EQuIP Rubric for Science

Earth Systems

How does changing the flow of water impact Earth's systems, and how can humans help?

Curriculum Developer: OpenSciEd

GRADE 5 | FEBRUARY 2026

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 5.3

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:

I.A Explaining Phenomena/Designing Solutions

- The lessons work together around an interesting central phenomenon concerning the dams on the Elwha River, which supports students in gaining proficiency in all the targeted learning. Ultimately, students are asked to apply their knowledge of Earth's systems and their interactions to design solutions to a different water problem.
- Using interviews and stories of lived experiences from the Klallam people sets the stage for sensemaking and engaging students with the culture of those who lived in the area for millennia.

I.B and I.F Three Dimensions and Math and ELA

- There is a robust use of the SEP, Using Mathematics and Computational Thinking, along with the effective integration of multiple science disciplines (Earth science and physical science). The connections to and leveraging of the CCSS for Mathematics and ELA are effective and essential for students to make sense of the Elwha River dams phenomenon and to design a solution for a unique water problem in a different part of the US.

II.A Student Ideas

- Students' ideas are valued and drive the learning throughout the unit. There are multiple opportunities for students to connect their families and learning about the Elwha River Dams, water usage in households, and water problems across the United States.

II.E Differentiated Instruction

- The differentiation strategies explicitly clarify how they address the needs of multilingual learners, students with special needs, struggling readers, struggling students, and students who have met the performance expectations or have high interests.

II.F Teacher Support for Unit Coherence

- Teachers are supported with strategies to help students make connections between the lessons to ensure sensemaking through integrated learning experiences. The Instructional Guidance Tools for the formal formative and mid-point summative assessments are especially helpful for making instructional decisions and providing feedback to students.

III.E Coherent Assessment System

- The materials provide an excellent, coherent assessment system with ample support for teachers to uncover student thinking, determine next steps instructionally, and provide feedback to students throughout the unit.

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 the unit received extensive ratings across all three categories, reviewers recommend focusing on the following criteria during revisions:

I.B Three Dimensions

- Consider adding the CCC Patterns (PAT-E2) to the Unit Front Matter under the Opportunities to Practice Crosscutting Concepts table, since it is included in the Alignment with the Three Dimensions of NGSS document.
- Consider removing SC-E2 as it is not addressed in the Groundwater Infographic or elsewhere in the lesson.

II.C Building Progressions

- Ensure that expected prior learning for each dimension is at the element level in the 5.3 Unit Front Matter.

II.G Scaffolded Differentiation Over Time

- Consider reducing the scaffolding provided in Lesson 14 so that students are using the INFO-E4 element more independently.

II.F Differentiation

- Consider revising suggestions in the Extension Opportunity callout for Lesson 10 to have students apply their learning in a new context rather than doing more calculations.

III.B Formative and III C. Scoring Guidance

- Consider including sample student work and/or videos showing various ways students might communicate understanding for Key Formative and Summative Assessments.

Why are there two colors of text in this report?

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

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

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

CATEGORY I
NGSS 3D Design

I.A. Explaining Phenomena / Designing Solutions

EXTENSIVE

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

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

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

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

The reviewers found **extensive** evidence that making sense of phenomena and/or designing solutions to a problem drive student learning. The materials are organized so that students are figuring out a central phenomenon, the impact of the Elwha dams on the Elwha River and the surrounding Earth systems. Students use what they figure out to design a solution to freshwater access caused by human activity. Students return regularly to the phenomenon in both lesson sets to add layers of explanation based on learning. In addition, students iterate solutions and apply their learning to suggest solutions for water problems in El Paso, Texas. Almost all of the student learning in the three dimensions targeted by the materials is in service to students making sense of the Elwha Dams phenomenon and solving water problems in other parts of the U.S. Student questions related to the phenomenon and to the problems create an explicit need from the students' perspective for the students to engage in learning throughout the unit. Materials provide structured support for teachers to draw out student questions and prior experiences related to the phenomenon and problems, and to use these connections to motivate student learning. Students have frequent opportunities to feel they are driving the learning through their questions and emerging understanding. The Elwha Dams phenomenon is clearly connected to water problems in other locales in a logical way from the students' perspective, and build upon each other coherently.

When engineering is a learning focus, it is integrated with developing disciplinary core ideas from earth and physical sciences. Students use grade-appropriate science ideas from earth and physical science to solve engineering problems, and these are included as part of the learning objectives. The way the materials support students to engage in the engineering design process results in students demonstrating new understanding of the targeted science ideas.

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, Explore, Step 3: "Make observations as a class of photos of the Elwha River. Tell students that we are now going to take a closer look at the Elwha River Dam by making observations of photos that were taken during and after the dam was built." (Lesson 1, Teacher Guide)
- Lesson 1, Connect, Step 6: "Discuss connections to the Elwha River dam phenomenon. Point out that the Elwha River may be far from where we live or really close, but either way, we've all probably seen or heard about some changes to natural things. Display slide N, and ask students to consider experiences they have had or things they have heard about where changes were made to natural things." (Lesson 1, Teacher Guide)
- Lesson 2, Navigate, Step 1: "Display slide B and invite students to look back on our DQB. Ask them to recall some of the things we were wondering about. Accept all responses. Point out that many of our wonderings had to do with the dams impact on the animals that are a part of the river system, particularly the salmon. Let's start by trying to answer

some of our questions about salmon. Asks students to share some of the wonderings we had about salmon. Use the prompts below to begin the discussion about how the salmon were impacted by the dam." (Lesson 2, Teacher Guide)

- Lesson 5, Navigate, Step 1: "Display slide C, and ask the students to look at the two images of the same dam at different times of the year. As they analyze the two photos, ask students to summarize what they notice and what they wonder about." (Lesson 5, Teacher Guide)
- Lesson 7, Navigate, Step 6: "Pass out new sticky notes and give students 1-2 minutes to think about what they are wondering about on their own and then 1-2 minutes to write their questions on their own. Then give students 3-5 minutes to share new questions and ideas with their group. Any question that the group agrees is still not answered can be added to the Driving Question Boards. After adding new questions, congratulate students on the ideas they have figured out so far and tell them we still have time to explore some of our new questions." (Lesson 7, Teacher Guide)
- Lesson 11, Navigate, Step 1: "Leverage students' observations, questions, and/or emotional responses about the potential overuse or scarcity of water to motivate curiosity about where all the water used to make different products comes from. Encourage students to recall water sources they explored earlier in this unit (Lesson Set 1) and in Unit 3.2: Why do plants only grow well in certain places, and how can we protect them?" (Lesson 11, Teacher Guide)
- Lesson 12, Navigate, Step 8: "Moving our engineering thinking forward. Remind students about the importance of developing and testing criteria and constraints. Call back to the impacts the river dams had on the Elwha Watershed system. Ask students *what problem were engineers trying to solve when they built the Elwha dams?* Look for students to say that the dams were built to create electricity. Then ask students, *does it seem like engineers back then used the same criteria and constraints we came up with today?*" (Lesson 12, Teacher Guide)

Consistent student-driven learning over time

- Lesson 3, Navigate, Step 7: "Summarize our question for next time. Point out that we have some wonderings about the direction the water in the Elwha River is actually going and where it comes from. Say something like, *It sounds like next time, we should investigate Why does the Elwha River flow from South to North?*" (Lesson 3, Teacher Guide)
- Lesson 6, Navigate, Step 1: "Navigate a conversation about how to move our science thinking forward. We know what the dam did to the water, sediment, and salmon, and but we have not looked to see how these changes could affect other parts of the system. But ask kids to consider how we could gather more evidence to support or refute these predictions." (Lesson 6, Teacher Guide)
- Lesson 7, Navigate, Step 1: "Display slide B and remind students that in our last lesson we discussed the kinds of decisions made by humans in our community that may impact the Earth's spheres and why it is important to explore those decisions. Ask students what ideas they have for how we could explore decisions that humans make in our own communities?" (Lesson 7, Teacher Guide)
- Lesson 8, Navigate, Step 1: "Revisit the questions groups want to add to the DQB. Show slide A. Use the prompts to guide the class discussion to revisit the questions that were added to the class' DQB. (Lesson 8, Teacher Guide)
- Lesson 9, Navigate, Step 1: "Decide where to go today. Display slide B. Ask students to think to themselves about how we could figure this out - what could we investigate or what kind of data would we need to help us answer that question about why people build dams. After a moment to think, have students tell a partner what ideas they have for investigation, and listen in while they share." (Lesson 9, Teacher Guide)
- Lesson 9, Navigate, Step 9: "Have students turn and talk about the questions they have now. Listen in while students talk with partners, then summarize the questions you heard. Especially elevate questions about how we use the limited fresh water we have access to, and possibly how we might be more careful about the water we use. Use those

questions to transition to taking an opportunity to document the ways we use water in our daily lives." (Lesson 9, Teacher Guide)

