it. If possible, have students record ideas onto the chart themselves." (Lesson 1, Teacher Guide)
- Lesson 9, Connect, Step 2: Community Connections: "Use students' words they use when naming objects in the sky. If they use names of objects in languages other than English or name objects you are not familiar with, ask follow-up questions to understand more about the object they are describing." (Lesson 9, Teacher Guide)
- OpenSciEd Elementary & Accessibility: "As students are learning a language, it is often helpful to repeat words aloud as they are being written. This gives all students two possible ways to access the information - through the written word and auditory listening. This is particularly necessary if any students in your class have visual needs that would prevent them from seeing a shared classroom representation that is written on a chart." (Additional Accessibility, OpenSciEd Elementary & Accessibility)

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

- Lesson 2, Explore, Step 3: Broadening Access: "To minimize threats and distractions, be sure to follow students' accommodations on their IEP or 504 plan to support observations and sense making through imagery. This can include but is not limited to preferential seating, magnifier or other assistive and instructional technologies, access

to a print copy of the image, and providing time to pause and process the image before prompting for a response." (Lesson 2, Teacher Guide)

- Lesson 5, Explore, Step 4: "Broadening Access: To offer alternatives for visual information, consider providing tactile representation for the Moon and Sun, such as placing or gluing an object, like gem stickers, on the Moon and Sun locations for each *Sun and Moon Data Cards*." (Lesson 5, Teacher Guide)
- Lesson 9, Connect, Step 2: Broadening Access: "To increase access to the visual information for students with visual impairments, you can provide students alternate versions of the image from such as with a printed hard copy or through assistive and instructional technology. In addition, consider using zoom in features, student proximity to the image when it is displayed and provide time for students to make observations before asking students to share their answers." (Lesson 9, Teacher Guide)
- Lesson 10, Explore, Step 2: Broadening Access: "To help guide information processing and visualization during the gallery tour consider the following strategies: read out loud the instructions and prompts provided on [EU.L10.HO1,1] and check for understanding before students begin to tour; enlarge the line plots for easy visual access; and consider providing multiple means of expressions such as allowing students to orally answer the prompts. If you feel that some of your students might be overwhelmed by looking at all of the groups of data, you can assign a range of line plots for students to focus on." (Lesson 10, Teacher Guide)
- Lesson 11, Connect, Step 2: "Broadening Access: To increase access to the visual information, you can provide students alternate versions of the image from such as with a printed and enlarged copy of the image; through support of assistive and instructional technology; or by adding small tactile items (e.g., balls of Playdoh) to the display to form the constellations. In addition, consider: using brightening and zoom in features, student proximity to the image when it is displayed, and provide time for students to make observations before asking students to share with their partner." (Lesson 11, Teacher Guide)

Learners reading below grade level

- Lesson 3, Connect, Step 4: "Broadening Access: You can make a copy of Scientists Represent Data book available for students to read individually or with a partner rather than in a whole class if that better fits students' needs. The optional handout, How Scientists Represent Data, can help students differentiate between graphical representations. Additionally, you could make the book available for students after the read-aloud to refer to as they think about data representations throughout the unit." (Lesson 3, Teacher Guide)
- Lesson 5, Connect, Step 3: "Connect to skywatchers from different communities. Organize students into groups of three, then display slide F and distribute one of the Lunar Calendars to each trio. Direct students to read and analyze their handout by discussing the following prompts: What patterns did this community notice when they watched the Moon? How did tracking the Moon's patterns support the community?" (Lesson 5, Teacher Guide) Supports are not provided to assist students who read below grade level.
- Lesson 5, Connect, Step 2: Literacy Supports callout: "Consider identifying the word hanííbą ˛ ą ˛ z (hah-NEE-bahnz) in the text prior to reading, since it may be difficult for some students to pronounce. Give students ample practice saying the name before reading to ensure their comprehension of the text. Additional strategies to help developing readers are described in the "Supporting Literacy for All Students" section of the Teacher Handbook." (Lesson 5, Teacher Guide)
- Lesson 7, Connect, Step 2: "Read The Scientists Use Evidence as a class, then use the following prompts to facilitate a discussion about how the book connects to evidence students have recorded on the Moon Evidence chart." (Lesson 7, Teacher Guide) It is implied that the teacher reads this to the class to support access by all students.

- Lesson 9, Explore, Step 3: "Obtain information from texts. Show slide E. Let students know they'll have 20 minutes in their pairs to capture their research. Circulate as students work, and check in on their research as they work. As you circulate, ask questions to get a sense for how students are making sense of the very large numbers. At this point, ask questions that make sure they're capturing research data accurately, but don't push on how they're comparing numbers. They will have another opportunity to compare numbers during Synthesize."
- Lesson 9, Explore, Step 2: Literacy Supports callout: "The website students use to research space objects includes multiple different representations of numerical information (e.g., standard form, words, fractions, decimals). Some students may benefit from additional time to process and comprehend the information on the website because it combines domain-specific vocabulary from math and science. You might consider allowing these students to read the website prior to the start of this lesson to ensure that every student has sufficient time to research space objects on the website. Additional strategies to help developing readers are described in the "Supporting Literacy for All Students" section of the Teacher Handbook." (Lesson 9, Teacher Guide)
- Lesson 10, Synthesize, Step 3: "Distribute Evaluating and Critiquing Arguments and display slide E. Read the first argument as a class and encourage students to underline any part of the argument that they think is incorrect. Once students have identified incorrect elements, ask them to consider if the argument is inaccurate, disconnected, or unclear. Direct students to the Space Object Classification chart they co-created and encourage them to use evidence from their classifications to disprove the argument. Group students into small groups and have them work to critique arguments 2 and 3." (Lesson 10, Teacher Guide) Additional supports are not provided for students who read below grade level.
- Lesson 11, Synthesize, Step 4: "Literacy Supports: Students will examine and critique the claims and evidence provided by the author of the example arguments (RI.5.8). Then students will develop and strengthen the provided arguments by revising and rewriting (W.5.5)." (Lesson 11, Teacher Guide) Additional supports are not provided for students who read below grade level.
- OpenSciEd Elementary & Accessibility: "Utilize text-to-speech and speech-to-text technologies. All OpenSciEd Google docs allow screen readers to read aloud the text for students. This can be helpful for students who need to hear a reading a second time or would benefit from seeing the words underlined and read aloud one at a time. Each school has different computing technologies, so we have compiled a Technical Glossary for you and your school to use as needed to integrate these technologies onto your computing devices. This glossary provides many additional technology options beyond speech-to-text or text-to-speech technologies, allowing students to communicate their learning in science by using assistive technology to do so." (Additional Accessibility, OpenSciEd Elementary & Accessibility)

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

- Lesson 4, Connect, Step 4: "Extension Activity: If students still need more support in understanding the pendulum you can take a few moments to have them kinesthetically model the pendulum. If students are ready to move on after the video you may skip this step. Select one student to act as the pendulum and ask them to walk back and forth in a straight line. Have several other students form a circle around the person walking back and forth. Point out that if the Earth was not turning then only a few pins (people) would be knocked over by the pendulum ball. Have students in the outside circle begin to move counterclockwise. Point out that each person in time would move into the path of the pendulum, because the Earth is turning underneath the swinging pendulum." (Lesson 4, Teacher Guide)
- Lesson 7, Synthesize, Step 3: "If students need additional support in reasoning where the position of the Moon will be over time, guide small groups in using their bodies as physical models, as they did in Lesson 5. You might also explain that when the Sun is rising, our perspective on Earth is facing south." (Lesson 7, Teacher Guide)

- Lesson 9, Synthesize, Step 4: "To help introduce numerical and categorical data, have students share how they organized the cards for each measurement or category. Highlight examples where students sorted cards in numerical order, like biggest to smallest, or grouped them by shared traits, as shown on the slide. This activity emphasizes the differences in organizing measurement versus categories data." (Lesson 9, Teacher Guide)

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

- Lesson 2, Explore, Step 3: "Extension Opportunity: Students likely learned how to use protractors to measure angles in fourth grade mathematics, and they or you may suggest using them as part of their investigation. If desired, allow students to use protractors to help them measure how the angle of the shadow changes in relation to its direction." (Lesson 2, Teacher Guide)
- Lesson 8, Explore, Step 4: "Extension Activity: If some students are wondering whether their local area would follow the same patterns, consider adding the day lengths for your local area. Use Time and Date find the day lengths. All places should follow the same patterns: highest in June, lowest in December, and the equinoxes in March and September." (Lesson 8, Teacher Guide)
- Lesson 9, Explore, Step 3: "Extension Opportunity: It is recommended that students choose at least two of their focal objects from the list on slide D. If they want to pick one object outside of this list, they should complete Part A of Comparison Research for the two objects from the list first. After that, students should use the process established in your class for researching online, focusing on articles rather than videos or simulations. Share that this will take more time, which is why we want to limit our research to one object beyond the source material." (Lesson 9, Teacher Guide)

Criterion-Based Suggestions for Improvement

- Ensure guidance for teachers to support differentiated instruction by including the following.
  - "Appropriate reading, writing, listening, and/or speaking alternatives (e.g., translations, picture support, graphic organizers, etc.) for students who…read well below grade level." (EQuIP Detailed Guidance, p. 27)

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 help teachers guide meaningful, connected learning over time by providing routines that make the structure and flow of the unit clear to students as it progresses. Strategies for linking student engagement across lessons are routine and occur at the beginning and end of every lesson. Guidance and support are provided on how to recognize what students figure out in a lesson, which questions remain unanswered, and which new questions could be answered in the next investigation. Frequent guidance or tools are provided to teachers to support linking student engagement across lessons. Strategies are provided to support teachers as they help students connect phenomena across lessons. Throughout the unit, teacher guidance and strategies are provided to ensure that students see their learning in all three dimensions as coherently linked to the progress they make toward explaining phenomena or designing solutions to problems.