- Lesson 10, Navigate, Step 6: "Review our class notice/wonder/feel chart. Ask students to review the things that our class noticed, wondered, and felt about the amount of fresh water needed to produce common items. Display slide S and encourage students to share any patterns they noticed in the things that we wondered." (Lesson 10, Teacher Guide)
- Lesson 11, Navigate, Step 7: "Discuss where we should go next. Point out that it's hard to come up with solutions or choose between them. Use this uncertainty to get students to start thinking about how we might find more solutions or choose the right solution for the different communities. Have students consider which solution from the board might be the best possible solution to their problem and invite them to share it with their partner." (Lesson 11, Teacher Guide)
- Lesson 12, Navigate, Step 1: "Determine where to go after generating possible water scarcity solutions. Display slide A, remind students that in the previous science class, they organized a list of possible solutions for water problems in California, Florida, and Indiana. Then, while pointing to Lesson 11's *What is the core water problem our locations are facing? chart,* ask students to discuss the slide prompts with a partner. After students have had enough time discussing the three prompts, ask for a few volunteers to share their thoughts. Listen for the following ideas." (Lesson 12, Teacher Guide)
- Lesson 14, Navigate, Step 1: "Discuss the process for choosing a solution to a water-related problem. Display slide A and ask students to recall how they were able to choose the best solution for the water-related problem in the area that they were researching." (Lesson 14, Teacher Guide).

When multiple phenomena and /or problems are used

- Lesson 8, Explore Section, Step 2: "Observe the differences between the Elwha system before and after the dams. Display slide B and let the students know that in the early 2010s, local leaders finally accomplished the feat of having the dams removed. Led by the local Klallam tribe, these dams were slowly removed over a four year period. While pointing out the consensus Elwha system model, ask students to consider the following prompts. Have students share their thoughts." (Lesson 8, Teacher Guide)
- Lesson 11, Navigate Section, Step 1: "Leverage students' observations, questions, and/or emotional responses about the potential overuse or scarcity of water to motivate curiosity about where all the water used to make different products comes from. Encourage students to recall water sources they explored earlier in this unit (Lesson Set 1) and in Unit 3.2: Why do plants only grow well in certain places, and how can we protect them?" (Lesson 9, Teacher Guide)
- Lesson 12, Navigate, Step 8: "Moving our engineering thinking forward. Remind students about the importance of developing and testing criteria and constraints. Call back to the impacts the river dams had on the Elwha Watershed system. Ask students what problem were engineers trying to solve when they built the Elwha dams? Look for students to say that the dams were built to create electricity. Then ask students, does it seem like engineers back then used the same criteria and constraints we came up with today? Accept all answers. Next, draw students' attention to the list solutions they generated at the end of Lesson 11 and ask them to consider how we might revise, then use our comparison tool to identify solutions for the three locations they researched in Lesson 11. Show slide L and listen for the following ideas" (Lesson 12, 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

- Lesson 5, Navigate, Step 1: "Generating new thinking about the Elwha River dams. Remind students that we have some ideas about how the dam impacted the amounts and location of water in our river models, but we haven't observed this in the Elwha River yet. Display slide B and tell students that there are actually two dams in the Elwha River. Use the prompts on the slide to introduce students to the Glines Canyon Dam. Display slide C, and ask the students to look at the two images of the same dam at different times of the year. As they analyze the two photos, ask students to summarize what they notice and what they wonder about." (Lesson 5, Teacher Guide)
- Lesson 9, Navigate, Step 1: "Recall the questions we have now. Invite students to turn and talk about the questions we have now that we understand the negative effects of building dams. Ask a few students what questions or concerns we have about building dams given all the problems we know them to cause." (Lesson 9, Teacher Guide)
- Lesson 11, Synthesize, Step 4: "Develop a class consensus model of the core water problem. Display slide G and a chart paper labeled 'What is the core water problem all our locations are facing?' and tell students that it seems like the problems we researched have similarities. We have models of the individual problems, but let's develop a class consensus model of the problem all of our locations are facing. Facilitate a discussion about what the model should include as you develop the model on the chart labeled 'What is the core water problem our locations are facing?'" (Lesson 11, Teacher Guide)
- Lesson 12, Synthesize, Step 4: "Begin to identify considerations to test the water solutions. While in a Scientist Circle, show slide G and discuss the patterns and connections students observed when analyzing the rainwater harvesting solution and the solutions from the infographic." (Lesson 12, Teacher Guide)
- Lesson 13, Explore, Step 5: "Evaluate each others' solutions using Peer Feedback. Display slide H and distribute Peer Feedback to each pair of students. Tell students that they will be testing the solution of a peer under a range of different conditions and providing them feedback about how likely the solution is to improve the problem when changes occur. Have students use the chart of possible changes that just recorded as a guide for completing the column labeled "possible changes" on Peer Feedback. Consider using an example solution from slide F to do one row on Peer Feedback as an example, before assigning students to a pair to review." (Lesson 13, 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)

- Lesson 6, Navigate, Step 8: "Decide where to go next. Show slide I and ask students to consider how we might use our knowledge about the decision to build dams along the Elwha River to analyze the decisions we make in our local community. Ask students to discuss the three prompts on slide I and then share their partner's thinking." (Lesson 6, Teacher Guide)
- Lesson 7, Navigate, Step 1: "Display slide B and remind students that in our last lesson we discussed the kinds of decisions made by humans in our community that may impact the Earth's spheres and why it is important to explore those decisions. Ask students what ideas they have for how we could explore decisions that humans make in our own communities?" (Lesson 7, Teacher Guide)
- Lesson 13, Explore, Step 6: "In pairs, choose the feedback that will be used to optimize solutions. Display slide J and tell students to discuss the feedback that they think would be the most helpful in optimizing their plan for improving the water problem. If available, distribute highlighters or colored markers to help students visualize the feedback that

they want to use. Ask students to highlight, circle, or underline the feedback that they are going to use. Ask them to use the column on Peer Feedback titled "How will you use this feedback to improve your design?" to capture their thoughts about how they will use that feedback to improve their plan." (Lesson 13, Teacher Guide)

- Lesson 14, Connect, Step 3: "Display slide E and tell students that people living and working in El Paso started thinking of solutions to this problem many years ago. We are going to get a chance to explore two of those solutions together. Tell students that after we figure out more about how these two solutions work, we will get a chance to compare them and to think of a solution of our own. Tell students that for now, we are going to watch a video about each solution and record information that can help us better understand how these solutions can improve the water problem." (Lesson 14, Teacher Guide)
- Lesson 14, Synthesize, Step 4: "Remind students that when comparing solutions for the last water related problem, we were looking for the solution that would improve the problem the most. While we will still consider which solution will improve the problem, we are going to be comparing the solutions with a different lens this time. We all know how many negative impacts the dams on the Elwha River had on the Earth's spheres. So we know how important it is to consider these impacts when choosing solutions. When comparing solutions for the El Paso water problem, you will consider the impacts the solution has on the Earth's systems." (Lesson 14, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

I.B. Three Dimensions

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

EXTENSIVE

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

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

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

The reviewers found **extensive** evidence that the materials give students opportunities to build understanding of grade-appropriate elements of the three dimensions because students regularly engage in elements of all three dimensions in order to make sense of the anchoring or lesson-level phenomenon. Through the instructional routines, students have an opportunity to build their understanding of elements of the three dimensions in every lesson. The unit centers on students using targeted elements of all three dimensions that are clearly identified and addressed throughout the unit to explain the impact of the Elwha dams on the Elwha River and surrounding Earth systems.

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: Asking Questions and Defining Problems (AQDP, Developing and Using Models, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions, Arguing from Evidence, and Obtaining, Evaluating, and Communicating Information. Students use the grade-appropriate SEP elements that are listed as key learning objectives in service of making sense of phenomena or designing solutions to problems. Elements that were developed and/or used: **AQDP-E5, MOD-E2, MOD-E3, MOD-E4, DATA-E1, DATA-E2, MATH-E3, CEDS-E4, CEDS-E5, ARG-E3, ARG-E4, INFO-E1, INFO-E4, INFO-E5**

ADQP: Asking Questions and Defining Problems

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

Claimed in Lesson 12. Evidence was found in lesson 12, examples include

- Lesson 12, Synthesize, Step 6: "Develop a list of criteria and constraints. Display the Solution Checklist chart (refer to slide J) and lead a consensus discussion with the goal of creating a checklist of all the things an ideal water solution would do, not do, and the obstacles it would need to overcome. Use the prompts below to support students in identifying the criteria and constraints of an ideal water solution." (Lesson 12, Teacher Guide)

MOD: Developing and Using Models

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

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

- Lesson 2, Synthesize, Slide H: "Let's work together to develop a model that explains how the salmon interact with the other components of the Elwha River system." (Lesson 2, 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 Lessons 3, 4, 5, 6, 7, and 13. Evidence was found in all claimed lessons, examples include

- Lesson 3, Explore, Slide B: "How can we use the materials we have to create an Elwha River System model to observe the impact the dams had on the sediment and water in the Elwha River?" (Lesson 3, Slides)
- Lesson 4, Synthesize, Step 3: "Develop a model to explain. Display slide J and a chart labeled "Why does the water in the Elwha flow south to north?" If time and space allow, consider leaving the investigation materials accessible and/or visible to students as they apply what they figured out from the investigation to modeling the way the Elwha River flows." (Lesson 4, Teacher Guide)

- Lesson 5, Student Materials, Handout 4: "Use words and/or drawings to develop a model to explain the interactions between the atmosphere and the hydrosphere in the Elwha River System." (Lesson 5, 5.3 Lesson 5 Handout 4 Model of Hydrosphere)
- Lesson 6, Synthesize, Slide I: "Then arrange these cards to: Create a model to explain the effects of the Elwha River dams on the Elwha River system" (Lesson 6, Slides)
- Lesson 7, Explore, Step 3: "In pairs, create a system model for one of the human decisions we observed. Display slide E and tell students that they will now work in pairs on Impact of Human Decisions to choose one of the human decisions that they observed and create a system model showing the impact that decision had on the spheres and their interactions." (Lesson 7, Teacher Guide)
- Lesson 13, Explore, Step 3: "Develop a model to explain the solution to our problem. Suggest to students that we could use a model to help others understand why their chosen solution tested best. Ask students to consider what might be useful for us to include in our models to help show why it's best, especially to their peers who have been researching a different problem." (Lesson 13, Teacher Guide)

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

Claimed in Lessons 1 and 11. Evidence was found in claimed lessons, examples include

- Lesson 1, Synthesize, Slide K: "Develop a model to explain how the dam could have caused changes to the lands, waters, and living things." (Lesson 1, Slides)
- Lesson 1, Synthesize, Step 5: Develop a consensus model. "How did the dam change the Elwha River?" (Lesson 1, Teacher Guide)
- Lesson 11, Student Materials, Handout 2: "Use words, drawings, and/or arrows to explain your ideas about: How is the community's use of water changing the local hydrosphere?" (Lesson 11, 5.3 Lesson 11 Handout 2 Model your problem)

DATA: Analyzing and Interpreting Data

Claimed Element: **DATA-E1 Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.**

Claimed in Lesson 5. Evidence was found in lesson 5, examples include

- Lesson 5, Explore, Step 2: "Constructing a precipitation graph. Distribute a copy of the 2018 -2023 Olympic Mountains Precipitation Data handout to each student. Display slide G and tell students they will individually be constructing a bar graph for either 2018-2019, 2020-2021, or 2022-2023. Assign students a set of data to work with and suggest that they circle it on the handout. After students have completed their graphs, have them form small groups and use the prompts on the slide to guide a discussion to analyze the patterns observed in the data table and the graph." (Lesson 5, Teacher Guide)

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

Claimed in Lesson 9. Evidence was found in lesson 9, examples include

- Lesson 9, Explore, Step 2: "Give instructions for analyzing and interpreting graph data. Display slide C. Review the directions on the page and define analyze (separate into parts and examine) and interpret (explain what it means). Clarify with students that they will be working with a partner so each of them can mark up the graph with what

they see (analyze and examine the parts) and what it means (interpret), and point out the space for questions at the bottom of the page." (Lesson 9, Teacher Guide)

- Lesson 9, Synthesize, Step 3: "Share ideas about why dams were built. Bring the class together with their What are dams built for? and display slide D. Invite students to the screen to point out what they see on the graph and share what they think that means." (Lesson 9, Teacher Guide)

MATH: Using Mathematics and Computational Thinking

Claimed Element: **MATH-E3 Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems.**

Claimed in Lessons 9 and 10. Evidence was found in claimed lessons, examples include

- Lesson 9, Explore, Step 4: "Plan for how to gather evidence of available water. Display slide F and ask students how this map could help us figure out how much water is available for us to use. Establish that we can make a rough estimate of the places on Earth that are covered with water (in various forms)." (Lesson 9, Teacher Guide)
- Lesson 9, Explore, Step 4: "Connect to finding area in math. If students did not already suggest it, connect to work they have done in math when they want to know how much space a shape covers. Recall counting squares or measuring in square units to find the area of a shape. Suggest that we can do the same with this map, but we will want to divide the work of counting squares because this is a big map." (Lesson 9, Teacher Guide)
- Lesson 10, Explore, Step 3: "Compare our predictions of water use amounts to the amounts listed on the data table. Display slide E and explain that you found a data table showing the typical water usage in gallons for each activity. Let students know that the information used to find an amount for the typical water usage is based on averages." (Lesson 10, Teacher Guide)

CEDS: Constructing Explanations and Designing Solutions

Claimed Element: **CEDS-E4 Apply scientific ideas to solve design problems.**

Claimed in Lesson 13. Evidence was found in lesson 13, examples include

- Lesson 13, Navigate, Step 7: "Celebrate creating a plan for improving a water problem. Display slide M and ask students to think about how they could use this work to help them solve other water related problems. Invite a few students to share their thoughts." (Lesson 13, Teacher Guide)

Claimed Element: **CEDS-E5 Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.**

Claimed in Lessons 12 and 14. Evidence was found in claimed lessons, examples include

- Lesson 12, Synthesize, Step 7: "Use our comparison tool to test different water solutions. Distribute Lesson 12 Comparison Tool to each pair of students and show slide K. Direct partners use our Solution Checklist poster to write down the class' criteria and constraints. Partners should then use the comparison tool to record how the Step on it and Time it right solutions from Save Water This Summer Infographic addresses the criteria and constraints differently. Partners will need to discuss how they'd like to do this." (Lesson 12, Teacher Guide)
- Lesson 14, Synthesize, Step 4: "Introduce the Comparing Solutions task. Display slide J and remind students that they have explored two solutions that are already being used in El Paso, but they will be comparing a third solution in this

task. Tell students that they are going to generate their own solution to the problem. Encourage students to use El Paso Searches for Answers to Its Water Problems, Understanding El Paso's Water Problem, and Exploring El Paso's Water Solutions to help them think through another solution. Point out the space on Comparing Solutions to El Paso's Water Problem where students should include their self generated solution." (Lesson 14, Teacher Guide)

ARG: Engaging in Argument from Evidence

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 Lesson 13. Evidence was found in lesson 13, examples include

- Lesson 13, Explore, Step 5: "Assign pairs that researched different locations to trade solutions. Ask them to bring their model on Modeling our solution and their copy of Peer Feedback to the area that they will be working. Have the pairs of students exchange models and use Peer Feedback to help them think through how likely the solution will be to still improve the problem with the various changes that are possible. Make sure students are clear that they will be writing their feedback on the first three columns of Peer Feedback. The last column will be for the students who receive the feedback to complete in the next step. Give students time to review each others' models and provide feedback." (Lesson 13, Teacher Guide)

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

Claimed in Lesson 4. Evidence was found in lesson 4, examples include

- Lesson 4, Student Materials, Handout 2 Modeling the Path: "Support your claim with evidence and reasoning: Explain why the model you chose represents what caused the water that fell in your community to end up where it did. How did the evidence you collected during the investigations support you in making your claim?" (Lesson 4, 5.3 Lesson 4 Handout 2 Modeling the Path)

INFO: Obtaining, Evaluating, and Communicating Information

Claimed Element: **INFO-E1 Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.**

Claimed in Lessons 6 and 11. Evidence was found in claimed lessons, examples include

- Lesson 6, Explore, Step 2: "After students have had time to read and annotate the handout, distribute System Effects from the Dams to each student and show slide G. Direct partners to think about the question: How and why did the Elwha River system change after the dams were built? Next, students should discuss which components are interacting with the salmon, sediment, and water. Have students work to identify these interactions, and record them and their effects on System Effects from the Dams." (Lesson 6, Teacher Guide) - This leads to the Gotta Have It Checklist.
- Lesson 11, Connect, Step 2: "Gather information about groundwater by analyzing an infographic. Show slide C and distribute 2 copies of the Groundwater Infographic to each group. Give groups 5 minutes to analyze the infographic, looking for information to help them answer their groundwater questions. After the time concludes, ask groups to share what they obtained." (Lesson 11, Teacher Guide)
- Lesson 11, Explore, Step 3: Display slide E. Distribute the Ground Water Infographic handout and an internet-connected device to each student, and direct students to the Water Wanted Website. Students will work on their own to research how their chosen community's water use is impacting the local hydrosphere." (Lesson 11, Teacher Guide)