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.).

- Lesson 1, Synthesize, Step 5: Broadening Access: "Sitting (or standing) in a circle where they can face one another can help support students' engagement and build a sense of shared mission. The Scientist's Circle is an important tool for developing students' agency in their learning as they take stock of what they have figured out and decide where they need to go next. Share with students that professional scientists also collaborate with one another to brainstorm, discuss, and review their work." (Lesson 1, Teacher Guide)
- Lesson 2, Explore, Step 3: "To ensure all students have opportunities to make observations, we encourage teachers to be creative around when supervised student pairs might make these observations. For instance, supervised pairs of students could make observations during transition times; during independent working time; and/or on the way to or from specials, other classrooms, or instructional-support meetings." (Lesson 2, Teacher Guide)
- Lesson 5, Synthesize, Step 5: Broadening Access: "To support students problematizing why the Earth's rotation cannot explain the difference of movements, consider placing the physical model from Lesson 4 at the center of the Scientist's Circle. Use an object to represent the Moon. Then spin the Earth to simulate its rotation as you ask the question "Can the Earth's rotation explain both the Sun's AND Moon's apparent motion across our sky?". This prompt will highlight patterns, and help students find patterns that relate to the learning goal. The goal of this moment is to get students to wonder whether more things are moving." (Lesson 5, Teacher Guide)
- Lesson 7, Synthesize, Step 4: Broadening Access: "If students have limited experience with peer review, or if directions seem unclear to students, project one group's work for the rest of the class. Work as a class to practice using "I wonder..." statements and the prompts on Tracking the Sun and Moon to evaluate the evidence together before moving on to evaluating evidence in small groups." (Lesson 7, Teacher Guide)

- Lesson 9, Explore, Step 3: Broadening Access: "If there are students who would benefit from scaffolding before starting to research, the teacher can give instructions both verbally and visually by modeling how to fill in a box or two on the handout before students start working on their own." (Lesson 9, Teacher Guide)
- Lesson 13, Navigate, Step 1: Broadening Access: "You can provide multiple means of action and expression by varying response methods and navigation. For example, provide ample time for students to process their thinking before recording their answers, allow students to answer orally while you record on the DQB, allow students to work in pairs, or provide choices for paper or writing tools to accommodate writing needs." (Lesson 13, Teacher Guide)

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

- Lesson 1, Navigate, Step 6: Ask questions, AQDP callout, "This is an opportunity for students to practice asking questions that can be investigated to explore the cause and effect relationships driving these observable patterns. Challenge students to develop a unit question pushing our thinking to better understand the mechanisms driving the observable patterns. Then in slide V as students are brainstorming ideas for investigations, call back to this co-constructed unit question by asking students to consider how their ideas for investigation would support us figuring out the unit question." (Lesson 1, Teacher Guide)
- Lesson 2, Synthesize, Step 4: Have a discussion, DATA callout: "This is an opportunity to intentionally develop the practice of Analyzing and Interpreting Data. Each group's Sun Tracker setup will have small differences, leading to variations in their measured shadow lengths. The goal of this discussion is to identify the similar patterns in each group's data, but acknowledging the differences is also an important moment. This type of analysis will help in Lessons 3 and 8, where data sets also show both similarities and differences. In all three of these lessons, the variations in data collection are acknowledged, but the sensemaking focuses on patterns that remain consistent across all locations, times, or setups." (Lesson 2, Teacher Guide)
- Lesson 4, Explore, Step 3: Teaching Tip: "Consider setting a timer for 12 minutes to keep students on track to finish the investigation in the time allotted. During this time it would be helpful to turn off the overhead lights and reduce outside light as much as possible." (Lesson 4, Teacher Guide)
- Lesson 6, Navigate, Step 1: Teaching Tip: "The student response of 'orbit' is included in this discussion to help support teachers in classrooms where students bring this prior knowledge into the discussion. It is not expected for students to use the word orbit at this point in the sensemaking. Asking kids to explain what they mean by this idea is important to ascertain the connections students are thinking about. The class will co-construct a definition for orbit during the Connect, so it is appropriate to keep this idea ambiguous at this moment." (Lesson 6, Teacher Guide)
- Lesson 13, Synthesize, Step 3: Developing and Using Models callout: "This is the final opportunity to have students practice revising a model collaboratively. Sometimes the revision of a model is not about adding or removing elements, but looking at the model from a different perspective. This movement of revision will serve as the evidence for their arguments in Arguments for Sky Patterns" (Lesson 13, Teacher Guide)
- Lesson 13, Synthesize, Step 3: Teaching Tip: "To support students in their arguments in Arguments for Sky Patterns, it's important to use this moment to explicitly identify the role of Earth's orbit AND rotation in causing the seasonal viewing of certain constellations. Earth's rotation allows us to move away from the Sun and see constellations each night as the Earth orbits around the Sun. And it is this orbit that causes us to view a different part of the universe each time the Earth rotates." (Lesson 13, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

II.G. Scaffolded differentiation over time

EXTENSIVE

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 **extensive** evidence that supports are provided to help students engage in the practices as needed and to gradually adjust supports over time so that students are increasingly responsible for making sense of phenomena for all of the intentionally developed SEP elements. These elements, which are scaffolded throughout the unit, are identified in the Front Matter, and evidence is presented showing how scaffolding is removed as students take more individual ownership of them.

DATA: Analyzing and Interpreting Data

- 5.4 Unit Front Matter: "Students' development of this practice is supported by multiple formative assessment opportunities throughout the unit, a summative assessment in Lesson 8, and self-reflections in Lessons 9 and 11." (5.4 Sun, Moon, & Star Patterns Unit Front Matter)

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 Lessons 3, 8, 9, and 11.

Students are supported in representing data in a table as a whole class and prompted to consider other ways that might be useful. Then they work with a partner to use a tool to create a line graph. Next, small groups create a table and a line plot of the same data, and individuals reflect on which helped them to understand the data. Finally, pairs determine which tool, a table or a graph, to use to find patterns in data. Evidence was found in claimed lessons, examples include

- Lesson 3, Explore, Step 3: "After the class has had a chance to share out some of the patterns that were revealed in the data, ask students to consider how the process of identifying patterns went and problematize new ways of representing the data that might help reveal patterns in shadow length." (Lesson 3, Teacher Guide) Students analyze data in a table as a whole class and are supported to consider other ways to represent data to reveal patterns.
- Lesson 8, Student Materials, Handout 2: "Use CODAP: Lesson 8 Link, to build a line graph comparing all three locations' hours of sunlight over a single year. Draw and label what you and your partner's graph in the space provided." (Lesson 8, 5.4 Lesson 8 Handout 2 Hours of Daylight) Students work with a partner to analyze data on a line graph they generated using CODAP, an online data exploration and analysis tool.
- Lesson 9, Synthesize, Step 4: "Set a timer or announce time remaining occasionally as groups work. As groups create their line plots, circulate and ask them clarifying questions about their scales and how they're making decisions about where to place different objects." (Lesson 9, Teacher Guide) Students work in small groups to create tables and line plots to compare measurements (e.g., size, distance, and temperature) for objects in the sky. Different groups are responsible for different measurements. After comparing, students self-reflect on what was easier for them to understand: a data table or a line plot.
- Lesson 11, Explore, Step 3: "Option 1 - Revealing patterns in star data using a data table. Display slide G and distribute Star Size, Distance and Brightness Data Table to each student. Have partners analyze parts of the data table by circling the largest and smallest values in different columns. After students have done the analysis, they should discuss whether any of the patterns might help us figure out how the Sun compares to other stars." (Lesson 11, Teacher Guide) Students work in pairs to consider which tool, a table or graph, would be more helpful in seeing patterns and relationships in their star data to explain why the sun looks so different from the other stars.

- Lesson 11, Explore, Step 3: "Option 2 - Revealing patterns in star data using a line plot. Display slide H and distribute Star Line Plots and an internet-connected device to each student. Have partners analyze parts of the data table by circling the largest and smallest values in different columns. After students have done the analysis, they should discuss whether any of the patterns might help us figure out how the Sun compares to other stars." (Lesson 11, Teacher Guide)

Claimed Element: **DATA-E2: Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.**

Claimed in Lessons 5, 8, 10, and 13.