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

Claimed in Lessons 1, 2, 8, and 14. Evidence was found in all claimed lessons, examples include

- Lesson 1, Connect, Step 1: "Read a book to learn more about the Elwha River. Display slide C and have Wonderful Waters: The Elwha River ready to display." (Lesson 1, Teacher Guide)
- Lesson 2, Connect, Step 3: "Introduce students to the salmon articles. Display slide E and tell students that you have articles that will help us figure out more about how salmon interact with the various parts of the Elwha River and the things living in or near it. Figuring out about how salmon live their lives in the river will help us figure out if they need to access all of its parts in order to survive. Tell students that they're going to work in pairs to read the articles." (Lesson 2, Teacher Guide)
- Lesson 8, Connect, Step 3: "Listen to people share experiences related to the dam removal. Tell students that each person has answered a series of questions that will help us gather evidence about the changes to the Elwha River system. Tell students that they will form 4 groups and each group will focus on one question." (Lesson 8, Teacher Guide)
- Lesson 14, Explore, Step 2: "Read El Paso Searches for Answers to Its Water Problems in pairs. Display slide C and remind students that they suggested finding out more about the problem in El Paso before considering how to help improve it. Tell them that they can work with a partner to read about the water problem in El Paso using El Paso Searches for Answers to Its Water Problems. Ask students to record the key ideas they figure out about the problem on Understanding El Paso's Water Problem." (Lesson 14, Teacher Guide)

Claimed Element: **INFO-E5 Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts.**

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

- Lesson 6, Explore, Step 2: "Gather evidence from data. Tell students that you have some data that was collected before and after the dams were built. Show slide B. Direct students to share with a partner what the bar graph shows and what effects this change could have on the system. Repeat the protocol for slides C-E." (Lesson 6, 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. There is a close match between the DCI elements that are claimed and evidence of their development and use in the materials. Students use the DCI elements that are listed as key learning objectives in service of making sense of the Elwha Dam phenomenon and in designing solutions to water related problems in other parts of the U.S. Students are supported to develop deep competence in specific elements such that they could be applied to more than one context.

Students have multiple opportunities to build the following science ideas:

- Claimed Element: **ESS2.A-E1 Earth Materials and Systems: Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.**
- Claimed Element: **ESS2.C-E1 The Role of Water in Earth's Surface Processes: Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.**
- Claimed Element: **ESS3.C-E1 Human Impacts on Earth Systems: Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.**
- Claimed Element: **PS2.B-E3 Types of Interactions: The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.**
- Claimed Element: **ETS1.A-E1 Defining Engineering Problems: Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.**
- Claimed Element: **ETS1.B-E1 Developing Possible Solutions: Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.**
- Claimed Element: **ETS1.C-E1 Optimizing the Design Solution: Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.**

ESS2.A: Earth Materials and Systems

Claimed Element: **ESS2.A-E1 Earth Materials and Systems: Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.**

Claimed in Lessons 1, 2, 3, 5, 6, and 7. Evidence was found in all claimed lessons, examples include

- Lesson 1, Connect, Step 2: "Read through page 16 using the following prompts to help to support students in recording their noticings on the Elwha River System Components chart. See the image below for a sample chart." (Lesson 1, Teacher Guide)
- Lesson 2, Synthesize, Step 4: "Develop the Salmon/Elwha River System Interactions model. Display slide H and the "How do salmon interact with different parts of the river system?" chart paper. Point out that we have figured out a lot about how salmon interact with some of the parts of the river when we read an article and shared the information with another group, but as a class, we do not have all of the information. Hold a Building Understanding Discussion

where students share what they read about how salmon interact with the Elwha River system during the stage in their life cycle that they read about. Encourage students to have their salmon article available for reference as they share. Explain that we will work together to develop a model that explains how the salmon interact with the parts of the Elwha River system. As each group shares, add the interactions to the part of the river they are explaining." (Lesson 2, Teacher Guide)

- Lesson 3, Synthesize, Step 5: "Develop a system model with a partner to show the dam effects. Display slide K and suggest we use our new model setup to explain how the geosphere and biosphere interact and how the dam could impact those interactions. Tell students that they will work with a partner and use the evidence that we gathered in this lesson and in Lesson 2 to develop their models." (Lesson 3, Teacher Guide)
- Lesson 5, Student Materials, Handout 4: "Use words and/or drawings to develop a model to explain the interactions between the atmosphere and the hydrosphere in the Elwha River System." (Lesson 5, 5.3 Lesson 5 Handout 4 Model of Hydrosphere)
- Lesson 6, Synthesize, Step 6: "Update the Elwha River System Components and Interactions consensus model. Display the Elwha River System Components and Interactions model (refer to slide L) and use a Consensus Discussion to support students in updating the consensus model. Refer to the sample prompts below to help students add new ideas to the model." (Lesson 6, Teacher Guide)
- Lesson 7, Navigate, Step 1: "Class discuss what we figured out about the way the dams on the Elwha River impacted the Earth's spheres. Display slide A and remind students that in our last lesson we were using our Elwha River System Model to think through the impacts that the dams on the Elwha River had on the Earth's spheres and the interactions between them." (Lesson 7, Teacher Guide)

ESS2.C: The Roles of Water in Earth's Surface Processes

Claimed Element: **ESS2.C-E1 The Role of Water in Earth's Surface Processes: Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.**

Claimed in Lesson 9. Evidence was found in lesson 9, examples include

- Lesson 9, Synthesize Section, Step 3: "Navigate toward investigating why we need reservoirs. Ask students why they think so many dams are used to collect and store water for people to use. Accept all ideas. If students propose that there must not be enough water in those places, propose that we find evidence to support that idea. If students have not suggested possible reasons, propose that we dig deeper into some more data to figure out why we need to build dams to get water for people to use." (Lesson 9, Teacher Guide)
- Lesson 9, Explore Section, Step 4: "Plan for how to gather evidence of available water. Display slide F and ask students how this map could help us figure out how much water is available for us to use. Establish that we can make a rough estimate of the places on Earth that are covered with water (in various forms)." (Lesson 9, Teacher Guide)
- Lesson 9, Explore Section, Step 5: "Establish the difference between salt water and fresh water. Point out that some students mentioned the ocean being salty. Ask a few students to clarify: How is ocean water different from the water in lakes and rivers? Confirm that water in the ocean is salt water and water in lakes and rivers is fresh water. The water we use in our homes and businesses, for farming, and (usually) for putting out fires is fresh water. Add these two words to the Word Wall." (Lesson 9, Teacher Guide)
- Lesson 9, Explore Section, Step 5: "Define 'glacier'. Students may picture ice as a thin layer on top of a frigid lake, or icebergs threatening ships in the ocean; they may not understand that huge masses of ice miles wide and thousands of feet thick exist on Earth. Take a moment to display slide J and explain that a huge *mass of ice* is called a glacier. If

helpful, flip back to the world map on slide F and point out that the largest glaciers on Earth are in Greenland and Antarctica. Add "glacier" to the Word Wall." (Lesson 9, Teacher Guide)

- Lesson 9, Explore Section, Step 6: "Give directions for graphing the distribution of fresh water. Display slide L and review the directions on the handout...Give students time to work on their graphs. Distribute the How much fresh water? handout, organize students into partners, and give them time to graph the information about where fresh water can be found on Earth." (Lesson 9, Teacher Guide)
- Lesson 9, Synthesize Section, Step 7: "Discuss the data we just graphed. Gather students in a Scientists Circle with their How much fresh water? handout and display slide M. Use prompts such as these to facilitate a Building Understandings Discussion about how fresh water is distributed around Earth." (Lesson 9, Teacher Guide)

ESS3.C: Human Impacts on Earth Systems

Claimed Element: **ESS3.C-E1 Human Impacts on Earth Systems: Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.**

Claimed in Lessons 1, 8, 10, 11, 12, 13, and 14. Evidence was found in all claimed lessons, examples include

- Lesson 1, Lesson Assessment Guidance, How can I use this assessment information?: "This is a pre-assessment opportunity. Do not take a grade or score. Instead, use the information to uncover students' initial ideas about the changes that can happen to interactions between Earth's systems caused by human impacts. Use the class initial consensus model as a collective record of student ideas. Also, refer to students' "After Dam" Initial Model handout for a record of students' initial ideas." (Lesson 1, Teacher Guide)
- Lesson 8, Synthesize Section, Slide N: "What evidence do we have that the Elwha River system is recovering? What evidence do we have that humans positively impacted the Earth's spheres?" (Lesson 8, Slides)
- Lesson 10, Navigate Section, Step 6: "Echo students' language to summarize that: it does seem like we have some real concerns about how this amount of fresh water usage will impact the Earth and we are not feeling good about this and want to do something about it. Suggest that we should do some exploring of the impacts overuse of fresh water has on the Earth and maybe even think about how to solve this problem in our next lesson." (Lesson 10, Teacher Guide)
- Lesson 11, Student Materials, Handout 2: "Use words, drawings, and/or arrows to explain your ideas about: How is the community's use of water changing the local hydrosphere?" (Lesson 11, 5.3 Lesson 11 Handout 2 Model your problem)
- Lesson 12, Navigate Section, Step 8: "Moving our engineering thinking forward. Remind students about the importance of developing and testing criteria and constraints. Call back to the impacts the river dams had on the Elwha Watershed system. Ask students what problem were engineers trying to solve when they built the Elwha dams? Look for students to say that the dams were built to create electricity. Then ask students, does it seem like engineers back then used the same criteria and constraints we came up with today? Accept all answers. Next, draw students' attention to the list solutions they generated at the end of Lesson 11 and ask them to consider how we might revise, then use our comparison tool to identify solutions for the three locations they researched in Lesson 11. Show slide L and listen for the following ideas" (Lesson 12, Teacher Guide)
- Lesson 13, Explore Section, Step 3: Cause and Effect Callout: "As students consider how human activity is contributing to the problem and how the solution solves the problem, they are engaging with cause and effect relationships. Look for evidence on their model that indicates they are considering causal relationships. Circulate as students work on their models and, if you see opportunities for students to represent cause and effect relationships more clearly, ask questions like, "How could you show how human activities caused the problem?" or "What effect does the solution have on the problem?" (Lesson 13, Teacher Guide)

- Lesson 13, Explore Section, Step 3: "Display slide D and have students create models for explaining how their proposed solution will address their water related problem. These models should also justify why the chosen solution is optimal, incorporating their analysis of the criteria and constraints from Lesson 13 Comparison Tool. Distribute one copy of Modeling our solution to each pair of students. Review what students should include and the resources they should use to guide their work with the class. Remind them that they can reference the checklists on their Modeling our solution while developing their model with their partner. Encourage students to develop their model using pencil, so they can revise it easily if they need to. See Unit 5.3: How does changing the flow of water impact Earth's systems, and how can humans help? to see the types of ideas students may incorporate into their models." (Lesson 13, Teacher Guide)
- Lesson 13, Modeling Our Solution Student Handout: "Directions: Develop a model that explains how the solution that you chose will cause the water related problem at the location that you have been researching to improve. Make sure to include: How human activity is contributing to the problem, How your solution causes the problem to improve, Evidence for how your solution meets the criteria and constraints in order to justify why it's the better solution, Arrows, labels, or annotations to show interactions between our systems parts or changes in how water moves." (Lesson 13, Student Handout)
- Lesson 14, Synthesize Section, Step 4: "Remind students that when comparing solutions for the last water related problem, we were looking for the solution that would improve the problem the most. While we will still consider which solution will improve the problem, we are going to be comparing the solutions with a different lens this time. We all know how many negative impacts the dams on the Elwha River had on the Earth's spheres. So we know how important it is to consider these impacts when choosing solutions. When comparing solutions for the El Paso water problem, you will consider the impacts the solution has on the Earth's systems." (Lesson 14, Teacher Guide)

PS2.B: Types of Interactions

Claimed Element: **PS2.B-E3 Types of Interactions: The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.**

Claimed in Lesson 4. Evidence was found in Lesson 4, examples include

- Lesson 4, Synthesize, Step 5: "Add to our 'Why does the water in the Elwha River flow south to north?' model. Display slide R and the "Why does the water in the Elwha River flow south to north?" model. Ask students to consider how we can use the ideas we figured out about gravity to help us further explain why the water in the Elwha flows south to north." (Lesson 4, Teacher Guide)

ETS1.A: Defining Engineering Problems

Claimed Element: **ETS1.A-E1 Defining Engineering Problems: Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.**

Claimed in Lesson 12. Evidence was found in 12, examples include

- Lesson 12, Synthesize, Step 7: "Use our comparison tool to test different water solutions. Distribute Lesson 12 Comparison Tool to each pair of students and show slide K. Direct partners use our Solution Checklist poster to write down the class' criteria and constraints. Partners should then use the comparison tool to record how the Step on it and Time it right solutions from Save Water This Summer Infographic addresses the criteria and constraints differently. Partners will need to discuss how they'd like to do this." (Lesson 12, Teacher Guide)

ETS1.B: Developing Possible Solutions

Claimed Element: **ETS1.B-E1 Developing Possible Solutions: Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.**

Claimed in Lessons 11, 13, and 14. Evidence was found in all claimed lessons, examples include

- Lesson 11, Connect, Step 2: "Gather information about groundwater by analyzing an infographic. Show slide C and distribute 2 copies of the Groundwater Infographic to each group. Give groups 5 minutes to analyze the infographic, looking for information to help them answer their groundwater questions. After the time concludes, ask groups to share what they obtained." (Lesson 11, Teacher Guide)
- Lesson 11, Explore, Step 3: Display slide E. Distribute the Ground Water Infographic handout and an internet-connected device to each student, and direct students to the Water Wanted Website. Students will work on their own to research how their chosen community's water use is impacting the local hydrosphere." (Lesson 11, Teacher Guide)
- Lesson 13, Synthesize, Step 2: "In pairs, decide on two solutions to compare. Display slide B and let students know that they will now get a chance to choose two solutions for the water problem facing the community in the location that they have been researching that they would like to compare. Let students know that if they want to revise any of the solutions from Lesson 11 or use an entirely new solution, that is okay too. We have done a lot of thinking about solutions, criteria, and constraints, so we may have new ideas about solutions that could work. Have a procedure in place for allowing students to reference the "What is the core water problem our locations are facing?" chart if they would like to review the solutions posted on it in Lesson 11 more carefully. Distribute one copy of Lesson 13 Comparison Tool to each pair of students and tell them that after they and their partner agree on two solutions to compare, they should write those solutions on the top row of Lesson 13 Comparison Tool." (Lesson 13, Teacher Guide)
- Lesson 14, Synthesize, Step 4: "Remind students that when comparing solutions for the last water related problem, we were looking for the solution that would improve the problem the most. While we will still consider which solution will improve the problem, we are going to be comparing the solutions with a different lens this time. We all know how many negative impacts the dams on the Elwha River had on the Earth's spheres. So we know how important it is to consider these impacts when choosing solutions. When comparing solutions for the El Paso water problem, you will consider the impacts the solution has on the Earth's systems." (Lesson 14, Teacher Guide)

ETS1.C: Optimizing the Design Solution

Claimed Element: **ETS1.C-E1 Optimizing the Design Solution: Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.**

Claimed in Lesson 13. Evidence was found in 13, examples include

- Lesson 13, Synthesize, Step 2: "Display slide C and tell students that now that they have their two solutions chosen, they can use Lesson 13 Comparison Tool to guide them through using the criteria and constraints to compare the solutions and choose the one that best improves the problem that they have been researching. Together, work through adding the criteria and constraints that we agreed upon in Lesson 12 to Lesson 13 Comparison Tool." (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. These pieces of evidence were selected because there is a close match between the CCC elements that are claimed and evidence of their development and use in the materials for most of the targeted CCC. Students come to understand and use the CCC elements that are listed as key learning objectives in service of making sense of the Elwha River phenomenon. 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 following crosscutting concepts:

- Claimed Element: **PAT-E2 Patterns of change can be used to make predictions.**
- Claimed Element: **SYS-E2 A system can be described in terms of its components and their interactions.**
- Claimed Element: **SPQ-E2 Standard units are used to measure and describe physical quantities such as weight and volume**
- Claimed Element: **CE-E1 Cause and effect relationships are routinely identified and used to explain change.**
- Claimed Element: **SC-E1 Change is measured in terms of differences over time and may occur at different rates.**

PAT: Patterns

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

Claimed in Lesson 12. Evidence was found in Lesson 12

- Lesson 12, Synthesize, Step 4: "Begin to identify considerations to test the water solutions. While in a Scientist Circle, show slide G and discuss the patterns and connections students observed when analyzing the rainwater harvesting solution and the solutions from the infographic." (Lesson 12, Teacher Guide)
- Patterns (PAT-E2) is not included in the Unit Front Matter under the Opportunities to Practice Crosscutting Concepts table.