There is a gradual release of scaffolding to support students in analyzing and interpreting data to make sense of a range of data, data representations, and amounts of data from practicing an example of mathematical analysis before group work; modeling a way to visualize data across multiple data sets; and supporting students to generate additional questions to investigate from a bar graph. Evidence was found in claimed lessons, examples include

- Lesson 5, Explore, Step 4: "Carry out Sun and Moon Tracking Investigation. Display slide K and distribute Tracking the Sun and Moon. Have students record the example algorithm (or other chosen subtraction method) on Page 1. Then distribute Sun and Moon Data Cards to each group. You can also provide scratch paper or grid paper for students to complete their calculations. Give groups enough time to calculate and organize their data using the data table on Page 2. After groups have finished organizing their distance data, have them analyze their data by discussing the prompt on the slide and at the bottom of Page 2 of Tracking the Sun and Moon." (Lesson 5, Teacher Guide) Students are provided with an example algorithm before working in groups to complete the calculations, organize the data in a provided table, and use a prompt to analyze.
- Lesson 8, Explore, Step 3: "Make observations and analyze day and night data for one location. Display slide D and divide the class into groups of four students. Assign each group by distributing enough copies of Bighorn Mountains Medicine Wheel, Chaco Canyon Kivas, or Uaxactun E-Groups to each member of the group. Guide students to examine both the site description and the local day-and-night data. Encourage them to look for patterns connecting what the observatory tracks to concepts explored earlier in the unit. For the data table, suggest that each group member focus on a single column. As they review, they should identify and circle the longest and shortest lengths or the earliest and latest times." (Lesson 8, Teacher Guide) Students work in small groups to identify patterns in the provided datasets. Limited support is provided by suggesting ways for each member to contribute and by identifying patterns within a subset of data.
- Lesson 8, Student Materials, Student Assessment: "Do the patterns show whether all these communities had the shortest or longest NIGHT on the same day? Support your argument with patterns revealed in the line graph and earlier data tables." (Lesson 8, 5.4 Lesson 8 Student Assessment 1 Day and Night) Some support is provided to focus students on relevant data by emphasizing NIGHT.
- Lesson 10, Explore, Step 2: "Facilitate a Building Understandings discussion of the line plot data. Bring students back together and display slide C. Guide students to discuss the patterns they recorded on their handouts using the following prompts. As students share, group sticky notes with the names of the space objects Space Object Classifications chart. See an example on slide C." (Lesson 10, Teacher Guide). After a Gallery Walk to explore number line data, the teacher supports the building understanding discussion by using post-its to help students visualize relationships across multiple data sets.
- Lesson 13, Explore, Step 2: "Describe the patterns that are revealed by analyzing a bar graph. Display slide D and ask students to discuss what they notice about the bar graph on the board. After a few moments, ask students to share what their partner said. As students share these patterns, add them to the Our Sky Observations chart." (Lesson 13, Teacher Guide) Students are supported in analyzing a bar graph to generate questions for further investigation.

ARG: Engaging in Argument from Evidence

- 5.4 Unit Front Matter: "Students' development of this practice is supported by multiple formative assessment opportunities throughout the unit, peer feedback in Lessons 7 and 11, a self-reflection moment in Lesson 10, and summative assessments in Lessons 8 and 13." (5.4 Sun, Moon, & Star Patterns Unit Front Matter)

Claimed Element: **ARG-E3: Respectfully provide and receive critiques from peers about a proposed procedure, explanation or model by citing relevant evidence and posing specific questions.**

Claimed in Lessons 7, 10, 11.

Students are given two different arguments to provide peer feedback, using the same criteria to help them clarify what makes evidence relevant and how to do so respectfully. The second opportunity provides students with additional feedback on their application of that criterion. Evidence was found in claimed lessons, examples include

- Lesson 7, Student Materials, Handout 2: "Evaluate evidence for connectedness. Evaluate how well your partner group's evidence connects to their argument. Look to see that your partner group's evidence explains how or why it took so long for the Moon to set while the sun is rising. Use "I wonder" statements to explore anything that seems disconnected in the evidence." (Lesson 7, 5.4 Lesson 7 Handout 2 Peer Review) Students are provided specific 'look fors' and a sentence stem to use to provide feedback on how well the group's evidence supports their argument.
- Lesson 7, Student Materials, Handout 2: "Evaluate evidence for clarity. What is clear and what is unclear about your partner group's evidence? Look to see that your partner group's evidence is explained with pictures, symbols and/or words and is clearly labeled or explained. Use "I wonder" statements to explore anything that is unclear about the evidence. Then complete the table below." (Lesson 7, 5.4 Lesson 7 Handout 2 Peer Review) Students are provided with specific criteria to look for and a sentence stem to use to provide feedback on the clarity of the evidence.
- Lesson 10, Synthesize, Step 3: "Lead students in critiquing arguments using evidence. Recall that in Lesson 7, students wrote and evaluated arguments about the Moon's position in the sky. They evaluated arguments based on whether the argument was accurate, clear, and connected. They will use the same criteria to evaluate arguments about Jupiter that have already been written. Explain that by evaluating whether the argument is accurate, connected, and clear, they will be able to respectfully critique (or point out incorrect components) the arguments." (Lesson 10, Teacher Guide) Students are provided additional practice when they apply the same criteria used in Lesson 7 for critiquing arguments for a different question in Lesson 10.
- Lesson 11, Synthesize, Step 5: "Give and receive peer feedback. After students complete their revised argument, display slide O and have students share their revised arguments with a partner. Remind students of the checklist on the slide: they should look for accurate and connected claims and evidence, and use questions and/or "I wonder..." statements to provide feedback based on evidence. After sharing feedback, provide students time to revise their own arguments using a different color so you can see the changes they chose to make." (Lesson 11, Teacher Guide) Students apply peer feedback to their revised argument with a partner using the same criteria and feedback stem they have practiced.

Claimed Element: **ARG-E4: Construct and/or support an argument with evidence, data, and/or a model.**

Claimed in Lessons 4, 6, 7, 8, 10, 11, and 13.

Students are provided multiple opportunities to construct and/or support an argument using evidence, data, and/or models throughout the unit. First, they are provided with specific criteria and prompts to use when providing feedback to a partner. Then, they use the same criteria multiple times to revise, critique, and/or construct a partner's or their own argument. Finally,

they are asked to construct an argument for a new question with no scaffolds or prompts. Evidence was found in claimed lessons, examples include

- Lesson 4, Synthesize, Step 5: "Share an explanation with a partner. Display slide O and have students turn and talk using the prompts on the slide, referring to their Earth-Sun Model Observations handout as needed. After 2-3 minutes, bring students together and use the prompts below to support students in using evidence to support claims about why the Sun appears to move westward every day. Have the materials from the investigation, including the globe, meeple, and flashlight, available in the middle of the Scientist's Circle for students to use as they share their ideas." (Lesson 4, Teacher Guide) Students are given the opportunity to share their thinking with a partner before sharing with the whole class.
- Lesson 6, Student Materials, Handout 1: "Use evidence from our models to argue what time and day of the Moon's cycle you'd expect the sky to appear like it does in the image below." (Lesson 6, 5.4 Lesson 6 Handout 1 Sun-Earth-Moon Argument) Students are prompted to use evidence from their models.
- Lesson 7, Student Materials, Handout 1: "Construct an argument. On October 30th, the Moon will rise in the East at the same time as the Sun. How long will it take before the Moon starts setting when the Sun is rising? How do you know? Use evidence from what you've learned about the Moon to explain your thinking. You may explain your thinking in words, drawings, tables, or another way." (Lesson 7, 5.4 Lesson 7 Handout 1 Arguing from Evidence) Students are prompted to consider a range of ways to support their thinking, not just using a model.
- Lesson 8, Student Materials, Student Assessment: "Do the patterns show whether all these communities had the shortest or longest NIGHT on the same day? Support your argument with patterns revealed in the line graph and earlier data tables." (Lesson 8, 5.4 Lesson 8 Student Assessment 1 Day and Night) Students are prompted to use patterns from data organized in tables and a line graph.
- Lesson 10, Synthesize, Step 4: "Guide students in constructing arguments. Display slide H. Direct students to part 2 of Constructing Arguments about the Sun. Ask students to examine the evidence they wrote in part 1 of the handout to consider whether the Sun can be accurately classified as a star. Lead the class in a discussion using the following prompt." (Lesson 10, Teacher Guide) Students are applying what they have learned, practiced, and received feedback on regarding evidence to construct a different argument.
- Lesson 11, Synthesize, Step 4: "Critique arguments for why the Sun looks different than other stars. Display slide L and distribute Critiquing Arguments about the Sun to each student. Ask the students to evaluate the two arguments for why the Sun looks different from the other stars. After critiquing the arguments, students should pick one to revise using the patterns they discussed today. Collecting this handout provides an opportunity to give students feedback on their scientific understanding of the differences in stars and their progress on arguing from evidence." (Lesson 11, Teacher Guide) Students independently critique two provided arguments and revise one argument based on their critique.
- Lesson 13, Synthesize, Slide H: "Construct and support arguments for the following questions: Which motion(s) lead to us seeing seasonal stars? Do people living closer to the North Pole see seasonal stars?" (Lesson 13, Slides) Students independently apply the criteria for constructing arguments using evidence, data, and/or a model to a new question.