SYS: Systems and System Models

Claimed Element: **SYS-E2 A system can be described in terms of its components and their interactions.**

Claimed in Lessons 1, 2, 3, 6, 7, and 14. Evidence was found in 1, 2, 3, 6, 7, and 14, examples include

- Lesson 1, Connect, Step 2: "Plan to chart our noticings about the Elwha River. Reveal the "Elwha River System Components chart." Tell students that there are many parts to the river that interact with one another which is why we refer to it as a system (refer to slide D). Ask students about their previous experiences with systems. Read the example definition on the Word Wall card and/or co-construct a definition together as a class, then add it to the Word Wall. Then, remind students that parts of a system are also called components, and that components interact, or *can have an effect or change each other.*" (Lesson 1, Teacher Guide)

- Lesson 2, Synthesize, Step 4: "Develop the Salmon/Elwha River System Interactions model. Display slide H and the "How do salmon interact with different parts of the river system?" chart paper. Point out that we have figured out a lot about how salmon interact with some of the parts of the river when we read an article and shared the information with another group, but as a class, we do not have all of the information." (Lesson 2, Teacher Guide)
- Lesson 2, Synthesize, Step 4, Callout System and System Models: "Students are describing the components of the Elwha River system and their interactions as they develop a model of the interactions between the salmon and the river." (Lesson 2, Teacher Guide)
- Lesson 2, Navigate, Step 5: "Display slide J. While pointing to the class' *Elwha River System Components* consensus model from L1 and the "How do salmon interact with different parts of the river system?" model, ask students to consider how the dam may cause changes to parts of the system that would impact the salmon. Also, ask students how we might figure out which parts the dam is affecting within the Elwha system." (Lesson 2, Teacher Guide)
- Lesson 3, Synthesize, Step 5: "Tell students that sometimes, when scientists are figuring out more about systems with many components, it can be helpful to group things together to better see the interactions between larger groups of components. Elevate that one part of the system we were interested in finding out more about was the salmon. Write the word salmon near the top of a green piece of paper, leaving space for a title. Ask students to review the Lesson 1 model and share other components that are similar to the salmon." (Lesson 3, Teacher Guide)
- Lesson 6, Navigate, Step 1: "Consider how to figure out what happened to the whole system after the dams were built. Show slide A, while pointing out the class consensus model and Driving Question Board, ask students to share what they've figured out about the dams immediate effect on the watershed system. After hearing from a couple of volunteers, ask students to consider how they could figure out more about how the blocking of water, sediment, and salmon affected the greater system." (Lesson 6, Teacher Guide)
- Lesson 6, Explore, Step 2: "After students have had time to read and annotate the handout, distribute System Effects from the Dams to each pair and show slide B. Direct partners to think about the question: How and why did the Elwha Watershed system change after the dams were built? Next, students should discuss which components are interacting with the salmon, sediment, and water. As partners identify these interactions, have them record them and their effects on System Effects from the Dams." (Lesson 6, Teacher Guide)
- Lesson 7, Navigate, Step 1: "Class discuss what we figured out about the way the dams on the Elwha River impacted the Earth's spheres. Display slide A and remind students that in our last lesson we were using our Elwha River System Model to think through the impacts that the dams on the Elwha River had on the Earth's spheres and the interactions between them. While pointing to the completed Elwha River System Model, ask students to recall what we figured out about the ways that [the] dams on the Elwha River impacted the Earth's spheres." (Lesson 7, Teacher Guide)
- Lesson 14, Synthesize, Step 4: "Remind students that when comparing solutions for the last water related problem, we were looking for the solution that would improve the problem the most. While we will still consider which solution will improve the problem, we are going to be comparing the solutions with a different lens this time. We all know how many negative impacts the dams on the Elwha River had on the Earth's spheres. So we know how important it is to consider these impacts when choosing solutions. When comparing solutions for the El Paso water problem, you will consider the impacts the solution has on the Earth's systems." (Lesson 14, Teacher Guide)

SPQ: Scale, Proportion, and Quantity

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

Claimed in Lessons 5, 9, and 10. Evidence was found in 5, 9, and 10, examples include

- Lesson 5, Explore, Step 2: "Constructing a precipitation graph. Distribute Olympic Mountains Precipitation Data and Graph 2022-2023, and using slide F, or a prepared chart paper, work as a whole class to construct the bar graph. Display slide F then use the following prompts to guide a discussion to analyze the patterns observed in the data table and the graph. As students share what they notice, ask them to point to the graph or data table to show where that observation came from. Let students know that they are scientists when they do this work of looking for patterns in the data to figure something out about the world." (Lesson 5, Teacher Guide)
- Lesson 9, Explore, Step 6: "Teaching Tip: Because the sheer volume of water on Earth is so large and widely distributed, exact measurements of fresh and salt water are not available. A quick online search will show varying measurements for the distribution of water. We chose the US Geological Survey (USGS How Much Water Is There on Earth?) as the source for this lesson's information. Clarify with students that while these figures are more accurate than the estimates they made using the map, they are still only estimates." (Lesson 9, Teacher Guide)
- Lesson 9, Explore, Step 6: "Point out that the units used in the data table/text are cubic miles. Explain that one cubic mile is a lot; help students picture how long a mile is by comparing it to a more familiar length. One mile is about the same as 350 cars lined up bumper to bumper, so imagine a cube that long on each side. To try to visualize in 3D, you can explain that a cubic mile of water would fill the largest football stadium in the US about 1,400 times." (Lesson 9, Teacher Guide)
- Lesson 9, Synthesize, Step 7: "Elicit that the scale of all the water on Earth is hard to comprehend - hundreds of millions of cubic miles in the oceans, etc. So reducing the scale to amounts that fit in our classroom can help us see just how much water is (or is not) available for humans to use." (Lesson 9, Teacher Guide)
- Lesson 10, Explore, Step 3: "Discuss using a gallon as the standard unit of measurement for the amounts of water we use. Display slide F to provide a familiar benchmark of what a gallon is. If possible, have a physical item that represents 1 gallon to provide students with a three-dimensional representation of what a gallon looks like. Tell students that since we are going to be talking about quantities of water using gallons as our unit of measurement, it would be really helpful if we all had a shared benchmark of how much 1 gallon of water really is! Facilitate a discussion to help students familiarize themselves with the idea of what a gallon represents." (Lesson 10, Teacher Guide)

CE: Cause and Effect

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

Claimed in Lessons 1, 4, 5, 7, 8, 13, and 14. Evidence was found in 1, 4, 5, 7, 8, 13, and 14, examples include

- Lesson 1, Explore, Step 3: "Display slide I. Repeat the same process for the photos on the slide, explaining to students that we are now looking at present day images. When students begin sharing their noticing and wonderings, encourage students to use cause-and-effect language in their wonderings." (Lesson 1, Teacher Guide)
- Lesson 4, Connect, Step 6: "Choose a model to explain why the water ended up where it did. Display slide T and tell students that they will have a chance to record where the water started and where it ended up and make a claim using a model that best explains what caused the water to end up there on Modeling the path of water" (Lesson 4, Teacher Guide)

- Lesson 5, Synthesize, Step 4: "Connect what we just figured out to the previous lesson. Display the Why does the Elwha River flow the way it does? model from last class, and support students in recalling what we figured out about the cause of the river flow. Use the prompts below to support students in making the connection that snow melting high in the mountains is what causes the river to have higher flow in the spring/summer." (Lesson 5, Teacher Guide)
- Lesson 7, Explore, Step 3: "In pairs, create a Parts and Effects model for one of the human decisions we observed. Display slide E and tell students that they will now work in pairs on Impact of Human Decisions to choose one of the human decisions that they observed and create a Parts and Effects model showing the impact that decision had on the spheres and their interactions." (Lesson 7, Teacher Guide)
- Lesson 7, Synthesize, Step 5: "Develop a model that describes the impact of creating lobster fishing port. Display Slide L. Tell students that now that we have explored this decision together, we are going to help Pilar by using our knowledge of the interactions of the Earth's spheres to develop a model that describes the ways that creating a lobster fishing port can have an impact on those spheres and the interactions between them." (Lesson 7, Teacher Guide)
- Lesson 8, Synthesize, Step 6: "Revise the Elwha River system model. Show slide N and use a Consensus Discussion to update the Elwha River system model based on the evidence that students collected from the interviews and cards. Tell students that you have some green stickers that we can place on our model to show the places where the system is experiencing positive changes (because of human intervention)." (Lesson 8, Teacher Guide)
- Lesson 13, Explore, Step 3, Cause and Effect Callout: "As students consider how human activity is contributing to the problem and how the solution solves the problem, they are engaging with cause and effect relationships. Look for evidence on their model that indicates they are considering causal relationships. Circulate as students work on their models and, if you see opportunities for students to represent cause and effect relationships more clearly, ask questions like, "How could you show how human activities caused the problem?" or "What effect does the solution have on the problem?" (Lesson 13, Teacher Guide)
- Lesson 13, Explore, Step 6, Cause and Effect Callout: "Over the course of Lesson Set 2, students have identified how water availability is positively and negatively impacted by human decision-making. This is an opportunity for students to intentionally demonstrate their understanding of how human decisions can positively impact a water system. Prompt students to evaluate their peers' models by looking for explicit explanations for how their identified solution impacts the water availability within their water system." (Lesson 13, Teacher Guide)
- Lesson 14, Synthesize, Step 4: "Remind students that when comparing solutions for the last water related problem, we were looking for the solution that would improve the problem the most. While we will still consider which solution will improve the problem, we are going to be comparing the solutions with a different lens this time. We all know how many negative impacts the dams on the Elwha River had on the Earth's spheres. So we know how important it is to consider these impacts when choosing solutions. When comparing solutions for the El Paso water problem, you will consider the impacts the solution has on the Earth's systems." (Lesson 14, Teacher Guide)