Criterion-Based Suggestions for Improvement: N/A

CATEGORY III

Monitoring NGSS Student Progress

III.A. Monitoring 3D Student Performance

EXTENSIVE

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

The reviewers found **extensive** evidence that materials elicit direct, observable evidence of three-dimensional learning and that students are using practices with core ideas and crosscutting concepts to make sense of phenomena. In Lessons 8 and 13, teachers are prompted to assess student performance by using transfer tasks focused on sensemaking and by using rich, puzzling scenarios to solve problems. There's a close match among SEP, CCC, and DCI elements that are intended to be assessed in each item and the evidence of those elements being required to respond to each prompt posed to students. Materials routinely elicit direct, observable evidence that students are integrating the three dimensions in service of sensemaking or problem solving in varied ways. Student artifacts that require grade-appropriate elements from all three dimensions to be used together are frequently used, including to evaluate targeted learning objectives.

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

- Lesson 8, Student Materials, Student Assessment 1: Students integrate the elements of **ARG-E4 Construct and/or support an argument with evidence, data, and/or a model**, **PAT-E1 Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products,** and **ESS1.B-E1 The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year** when they use patterns in data to support whether all these communities had the shortest or longest night on the same day using the Earth-Sun-Moon system.
- Lesson 13, Synthesize, Step 4: "Introduce the transfer task. Display Slide H, and explain to students that, now that we have figured out why the constellations of the southern and northern sky appear to move differently, we are going to use what we know about the seasonality of constellations to make an argument for what we would expect to see at a different location on Earth. Distribute the Arguments for Sky Patterns assessment to each student." (Lesson 13, Teacher Guide)
- Lesson 13, Student Materials, 5.4 Lesson 13 Student Assessment 1 Arguments for Sky: "Use the space below to evaluate this group's claim and evidence. Show how you used the graph and our past models/graphs to do your evaluation. You can share your thinking by writing sentences or drawing pictures." (Lesson 13, 5.4 Lesson 13 Student Assessment 1 Arguments for Sky)

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

- Lesson 1, Synthesize, Step 5: Introduce modeling our initial ideas about the sun-moon-star system. Students integrate elements of **MOD-E4 Develop and/or use models to describe and/or predict phenomena**, **CE-E1 Cause and effect relationships are routinely identified, tested, and used to explain change**, and **ESS1.B-E1 The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at**

different times of the day, month, and year when they create models to explain "why the Moon sometimes appears with the Sun during the day, and other times with the stars at night?"

- Lesson 2, Student Materials, Handout 1: Students integrate the elements of **DATA-E3 Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings, PAT-E2 Patterns of change can be used to make predictions, and ESS1.B-E1 The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year** when they gather data while completing the Sun Tracking investigation and use it to reveal patterns.
- Lesson 4, Explore, Step 3: Students integrate the elements of **MOD-E6 Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system**, **PAT-E3 Patterns can be used as evidence to support an explanation**, and **ESS1.B-E1 The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year** when they complete the Earth-Sun Model Observations handout to provide evidence for the rotation of the Earth as a cause for changes in shadows throughout the day.
- Lesson 7, Synthesize, Step 3: Students integrate the elements of **ARG-E1, Compare and refine arguments based on an evaluation of the evidence presented**, **PAT-E2 Patterns of change can be used to make predictions**, and **ESS1.B-E1 The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year** when they construct arguments by evaluating multiple types of evidence for relevance (e.g., data of moon rising and setting, physical, paper, or bodily modeling of the Moon, Earth, and Sun, or mathematics to figure out when the moon is setting).
- Lesson 10, Student Materials, Handout 2: Students integrate the elements of **DATA-E3 Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings**, **PAT-E3 Patterns can be used as evidence to support an explanation**, and **ESS1.A-E1 The Sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth** when they construct an argument using patterns from data to support a claim that the Sun is or is not a star.
- Lesson 11, Synthesize, Step 4: Students integrate the elements of **ARG-E3 Respectfully provide and receive critiques from peers about a proposed procedure, explanation or model by citing relevant evidence and posing specific questions**, **DATA-E1 Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships**, **SPQ-E1 Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods**, and **ESS1.A-E1 The Sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth** when they critique two arguments and then revise one using data.
- Lesson 12, Explore, Step 2: Students integrate elements of **MOD-E6 Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system**, **PAT-E1 Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products**, and **ESS1.B-E1 The orbits of Earth around**

the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year when they complete the Seasonal Constellations Model to explain why some constellations are visible only during parts of the year.

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

- Lesson 1, Synthesize, Step 5: "Model our initial ideas about the Sun-Moon-star system. Display slide O. Give students 10 minutes to create their initial model." (Lesson 1, Teacher Guide)
- Lesson 4, Synthesize, Step 5: Students use data from an investigation and information from text to complete the Earth-Sun Model Observation handout which asks them to "draw a model that shows where someone would have to be on the Earth to experience night and explain "[What] would have to happen for that person to experience daylight." (5.4 Lesson 4 Handout 1 Earth-Sun Model Observations)
- Lesson 5, Explore, Step 4: "Carry out Sun and Moon Tracking Investigation. Display slide K and distribute Tracking the Sun and Moon. Have students record the example algorithm (or other chosen subtraction method) on Page 1. Then distribute Sun and Moon Data Cards to each group. You can also provide scratch paper or grid paper for students to complete their calculations. Give groups enough time to calculate and organize their data using the data table on Page 2. After groups have finished organizing their distance data, have them analyze their data by discussing the prompt on the slide and at the bottom of Page 2 of Tracking the Sun and Moon." (Lesson 5, Teacher Guide)
- Lesson 6, Explore, Step 2: "Develop a physical model for explaining the Moon's monthly patterns while in a Scientist's Circle. Invite the students to form a Scientist's Circle. Make sure they bring Sun and Moon Data Cards. Display slide C and start developing a physical model of the Sun-Earth-Moon for Day 0 using the following prompts:" (Lesson 6, Teacher Guide)
- Lesson 7, Student Materials, Handout 2: "Part 1: Compare Argument Claims What is similar and different between your group's argument claim and your partner group's argument claim?" (Lesson 7, 5.4 Lesson 7 Handout 2 Peer Review and)
- Lesson 9, Student Materials, Handout 1: "Read the digital articles for the three objects you are comparing. Take notes on your Comparison Research handout. If one of your objects is from our class chart, use the "More Resources" page to find information about that object." (Lesson 9, 5.4 Lesson 9 Handout 1 Comparison Research)

Criterion-Based Suggestions for Improvement: N/A

III.B. Formative

EXTENSIVE

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

The reviewers found **extensive** evidence that formative assessment processes evaluate student learning to inform instruction. There are opportunities in every lesson to gather, record, and use formative assessment information to inform future instruction. These pieces of evidence were selected because the materials include opportunities for formative assessment that are explicitly called out and occur several times within each lesson. Most formative assessment opportunities are accompanied by clear guidance for the teacher on how to modify instruction based on varied student responses. Rubrics or teacher materials include supports for informing instruction and for student self-assessment based on a range of possible student responses or levels of student proficiency. Formative assessments take varied forms, are tied to grade-appropriate elements of all three dimensions, and clearly build from student engagement with the dimensions. Formative assessments regularly address issues of student equity and access by providing multiple ways for students to demonstrate their thinking, such as writing, drawing, and oral presentations.

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

- Lesson 2, Lesson Assessment Guidance: "Use this formative assessment opportunity to determine whether students need more support in organizing or analyzing data. During the Building Understandings Discussion in Synthesize, students should work to understand what patterns are present across the different Sun Tracking Devices. This will require groups to compare data sets. Although individual shadow lengths will depend on the height of students' Sun Tracking Devices, consistent changes in directionality and relative lengths at specific times of day. You can support students in uncovering these patterns, by classifying shadow lengths in more qualitative terms (long, short) at specific times of day. These patterns are then used to recreate the apparent path of the sun by using a flashlight to recreate the shadow patterns identified in the Organized Shadow Data chart. To support student sensemaking during the Consensus Discussion in Synthesize, ask students to use gestures to support their explanations to the discussion prompts." (Lesson 2, Teacher Guide)
- Lesson 3, Lesson Assessment Guidance: "Use this formative assessment opportunity to determine whether students need more support in analyzing data. During the Explore [2], groups should use multiple graphs to identify patterns they notice between months and seasons. Although the exact months that students compare will be different from one group to another, guide students in comparing the time shadows are present (length of day) and length of shadows throughout the day. You can support students in uncovering seasonal patterns by having them notice the similarities in months that share the same season and/or notice how months in different seasons show a greater change. Analyzing these patterns will take place in the Synthesize, where the class carries out a Building Understanding Discussion. During this discussion, students use their sensemaking from Lesson 2 to analyze the observed patterns and explain what those patterns tell us about the Sun's daily, monthly, and yearly location throughout the year. If you notice that students need additional support in understanding how shadow data can be used to predict the sun's apparent motion, consider recreating the Synthesis moment from Lesson 2 where a student can simulate the motion of the sun while observing the changes to a shadow's length and direction. Students will figure out the role of the Earth's rotation in Lesson 4." (Lesson 3, Teacher Guide)
- Lesson 4, Lesson Assessment Guidance provides multiple opportunities for "key formative assessment" in this lesson: "Use this assessment moment as an opportunity to see where your students are in their understanding of the Earth's counterclockwise rotation causing the shadow patterns. Discussions and questioning while students are investigating provides a scaffold to support their sensemaking. Refer to the Instructional Guidance for Lesson 4 tool for more details to three-dimensionally assess and support students. The tool can be used as a guide for assessing

individual or group progress, depending on your assessment needs, and can be used to assess students' observations and answers on the Earth-Sun Model Observations handout." (Lesson 4, Teacher Guide)

- Lesson 6, Synthesize, Step 5: Argue from evidence, Assessment Opportunity callout: "Formative assessment: While students work together to support an argument with evidence you have an opportunity to formatively assess learning goal 6. As students work to support their argument, ask probing questions of each group about the evidence that supports their choice. What do they notice about the image in Sun-Earth-Moon Argument? How is it similar or different to previous Stellarium images we have analyzed? Based on the position of the Moon and Sun, where do you think the Moon is in its rotation? How could we use our models to figure this out? See the Assessment Guidance table at the beginning of the lesson for further details." (Lesson 6, Teacher Guide)
- Lesson 7, Synthesize, Step 3: Argue from Evidence, Broadening Access: "If students need language support constructing arguments, Consider providing sentence stems like: It will take _____ days until the Moon starts setting when the Sun is rising. I know this is accurate because.... The Moon will set when the Sun rises on the date _____. I know this is true because...." (Lesson 7, Teacher Guide).
- Lesson 9, Explore, Step 3: "Possible Back-Pocket-Questions are: What have you figured out so far? What evidence have you seen to support those ideas? What is something you have found interesting or surprising? How does that compare with other objects in space? Why did you pick these specific categories or measurements? Why do you think that is a significant piece of information?" (Lesson 9, Teacher Guide)

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

- Lesson 5, Lesson Assessment Guidance: "This is a formative assessment opportunity where you will take stock of the students' progress in observing patterns in the location of the Moon at different times and data analysis. In the previous lesson, students investigated the patterns that are the result of the Earth's rotation (the Sun's westward movement). Here in this lesson, students can use the Earth's rotation to explain the similar path of the Moon across our sky. There are limitations with using this interaction because they do not explain why the Moon travels less than the Sun each day. This moment gives students the opportunity to consider that other interactions must be occurring to lead to this difference. Students intentionally develop the Analyzing and Interpreting Data practice in this lesson by organizing distance data into graphical representations which allow them to see that the rates by which Sun and Moon travel each day differ." (Lesson 5, Teacher Guide)
- Lesson 6, Lesson Assessment Guidance: "This is a formative assessment opportunity where you will take stock of the students' progress in analyzing and communicating patterns and engaging in argument from evidence. In the previous lesson, students analyzed the apparent locations of the Moon and Sun over a month-long period. During that analysis students should have noticed that during that time frame, the Moon seems to travel at a different rate than the sun. Here in this lesson, students use that analysis to construct a physical model to explain the Moon's orbit as the mechanism for why the Moon appears at different locations at noon each day. This model for the Moon's orbit is used as evidence for the students to argue the time and day presented in Sun-Earth-Moon Argument. This moment gives you the opportunity to provide some initial support around using models as evidence. This skill will be further assessed in Lesson 7 and Lesson 11 of this unit." This highlights the three dimensions that will be integrated in the student response for this formative assessment opportunity (Lesson 6, Teacher Guide).
- Lesson 10, Synthesize, Step 3: Broadening Access: "Students may need support identifying related evidence to disprove inaccurate evidence in Claim 1. Ask students, which line plot category is this evidence most like? Next, ask what does our line plot data show us about Jupiter?" (Lesson 10, Teacher Guide)

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

- Lesson 7, Synthesize, Step 3: Argue from Evidence, Broadening Access: "Pairing students in groups of 3 or more will help support students who want to use their bodies to model the Earth's rotation and Moon's orbit, like they did in Lesson 5." (Lesson 7, Teacher Guide)
- Lesson 7, Synthesize, Step 3: Broadening Access: "If students need language support constructing arguments, Consider providing sentence stems like: It will take _____ days until the Moon starts setting when the Sun is rising. I know this is accurate because…. The Moon will set when the Sun rises on the date _____. I know this is true because…." (Lesson 7, Teacher Guide).
- Lesson 9, Lesson Assessment Guidance: "If the amount of choice is challenging for some students, this activity can be scaffolded by suggesting measurements or categories to record that are more straightforward: size, composition, and whether light is produced or reflected are all more straightforward categories." (Lesson 9, Teacher Guide).
- Lesson 10, Synthesize, Step 4: Broadening Access: "Students may benefit from writing supports such as sentence frames. You may provide frames such as 'The Sun is/is not a star because…' One requirement of a star is… Another requirement of a star is.. Therefore, the Sun does/does not meet the classification requirements of a star." (Lesson 10, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

III.C. Scoring Guidance

EXTENSIVE

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

The reviewers found **extensive** evidence that the materials include scoring guidelines that provide guidance for interpreting student performance along the three dimensions to support teachers in (a) planning instruction and (b) providing ongoing feedback to students. These pieces of evidence were selected because the materials include explicit guidance on levels of student understanding and proficiency for all three dimensions and their use together. Scoring rubrics help teachers determine the level of understanding that students have achieved in using each of the three dimensions for sensemaking. Scoring guidance is provided for major formative assessments and summative assessments. Both teachers and students are supported in interpreting student progress over time. Every lesson contains Lesson Assessment Guidance that indicates where to use the assessment within the lesson, what to look and listen for, and detailed guidance on how to use the information. Every lesson contains at least one Assessment Opportunity embedded that provides guidance on what to look for and listen for and how to use the information. Key formative assessment opportunities include an Instructional Guidance document that provides possible responses to help interpret student responses. The Instructional Guidance documents provide planning for instruction in response to student performances to move the learning forward.

Support for planning instruction

- Lesson 1, Lesson Assessment Guidance: "This is a community based pre-assessment opportunity. Therefore, do not assign a grade or score. Use this opportunity to determine the support the class may need around the ways patterns are identified and used to make predictions or support arguments. These skills and the community model will continue to evolve throughout this unit. Pay attention to ideas related to the motion of the sun, moon, and stars, but it's perfectly fine if some ideas are not fully developed at this stage. Throughout the unit, students will get the opportunity to practice developing models to support their sensemaking and argumentation. At this point, encourage students to include evidence to support why they think what they think, or to consider what types of evidence would help fill in the gaps in their explanations. Some example back-pocket questions could be: What patterns are you basing your thinking on? What have you seen that supports your thinking? What would you like to see to help to figure out your question?" (Lesson 1, Teacher Guide)
- Lesson 4, 5.4 Lesson 4 Teacher Assessment Tool Instructional Guidance: "Based on which of the statements below align with what you notice about your students (most of the class, some of the class, or a few students), you may choose to take some or several of the next steps suggested here." (Lesson 4, 5.4 Lesson 4 Teacher Assessment Tool Instructional Guidance)
- Lesson 7, Lesson Assessment Guidance: "Use this assessment moment as an opportunity to see where your students are in their understanding of the position of the Sun and Moon during certain times of day and month. This assessment is also an opportunity to assess students' ability to argue from evidence. Refer to the Instructional Guidance for Lesson 7 tool for more details to three-dimensionally assess and support students. The tool can be used as a guide for assessing individual or group progress, depending on your assessment needs, and can be used to assess students' observations and answers on the Arguing from Evidence and Peer Review and Self Assessment handouts." (Lesson 7, Teacher Guide)
- Lesson 8, 5.4 Lesson 8 Teacher Assessment Tool Instructional Guidance: "Please note that the above statement draws primarily from one NGSS Performance Expectation: 5-ESS1-2 (Represent data in graphical displays to reveal patterns of daily changes in length and directions of shadows, day and night, and the seasonal appearance of some stars in the night sky). This assessment focuses on revealing the similarities in day and night patterns at different times of year. Previous lessons in the unit (Lessons 2-4) developed and assessed the causal explanations for changes in shadows (Earth's Rotation in Lesson 4) and the Moon's observable patterns (Moon's orbit in Lessons 6 and 7). This assessment also doesn't assess the revealing and explanation for the seasonality of stars, which will be practiced and assessed in Lessons 12 and 13." (Lesson 8, 5.4 Lesson 8 Teacher Assessment Tool Instructional Guidance)
- Lesson 11, Lesson Assessment Guidance: "This Key Formative assessment starts to push beyond just making individual arguments to having students start critiquing the arguments of others. Using a similar scaffold to Lesson 7, students evaluate the claim and evidence of the provided arguments on Critiquing Arguments about the Sun. Look that students include quantitative descriptions revealed in the tables and/or graphs in their revised arguments. Refer to the Instructional Guidance for Lesson 11 tool for more details to three-dimensional assess and support students. The tool can be used as a guide for assessing individual or group progress, depending on your assessment needs, and can be used to assess students' observations and answers on the Critiquing Arguments about the Sun." (Lesson 11, Teacher Guide)
- Lesson 13, 5.4 Lesson 13 Lesson 4 Teacher Assessment Tool Instructional Guidance: "Please note that the above statement draws primarily from two NGSS Performance Expectations: 5-ESS1-1 (Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth) and 5-ESS1-2 (Represent data in graphical displays to reveal patterns of daily changes in length and directions of shadows, day and night, and the seasonal appearance of some stars in the night sky). This assessment focuses on the Science and Engineering Practice of 5-ESS1-1 (Engaging in Argument from Evidence) and the Disciplinary Core Ideas and Crosscutting Concepts of 5-ESS1-2." (Lesson 13, 5.3 Lesson 13 Teacher Assessment Tool Instructional Guidance)