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 Lesson 5. Evidence was found in 5

- Lesson 5, Synthesize, Step 4: "Construct an understanding around water flow in the Elwha River. Display slide K and start by unpacking the observations students made in the water flow graph. Use the following two prompts while looking for the following responses: What did you notice about the Water Flow data? Do the precipitation patterns match the water flow data?" (Lesson 5, Teacher Guide)

Claimed Element: **SC-E2 Some systems appear stable, but over long periods of time will eventually change.**

Claimed in Lesson 11.

- This element was claimed in Lesson 11 in the 5.3 Earth Systems SEP-DCI-CCC-ELA-Math-Matrix. Reviewers found no evidence that students engage with the element in the lesson. While the infographic, "What is Groundwater?" from Lesson 11 provides information on what groundwater is and how it moves, it does not address stability and change over variable time periods, including long periods of time.

Criterion-Based Suggestions for Improvement:

- Ensure "[t]here is a close match between the SEP, CCC, and DCI elements that are claimed and evidence of their development and use in the materials." (Detailed Guidance, p.10)
  - Consider adding the CCC Patterns PAT-E2 to the Unit Front Matter under the Opportunities to Practice Crosscutting Concepts table, since it is included in the 5.3 Earth Systems SEP-DCI-CCC-ELA-Math-Matrix.
  - Consider not claiming SC-E2 in Lesson 11. It is not addressed in the Groundwater Infographic or in the lesson materials. Or consider revising the Groundwater Infographic to address stability and change in this system over variable periods of time, including long periods of time.

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 sense-making of the Elwha River Dams impact on Earth's four spheres requires student performances that integrate elements of the SEPs, CCCs, and DCIs. The three dimensions rarely appear in isolation and are generally learned in tandem, with each dimension supporting understanding of the others. This integrated learning supports student sensemaking over time. 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

- Lesson 4, Connect, Step 6, students integrate the use of the elements of the three dimensions when they select a model to explain why water ended up where it did: **CCC CE-E1 Cause and effect relationships are routinely identified, tested, and used to explain change. DCI PS2.B-E3 The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. SEP MOD-E3 Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.**
- Lesson 6, Synthesize, Step 4, students integrate the use of the elements when they construct an Elwha River model using system effects from the dams: **CCC SYS-E2 A system can be described in terms of its components and their interactions. DCI ESS2.A-E1 Earth's major systems are the geosphere (solid and molten rock, soil,**

and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. SEP MOD-E3 Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.

- Lesson 7, Synthesize, Step 5, students integrate the use of the elements when they develop a model to explain how the decision to create a lobster fishing port would impact the spheres of the Earth and their interactions: **CCC CE-1 Cause and effect relationships are routinely identified, tested, and used to explain change. DCI ESS2.A-E1 Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. SEP MOD-E3 Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.**
- Lesson 9, Explore, Step 6, students integrate the use of the elements when they graph data to describe the amounts of fresh and salt water on Earth: **CCC SPQ-E2 Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. DCI ESS2.C-E1 Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. SEP DATA E-2 Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. SEP MATH E-3 Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems.**
- Lesson 13, Explore, Step 3, students integrate the use of the elements when they develop a model that explains how the solution they chose will cause the water related problem at the location they have been researching to improve: **CCC CE-E1 Cause and effect relationships are routinely identified, tested, and used to explain change. DCI ESS3.C-E1 Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. DCI ETS1.B-E1 Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. SEP CEDS-E4 Apply scientific ideas to solve design problems.**
- Lesson 14, Synthesize, Step 4, students integrate the use of the elements to generate and compare solutions to a new water related problem: **CCC CE-E1 Cause and effect relationships are routinely identified, tested, and used to explain change. DCI ESS3.C-E1 Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. DCI ETS1.B-E1 Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. SEP CEDS-E5 Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.**

Integration to support student sense-making over time

- Lesson 2, Navigate, Step 5: "Display slide J. While pointing to the class' *Elwha River System Components* consensus model from L1 and the "How do salmon interact with different parts of the river system?" model, ask students to consider how the dam may cause changes to parts of the system that would impact the salmon. Also, ask students how we might figure out which parts the dam is affecting within the Elwha system." (Lesson 2, Teacher Guide)
- Lesson 4, Synthesize, Step 5: "Add to our 'Why does the water in the Elwha River flow south to north?' model. Display slide R and the "Why does the water in the Elwha River flow south to north?" model. Ask students to consider how we can use the ideas we figured out about gravity to help us further explain why the water in the Elwha flows south to north." (Lesson 4, Teacher Guide)
- Lesson 5, Explore, Step 2 Planning and Carrying Out Investigations Callout: "This is the first time in the unit that students will be using data that has standard measurements to figure out a science idea related to the Elwha River System. In this part of the lesson students are working with data that reports inches of rain. Consider using a ruler to help students visualize the data they are working with. Later in this lesson students will consider a different measurement, volume, as they work to figure out the flow rate of the river." (Lesson 5, Teacher Guide)
- Lesson 6, Navigate, Step 1: "Consider how to figure out what happened to the whole system after the dams were built. Show slide A, while pointing out the class consensus model and Driving Question Board, ask students to share what they've figured out about the dams immediate effect on the River system. After hearing from a couple of volunteers, ask students to consider how they could figure out more about how the blocking of water, sediment, and salmon affected the greater system." (Lesson 6, Teacher Guide)
- Lesson 8, Synthesize, Step 8 Formative Assessment: "Students using evidence they gathered from the interviews and cards to identify the components and interactions in the Elwha River system that could benefit from the removal of the dam as well as other restoration activities." (Lesson 8, Teacher Guide)
- Lesson 11, Explore, Step 3: "Develop a model that explains the water problem. Display slide D and share with students that we have some information about 3 different communities in the United States and their water use. Read the names of the locations to students, and use the map on slide D to show students where the communities are located. Share with students that in a moment, they are going to research one of these communities to figure out the impact of their water use." (Lesson 11, Teacher Guide)
- Lesson 12, Synthesize, Step 4: "Begin to identify considerations to test the water solutions. While in a Scientist Circle, show slide G and discuss the patterns and connections students observed when analyzing the rainwater harvesting solution and the solutions from the infographic." (Lesson 12, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

I.D. Unit Coherence

EXTENSIVE

Lessons fit together to target a set of performance expectations.

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

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

The reviewers found **extensive** evidence that the lessons fit together coherently to target a set of performance expectations because the lessons are sequenced coherently and explicitly from the student's perspective. Each lesson builds directly on prior lessons and makes the links between the lessons explicit to the students. The lessons work together to provide sufficient opportunities for students to build proficiency in all of the targeted learning for all three dimensions. Students can see how what they are trying to figure out or solve in one lesson builds on previous lessons and fits into the larger goal for the unit.

The targeted performance expectations are:

- 5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- 5-ESS2-2: Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.
- 5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.
- 5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
- 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

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

The Navigation section on the Storyline contains a summary of how each lesson leads to the next using what students have figured out and new questions that arose. (5.3 Earth Systems Storyline) Each lesson begins and ends with a Navigation Routine that supports students in connecting the learning from one lesson to the next.