Support for ongoing feedback

- Each lesson has a Lesson Assessment Guidance section that provides teachers with a three-dimensional learning target, where they can check for understanding in the lesson, and how they can use the assessment information. Additionally, the assessment opportunities are embedded in the lesson sequence and distinguished from other components by being in a goldenrod-colored box.
- Lesson 6, Synthesize, Step 5: "Argue from evidence: After students finish supporting their arguments with evidence, ask students to share the evidence their group came up with. Collecting this assessment opportunity is recommended as students can receive feedback on the progress in their evidence-based argumentation skillset." (Lesson 6, Teacher Guide)
- Lesson 9, Explore, Step 3: "Obtain information from a text, Assessment Opportunity: Formative assessment: The Comparison Research provides an opportunity to gather evidence about Learning Goal 9.A, with the purpose of providing feedback and supporting students in combining information across multiple digital articles to compare different objects in space. Use the following questions to provide feedback and determine next steps before students share their research in small groups: Can you show me where you found that information? Why did you choose that measurement or category to compare? What do these comparisons tell you about the relationship between these space objects? Does this information bring up any new questions for you?" (Lesson 9, Teacher Guide)
- Lesson 10, Lesson Assessment Guidance: "Use the information from Evaluating and Critiquing Arguments to assess and verbally provide feedback on their use of evidence to support a classification of Jupiter. The focus on this portion of the assessment is to look at how students are using evidence of patterns to support a claim. Use the information from Constructing Arguments about the Sun to assess where students are in their ability to argue accurately from evidence specifically tied to the Sun being a star. Provide feedback and support for students whose claims are inaccurate or not informed by evidence. You may direct students back to part 1 of the handout to assist them in completing part 2 accurately. Ensure students' evidence is a reflection of the line plot data the class collected in Lesson 10, and uses criteria from the Sky Object Classification chart they constructed as a class. Guide students in being able to identify (or point to) the source of the information they are using as evidence. Constructing Arguments about the Sun also provides an opportunity to give students written feedback to individual students which should help in their development towards Lesson 11's Key Formative and Lesson 13's Summative assessments." (Lesson 10, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

III.D. Unbiased Tasks/Items

EXTENSIVE

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

The reviewers found **extensive** evidence that tasks/items assess student proficiency using methods, vocabulary, representations, and examples that are accessible and unbiased for all students. Tasks use multiple modalities to present information to students in meaningful ways, capitalizing on what is communicated best by each modality—not just the exact same information in two different formats. There is structured variety in the modalities expected for student responses (e.g., talking about their learning, creating visual representations, writing short and more complex answers, etc.), and use of different modalities is balanced (e.g., not relying mostly on writing with only one opportunity to share orally). The transfer tasks provide students with a choice of responses across multiple modalities.

Multiple modes of communication

- Lesson 4, Explore, Step 2: Plan an investigation, Broadening Access: "You can provide multiple means of action and expression by varying response methods and navigation. For example, provide ample time for students to process their thinking before recording their answers, allow students to answer orally while you record on the Investigation Chart, allow students to discuss in pairs, or provide choices to write or draw their ideas." (Lesson 4, Teacher Guide)
- Lesson 4, 5.4 Lesson 4 Handout 1 Earth-Sun Model Observations: "Part 1: Use words, symbols, and/or drawings to record your observations...Part 3: Use your model to help you draw a model that shows where someone would have to be on the Earth to experience night. (use words, symbols, and/or drawings to help describe your idea)" (Lesson 4, 5.4 Lesson 4 Handout 1 Earth-Sun Model Observations)
- Lesson 7, 5.4 Lesson 7 Handout 1 Arguing from Evidence: "Part 2: Argue with Evidence Construct an argument. On October 30th, the Moon will rise in the East at the same time as the Sun. How long will it take before the Moon starts setting when the Sun is rising? How do you know? Use evidence from what you've learned about the Moon to explain your thinking. You may explain your thinking in words, drawings, tables, or another way." (Lesson 7, 5.4 Lesson 7 Handout 1 Arguing from Evidence)
- Lesson 13, 5.4 Lesson 13 Student Assessment 1 Arguments for Sky: "1a. Which motion(s) lead to us seeing seasonal stars? (check all that apply)...1b. Use the box and/or lines below to write or draw how you used the graph or our past models to evaluate the students' claims and evidence above. Your evaluation can be sentences, diagrams, or pictures." (Lesson 13, 5.4 Lesson 13 Student Assessment 1 Arguments for Sky)

Supports success for all students

- All students are supported to be successful because there are suggestions for teachers to: consider alternatives for making observations outdoors, support connecting the use of evidence in ELA and in science, make different instructional moves based on analysis of formative assessments and student needs, provide language supports for constructing arguments, and prompt students to consider orbit and rotation to explain seasonality of certain constellations.
- Lesson 2, Explore, Step 3: "Throughout the day, use recess and/or send supervised pairs outside. Show slide H. Ideally, additional observations happen every hour. In a way that aligns with your classroom and school expectations, use additional outside time (such as at recess) and/or send supervised pairs outside to trace the shadow using their Sun Tracking Device. To ensure all students have opportunities to make observations, we encourage teachers to be

creative around when supervised student pairs might make these observations. For instance, supervised pairs of students could make observations during transition times; during independent working time; and/or on the way to or from specials, other classrooms, or instructional-support meetings." (Lesson 2, Teacher Guide)

- Lesson 4, Connect, Step 4: "Literacy Supports: Support students' understanding of the ways that evidence is used in ELA and science time. Students can explain how the author of the book uses evidence in the same way that scientists used evidence to support their claims about Earth's rotation. This supports RI.5.8 and prepares students for using evidence to support their own claims." (Lesson 4, Teacher Guide)
- Lesson 4 Teacher Guide, Lesson Assessment Guidance provides multiple opportunities for "key formative assessment" in this lesson: "Use this assessment moment as an opportunity to see where your students are in their understanding of the Earth's counterclockwise rotation causing the shadow patterns. Discussions and questioning while students are investigating provides a scaffold to support their sensemaking. Refer to the Instructional Guidance for Lesson 4 tool for more details to three-dimensionally assess and support students. The tool can be used as a guide for assessing individual or group progress, depending on your assessment needs, and can be used to assess students' observations and answers on the Earth-Sun Model Observations handout." (Lesson 4, Teacher Guide) Though the handout includes a wall clock to help students visualize clockwise and counterclockwise, the task requires students to have a bird's-eye view of the Earth, which is not represented visually.
- Lesson 6, Navigate, Step 1: Teaching Tip: "The student response of 'orbit' is included in this discussion to help support teachers in classrooms where students bring this prior knowledge into the discussion. It is not expected for students to use the word orbit at this point in the sensemaking. Asking kids to explain what they mean by this idea is important to ascertain the connections students are thinking about. The class will co-construct a definition for orbit during the Connect, so it is appropriate to keep this idea ambiguous at this moment." (Lesson 6, Teacher Guide)
- Lesson 7, Synthesize, Step 3: "Broadening Access: If students need language support constructing arguments, Consider providing sentence stems like: It will take _____ days until the Moon starts setting when the Sun is rising. I know this is accurate because.... The Moon will set when the Sun rises on the date _____. I know this is true because...." (Lesson 7, Teacher Guide)
- Lesson 13, Synthesize, Step 3: "Teaching Tip: To support students in their arguments in Arguments for Sky Patterns, it's important to use this moment to explicitly identify the role of Earth's orbit AND rotation in causing the seasonal viewing of certain constellations. Earth's rotation allows us to move away from the Sun and see constellations each night as the Earth orbits around the Sun. And it is this orbit that causes us to view a different part of the universe each time the Earth rotates." (Lesson 13, Teacher Guide)

Multiple modalities and student choice

- Lesson 1, Explore, Step 2: "Introduce time lapse photography as a way to observe the sun, moon, and stars. Display slide D and tell students that one method of observing an object over a long period of time is time lapse photography. Ask students to raise their hands if they've ever used or seen it used before. Share with students that you've found three time lapse videos of the objects we've been discussing. Distribute My Sky Observations Handout and direct students that as they watch the video they can record their noticings and wonderings on My Sky Observations Handout. Remind students that they can use drawings, sentences, or diagrams to share their ideas." (Lesson 1, Teacher Guide)
- Lesson 7, Connect, Step 2: "Connect to our Moon evidence. Show slide E. Have students connect the different types of evidence that scientists use to support their arguments with the types of evidence we've collected. Encourage both scientific and everyday language, as well as gestures, for students to express their ideas." (Lesson 7, Teacher Guide)

- Lesson 9, Explore, Step 3: "Ask comparison questions about student-selected space objects. Display slide D. Tell the class that they will have the opportunity to investigate sky objects they are curious about. Let the class know before starting our research, we'll choose research questions to help us obtain the information we are investigating. Share that we have a website with reliable information we can use for our research and that this website has information about each of the objects on the slide. If students want to research objects from the *Our Sky Observations* chart that are not on the list, there will be an opportunity to research an object not on the list." (Lesson 9, Teacher Guide)
- Lesson 9, 5.4 Lesson 9 Handout Comparison Research: Students are provided supports for organizing information extracted from a website and prompted to use information from their line graph. (Lesson 9, 5.4 Lesson 9 Handout Comparison Research)
- Lesson 13, Navigate, Step 1: Broadening Access: "You can provide multiple means of action and expression by varying response methods and navigation. For example, provide ample time for students to process their thinking before recording their answers, allow students to answer orally while you record on the DQB, allow students to work in pairs, or provide choices for paper or writing tools to accommodate writing needs." (Lesson 13, Teacher Guide)
- Lesson 13, Student Materials, 5.4 Lesson 13 Student Assessment 1 Arguments for Sky: "Use the space below to evaluate this group's claim and evidence. Show how you used the graph and our past models/graphs to do your evaluation. You can share your thinking by writing sentences or drawing pictures." (Lesson 13, 5.4 Lesson 13 Student Assessment 1 Arguments for Sky)

Criterion-Based Suggestions for Improvement

- Consider including a bird's eye view of the Earth in Lesson 4 to aid in visualizing rotation to '[p]rovide appropriate on-ramping for students to engage with and attend to the appropriate parts of the task.' [EQuIP Detailed Guidance, p. 47]

III.E. Coherent Assessment System

EXTENSIVE

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

The reviewers found **extensive** evidence that the materials include pre-, formative, summative, and self-assessment measures that assess three-dimensional learning. All four assessment types mentioned in the criterion are present, and assessment opportunities are found throughout the learning experience. Assessments are connected to learning objectives and require students to apply grade-appropriate elements of the three dimensions to make sense of phenomena and/or solve problems. The assessment of the three dimensions proportionally matches the learning objectives. The assessment purpose and rationale are coherent across the materials. They are explicitly described for all three dimensions, including how the different types of assessment, including informal assessment opportunities, work together to provide regular feedback.

Matches three-dimensional learning objectives

- Lesson 2, Student Materials, Handout 1: Students integrate the elements of **DATA-E3 Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings, PAT-E2 Patterns of change can be used to make predictions, and ESS1.B-E1 The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South**

poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year when they gather data while completing the Sun Tracking investigation and use it to reveal patterns.

- Lesson 4, Explore, Step 3: Students integrate the elements of **MOD-E6 Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system**, **PAT-E3 Patterns can be used as evidence to support an explanation**, and **ESS1.B-E1 The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year** when they complete the Earth-Sun Model Observations handout to provide evidence for the rotation of the earth as a cause for changes in shadows throughout the day.
- Lesson 8, Student Materials, Student Assessment 1: Students integrate the elements of **ARG-E4 Construct and/or support an argument with evidence, data, and/or a model**, **PAT-E1 Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products,** and **ESS1.B-E1 The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year** when they use patterns in data to support whether all these communities had the shortest or longest night on the same day using the Earth-Sun-Moon system.
- Lesson 10, Student Materials, Handout 2: Students integrate the elements of **DATA-E3 Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings**, **PAT-E3 Patterns can be used as evidence to support an explanation**, and **ESS1.A-E1 The Sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth** when they construct an argument using patterns from data to support a claim that the Sun is or is not a star.

Pre-, formative, summative, and self-assessment

Pre-Assessment

- Lesson 1, Synthesize, Step 5: "The prompts on the Initial Model handout ask students to consider why the sun and moon appear together. You may need to reassure students that it's okay to not be able to explain exactly what is going on right now–scientists often model to help them understand what they haven't figured out yet. One way to reassure students about their uncertainty is to prompt them to add question marks to the places in their model where they're not sure how/whether something happens." (Lesson 1, 5.4 Lesson 1 Handout 4 Initial Model)

Formative Assessment

- Lesson 4, Synthesize, Step 5: Assessment Opportunity: "Small group discussions and Part 2 of Earth-Sun Model Observations handout provide an opportunity to gather evidence about Learning Goal 4, with the purpose of providing feedback and supporting students in supporting an argument using evidence collected from a model for Earth's rotation causes. Refer to the Instructional Guidance for Lesson 4 tool and the Assessment Guidance at the beginning of the lesson before moving on to the second Synthesize." (Lesson 4, Teacher Guide)
- Lesson 7, Student Materials, 5.4 Lesson 7 Handout 1 Arguing from Evidence: "Part 2: Argue with Evidence Construct an argument. On October 30th, the Moon will rise in the East at the same time as the Sun. How long will it take

before the Moon starts setting when the Sun is rising? How do you know? Use evidence from what you've learned about the Moon to explain your thinking. You may explain your thinking in words, drawings, tables, or another way." (Lesson 7, 5.4 Lesson 7 Handout 1 Arguing from Evidence)

Summative Assessment

- Lesson 8, Lesson Slides, Slide H: "Use the patterns revealed in the graphs to explain when different communities should expect the, Longest day Shortest day Also consider the benefit to being able to predict changes to the Sun's position." (Lesson 8, Slides)
- Lesson 8, 5.4 Lesson 8 Student Assessment 1 Day and Night: "Do the patterns show whether all these communities had the shortest or longest NIGHT on the same day? Support your argument with patterns revealed in the line graph and earlier data tables." (Lesson 8, 5.4 Lesson 8 Student Assessment 1 Day and Night)
- Lesson 13, Student Materials, 5.4 Lesson 13 Student Assessment 1 Arguments for Sky: "Use the space below to evaluate this group's claim and evidence. Show how you used the graph and our past models/graphs to do your evaluation. You can share your thinking by writing sentences or drawing pictures." (Lesson 13, 5.4 Lesson 13 Student Assessment 1 Arguments for Sky)

Self Assessment

- Lesson 7, Lesson Slides, Slide J: "Part 2 What revisions did you make to your claim and/or evidence after working with peers to evaluate your evidence?" (Lesson 7, Slides)
- Lesson 9, Lesson Assessment Guidance: "This is an opportunity for students to reflect on one of the key SEPs for the unit: analyzing and interpreting data. They can consider the affordances and limitations of different data representations. Students will reflect on their initial ideas about similarities and differences and whether their ideas have changed based on the line graph of the data." (Lesson 9, Teacher Guide)
- Lesson 9, Lesson Slides, Slide I: "We represented data two different ways, using: Categorical Groupings Measurement Scales Let's take a moment to self-reflect the impact of these representations." (Lesson 9, Slides)
- Lesson 10, Lesson Slides, Slide I: "Use the following checklist to evaluate your argument: My claim and my evidence are accurate My evidence is connected to my claim My argument is clear and easy to understand" (Lesson 10, Slides)

Coherent three-dimensional assessment system rationale is clearly described.

- 5.4 Lesson Assessment System Overview: "Each OpenSciEd unit includes an assessment system that offers many opportunities for different types of assessments throughout the lessons. These opportunities include: pre-assessment, formative assessment, summative assessment, peer assessment (called peer feedback with students), and/or self assessment (called self reflection with students). Grades K-2 units may only include peer or self assessment, not always both. Assessment opportunities are embedded and called out directly in the lesson plans. Please look for the yellow "Assessment Opportunity" support in each lesson plan to identify suggested assessments. In addition, there are two tables below that outline where each type of assessment can be found in the unit. The first table, Unit Assessment Plan by Assessment Type, lists the purpose, placement, and tools for each assessment type. The second table, Lesson-by-Lesson Assessment Opportunities, chronologically lists the assessment guidance for each lesson. For more information about the OpenSciEd approach to assessment, visit the OpenSciEd Elementary Teacher Handbook." (5.4 Lesson Assessment System Overview (ES))

Criterion-Based Suggestions for Improvement: N/A

III.F. Opportunity to Learn

EXTENSIVE

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 **extensive** evidence that the materials provide multiple opportunities for students to demonstrate the performance of practices connected to their understanding of disciplinary core ideas and crosscutting concepts, and to receive feedback. Assessment opportunities are coherent and interconnected. The materials explicitly include both claimed Assessment Statements (learning objectives) in more than one activity and assessment, allowing students to develop and improve their performance over time. Students also have opportunities to apply peer and teacher feedback from prior activities to help them progress in their learning.

Multiple, interconnected opportunities over time

- Lesson 8, Lesson Assessment Guidance: "Students have had multiple collective opportunities in this unit to demonstrate their progress toward using graphical representations to reveal patterns in how the Sun and Moon seem to move across our sky. The Day and Night Transfer Task assessment is a formal opportunity to gather summative information about individual students' understanding and an opportunity for students to apply that understanding in a new context. See guidance for interpreting student responses in the Scoring Guide for Lesson 8 Transfer Task tool." (Lesson 8, Teacher Guide)
- Lesson 10 Teacher Guide, Lesson Assessment Guidance: "Constructing Arguments about the Sun also provides an opportunity to give students written feedback to individual students which should help in their development towards Lesson 11's Key Formative and Lesson 13's Summative assessments." (Lesson 10, Teacher Guide)
- Lesson 11, Lesson Assessment Guidance: "Students have had multiple collective opportunities in this unit to demonstrate their progress in arguing with evidence. This Key Formative assessment starts to push beyond just making individual arguments to having students start critiquing the arguments of others. Using a similar scaffold to Lesson 7, students evaluate the claim and evidence of the provided arguments on Critiquing Arguments about the Sun. Look that students include quantitative descriptions revealed in the tables and/or graphs in their revised arguments. Refer to the Instructional Guidance for Lesson 11 tool for more details to three-dimensional assess and support students. The tool can be used as a guide for assessing individual or group progress, depending on your assessment needs, and can be used to assess students' observations and answers on the Critiquing Arguments about the Sun." (Lesson 11, Teacher Guide)
- Lesson 13, Lesson Assessment Guidance: "This is the final formal assessment opportunity for arguing from evidence in this unit. Students will have additional opportunities to argue from evidence in future units. You can use what you learn about students' progress on this practice in this lesson to guide your planning for those upcoming units as well as Scoring Guide for Lesson 13 Transfer Task" (Lesson 13, Teacher Guide)

Learning Goal 8: "**Use the patterns revealed in graphical displays to argue whether different locations experience the longest and shortest days and nights at the same time of year**."

- Lesson 2, Synthesize, Step 4: "As the class comes to consensus on how to organize and represent their data, record these entries on the Organized Shadow Data chart." (Lesson 2, Teacher Guide)

- Lesson 2, Navigate, Step 5: "Make predictions about future sun patterns. Display slide M and ask students to make predictions about what they would expect the result of today's investigation would be tomorrow and for future dates. Be sure to ask students to justify their predictions using their past experiences." (Lesson 2, Teacher Guide)
- Lesson 3, Explore, Step 3: "After the class has had a chance to share out some of the patterns that were revealed in the data, ask students to consider how the process of identifying patterns went and problematize new ways of representing the data that might help reveal patterns in shadow length." (Lesson 3, Teacher Guide)
- Lesson 5, Explore, Step 4: "Carry out Sun and Moon Tracking Investigation. Display slide K and distribute Tracking the Sun and Moon. Have students record the example algorithm (or other chosen subtraction method) on Page 1. Then distribute Sun and Moon Data Cards to each group. You can also provide scratch paper or grid paper for students to complete their calculations. Give groups enough time to calculate and organize their data using the data table on Page 2. After groups have finished organizing their distance data, have them analyze their data by discussing the prompt on the slide and at the bottom of Page 2 of Tracking the Sun and Moon." (Lesson 5, Teacher Guide)
- Lesson 7, Navigate, Step 1: "If we wanted to predict where the Sun or the Moon might be in the sky at a certain time and day, what types of evidence do you think would be most useful?" (Lesson 7, Teacher Guide)
- Lesson 8, Student Materials, Handout 2: "Use CODAP: Lesson 8 Link, to build a line graph comparing all three locations' hours of sunlight over a single year. Draw and label what you and your partner's graph in the space provided." (Lesson 8, 5.4 Lesson 8 Handout 2 Hours of Daylight)

Learning Goal 13: "**Support an argument** that the **seasonality of stars is the** result of the **Earth's motion and the stars' relative position to Earth's poles as observed by their position in our sky.**"

- Lesson 10, Synthesize, Step 4: "Guide students in constructing arguments. Display slide H. Direct students to part 2 of Constructing Arguments about the Sun. Ask students to examine the evidence they wrote in part 1 of the handout to consider whether the Sun can be accurately classified as a star. Lead the class in a discussion using the following prompt." (Lesson 10, Teacher Guide)
- Lesson 11, Synthesize, Step 4: "Discuss the relationships between distance and apparent size of light. While still displaying slide K and having the student volunteers return to their spots, have the class consider another perspective of the effect that distance has on light. This time if we are looking at a light that is further away. Connect back that the Sun appears brighter since it is close, but it also looks bigger than the other stars. Share with students that you have a video of cars moving closer to a camera at night. Invite students to make observations about how the light seems to change as the cars get closer." (Lesson 11, Teacher Guide)
- Lesson 11, Synthesize, Step 4: "Critique arguments for why the Sun looks different than other stars. Display slide L and distribute Critiquing Arguments about the Sun to each student. Ask the students to evaluate the two arguments for why the Sun looks different from the other stars. After critiquing the arguments, students should pick one to revise using the patterns they discussed today. Collecting this handout provides an opportunity to give students feedback on their scientific understanding of the differences in stars and their progress on arguing from evidence." (Lesson 11, Teacher Guide)
- Lesson 12, Synthesize, Step 4: "As students share their explanations using the Orbit Model, listen for evidence that students understand how the Earth's different positions around its orbit cause certain constellations to be visible at certain times of year. Be sure to press students on whether this would be a pattern every year and their evidence to support that claim" (Lesson 12, Teacher Guide)
- Lesson 13, Synthesize, Step 4: "Introduce the transfer task. Display Slide H, and explain to students that, now that we have figured out why the constellations of the southern and northern sky appear to move differently, we are going

to use what we know about the seasonality of constellations to make an argument for what we would expect to see at a different location on Earth. Distribute the Arguments for Sky Patterns assessment to each student." (Lesson 13, Teacher Guide)

- Lesson 13, Synthesize, Slide H: "Construct and support arguments for the following questions: Which motion(s) lead to us seeing seasonal stars? Do people living closer to the North Pole see seasonal stars?" (Lesson 13, Slides)

Multi-modal feedback loops

- Lesson 4, Synthesize, Step 5: "Share an explanation with a partner. Display slide H and have students turn and talk using the prompts on the slide. After 2-3 minutes bring students together and use the prompts below to support students in explaining why the Sun appears to move westward no matter what time of year. Have the materials from today's lesson, including the globe, meeple, and flashlight, available in the middle of the Scientist's Circle for students to reference and use as they share their ideas." (Lesson 4, Teacher Guide)
- Lesson 7, Synthesize, Step 4: "Refine arguments after evaluating the evidence. Distribute Sun and Moon Data Cards and display slide I. Direct students to part 1 of the handout. Provide students time to discuss revisions they need to make with their small group. Students should refine their argument using another color. Encourage students not to erase anything that they wrote or drew because we want to see how our ideas improve when we evaluate them. They should use the checklist on Sun and Moon Data Cards and the Peer Review feedback they received to improve their arguments. Encourage students to keep the Peer Review handout out on their workspace and refer to the feedback they received as they revise." (Lesson 7, Teacher Guide)
- Lesson 7, Student Materials, Handout 3: "Evaluate arguments for accuracy. Do your groups have consensus about your argument? Why or why not? Use "I wonder" statements to explore any differences. (For example, I wonder what caused us to make different claims.) (Lesson 7, 5.4 Lesson 7 Handout 3 Argument Peer Review)
- Lesson 11, Synthesize, Step 4: "Critique arguments for why the Sun looks different than other stars. Display slide L and distribute Critiquing Arguments about the Sun to each student. Ask the students to evaluate the two arguments for why the Sun looks different from the other stars. After critiquing the arguments, students should pick one to revise using the patterns they discussed today. Collecting this handout provides an opportunity to give students feedback on their scientific understanding of the differences in stars and their progress on arguing from evidence." (Lesson 11, Teacher Guide)
- Lesson 11, Student Materials, Handout 4: "Choose one of the arguments and revise it so the claim and evidence are accurate and the evidence is connected to the claim. Write your revised argument here (and continue on the back of the page as needed)." (Lesson 11, 5.4 Lesson 11 Handout 4 Critique Arguments About)

Criterion-Based Suggestions for Improvement: N/A

Category Ratings

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

Overall Ratings

Overall ratings:

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

E: Example of high quality NGSS design—High quality design for the NGSS across all three categories of the rubric; a lesson or unit with this rating will still need adjustments for a specific classroom, but the support is there to make this possible; exemplifies most criteria across Categories I, II, & III of the rubric. (total score ~8–9)

E/I: Example of high quality NGSS design if Improved—Adequate design for the NGSS, but would benefit from some improvement in one or more categories; most criteria have at least adequate evidence (total score ~6–7)

R: Revision needed—Partially designed for the NGSS, but needs significant revision in one or more categories (total ~3–5)

N: Not ready to review—Not designed for the NGSS; does not meet criteria (total 0–2)

Overall rating below:

E