- Lesson 2, Navigate, Step 1: "Recall where we left off. Ask students to consider where they left off from the previous science class. Show slide A and ask for a few volunteers to recap what was discovered in the previous science lesson. Remind students that they can look at the DQB, our consensus model, and/or investigation ideas to help them remember what we figured out in our last lesson." (Lesson 2, Teacher Guide)
- Lesson 6, Navigate, Step 1: "Consider how to figure out what happened to the whole system after the dams were built. Show slide A, while pointing out the class consensus model and Driving Question Board, ask students to share what they've figured out about the dams immediate effect on the River system. After hearing from a couple of volunteers, ask students to consider how they could figure out more about how the blocking of water, sediment, and salmon affected the greater system." (Lesson 6, Teacher Guide)

- Lesson 7, Navigate, Step 6: "Pass out new sticky notes and give students 1-2 minutes to think about what they are wondering about on their own and then 1-2 minutes to write their questions on their own. Then give students 3-5 minutes to share new questions and ideas with their group. Any question that the group agrees is still not answered can be added to the Driving Question Boards. After adding new questions, congratulate students on the ideas they have figured out so far and tell them we still have time to explore some of our new questions." (Lesson 7, Teacher Guide)
- Lesson 11, Navigate, Step 7: "Discuss where we should go next. Point out that it's hard to come up with solutions or choose between them. Use this uncertainty to get students to start thinking about how we might find more solutions or choose the right solution for the different communities. Have students consider which solution from the board might be the best possible solution to their problem and invite them to share it with their partner." (Lesson 11, Teacher Guide)
- Lesson 13, Navigate, Step 7: "Celebrate creating a plan for improving a water problem. Display slide L and ask students to think about how they could use this work to help them solve other water related problems?" (Lesson 13, Teacher Guide)

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

5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

- Lesson 2: "Salmon interact with various components of the Elwha River system throughout their life cycle." (5.3 Storyline)
- Lesson 3: "Salmon and the other living things are part of the biosphere. The sediment, rocks, and sand are part of the geosphere. The dam blocked parts of the geosphere and parts of the biosphere." (5.3 Storyline)
- Lesson 5: "Precipitation helps to add water to the river. Snow melting from the mountains is a large source of water for the river. The atmosphere (wind) helps water move from the oceans to the mountains." (5.3 Storyline)
- Lesson 6: "The dams led to a large decline in salmon population because the salmon couldn't access the upper river. Salmon provide food for many animals who couldn't be found around the system after the dams were built. The sediment held back by the dam affected the ocean ecosystems which impacted the people living there." (5.3 Storyline)
- Lesson 7: "There are human decisions being made within our own community that are impacting the spheres of the Earth and the interactions between them." (5.3 Storyline)

5-ESS2-2: Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

- Lesson 9: "Dams in the US are mostly constructed to help control flooding and to provide water access. There is a lot more salt water on the Earth than fresh water. Earth's fresh water is mostly frozen, so people dam rivers to create reservoirs for fresh water access." (5.3 Storyline)

5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.

- Lesson 4: "The Elwha River flows from south to north. Water travels from the highest point to the lowest point. Gravity pulls things (including water) to the center of the Earth." (5.3 Storyline)

5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

- Lesson 1: Dams were built on the Elwha River in the early 1900s. The Lower Elwha Klallam Tribe relies on the river and are affected by the changes caused by the dam. We have a lot of questions about the way that the dam affects the river and the nearby plants, animals, lands, and water." (5.3 Storyline)
- Lesson 8: "Although not fully recovered, the system has improved with the help of local leaders' efforts." (5.3 Storyline)
- Lesson 10: "Using a standard unit of measurement for water, like gallons, helps us compare and discuss quantities of water. Humans are using very large quantities of freshwater everyday to produce common items." (5.3 Storyline)
- Lesson 11: "Research is needed to understand a problem and help identify possible solutions. There are many communities impacting their local hydrosphere." (5.3 Storyline)
- Lesson 12: "Water solutions can either increase the availability of water or reduce the water used." (5.3 Storyline)
- Lesson 13: "Choose a solution to our water related problem. Develop a model that explains how the solution will improve the problem." (5.3 Storyline)
- Lesson 14: "Desalination and wastewater treatment are solutions that can improve problems related to freshwater access." (5.3 Storyline)

3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

- Lesson 11: "Research one of three locations that are experiencing a freshwater overuse problem, develop a model with a partner that explains the problem. Review a peer's model, develop a class consensus model of the core freshwater problem. Brainstorm and organize initial ideas for solutions to your location's problem" (5.3 Storyline)
- Lesson 12: "Will compare various water solutions in order to identify the criteria and constraints that will be used to test the potential success for the water solutions." (5.3 Storyline)
- Lesson 13: "Choose a solution to our water related problem. Develop a model that explains how the solution will improve the problem. Give and receive feedback on the plan for improving the problem. Apply feedback to the plan for improving the problem" (5.3 Storyline)
- Lesson 14: "Compare all three solutions. Choose which solution has the least amount of negative impacts on the Earth's spheres while still improving the problem." (5.3 Storyline)

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 unit uses ideas from physical science to help students figure out the Elwha River dams phenomenon, which cannot be explained by earth science alone. Grade-appropriate elements of the CCC, Cause and Effect, are used as thinking frames that are applied across the different science domains to make sense of why the Elwha River flows the way it does.

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

The unit uses science ideas from both the earth science and physical science domains to explain "How does changing the flow of water impact Earth's systems and how can humans help?" As students explore how the Elwha River dams impacted Earth's spheres, the phenomenon requires multiple domains in order for students to explain it.

- Earth Systems About the Science: "Lessons 3-6 gradually support students through experiences and investigations to figure out that Earth's components interact with one another. They first show in Lesson 3 that when the dams were built, the flow of water and sediment was slowed, which led to less water and sediment reaching the mouth of the Elwha River. Students build upon this finding in Lesson 4 to determine why the river flows from south to north. Through the use of a simulation that allows students to trace a drop of water through the Elwha system, a demonstration, in which students pour water over a sheet of varying elevations, and a hands-on investigation, students figure out that gravity pulls the water (and all objects) toward the center of the Earth, which causes the water to move from higher elevations to lower elevations." (5.3 Earth Systems About the Science)
- Lesson 3, Synthesize, Step 5: "Develop a system model with a partner to show the dam effects. Display slide K and suggest we use our new model setup to explain how the geosphere and biosphere interact and how the dam could impact those interactions. Tell students that they will work with a partner and use the evidence that we gathered in this lesson and in Lesson 2 to develop their models." (Lesson 3, Teacher Guide)
- Lesson 4, Synthesize, Step 3, Teaching Tip: "While bringing in the idea of gravity during this unit may feel out of place, none of the interactions students have been discussing would happen without the interaction between the force of gravity pulling water toward the Earth's center and the varying altitudes of the landscape." (Lesson 4, Teacher Guide)
- Lesson 4, Synthesize, Step 5: "Add to our 'Why does the water in the Elwha River flow south to north?' model. Display slide R and the "Why does the water in the Elwha River flow south to north?" model. Ask students to consider how we can use the ideas we figured out about gravity to help us further explain why the water in the Elwha flows south to north." (Lesson 4, Teacher Guide)
- Lesson 4, Connect, Step 6: "Choose a model to explain why the water ended up where it did. Display slide T and tell students that they will have a chance to record where the water started and where it ended up and make a claim using a model that best explains what caused the water to end up there on Modeling the path of water. Explain that this will be an opportunity for them to consider what they have figured out about gravity's impact on water flow in their community on their own. Encourage students to use resources in the classroom and on Investigating the direction

gravity pulls as a reference and use evidence from their investigations to support their claim. Distribute Modeling the path of water and give students time to complete it on their own." (Lesson 4, Teacher Guide)

- Lesson 5, Student Materials, Handout 4: "Use words and/or drawings to develop a model to explain the interactions between the atmosphere and the hydrosphere in the Elwha River System." (Lesson 5, 5.3 Lesson 5 Handout 4 Model of Hydrosphere)

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

The focal CCCs for the unit are Cause and Effect, Systems and System Models, and Scale, Proportion, and Quantity. The crosscutting concept of Cause and Effect is used to make sense of phenomena where linking understanding of both earth and physical science is required.

- Lesson 4, Student Materials, Handout 2 Modeling the Path:" Support your claim with evidence and reasoning: Explain why the model you chose represents what caused the water that fell in your community to end up where it did. How did the evidence you collected during the investigations support you in making your claim?" (Lesson 4, 5.3 Lesson 4 Handout 2 Modeling the Path)
- Lesson 5, Synthesize, Step 4: "Connect what we just figured out to the previous lesson. Display the Why does the Elwha River flow the way it does? model from last class, and support students in recalling what we figured out about the cause of the river flow. Use the prompts below to support students in making the connection that snow melting high in the mountains is what causes the river to have higher flow in the spring/summer." (Lesson 5, Teacher Guide)

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 connection between the content areas. The literacy and mathematics skills expected are not above students' grade level. Mathematics concepts are explicitly incorporated into lessons such that students use them to explain or help understand the scientific concepts, phenomena, and results. All students use reading skills at a grade-appropriate level to develop understanding of scientific concepts and results, supporting their sense-making and problem-solving. The reading materials include non-fiction books, newspaper articles, an infographic, informational handouts, and information from websites. Students use writing skills to explain and communicate their understanding of scientific concepts, results, and phenomena. Writing assignments are varied in structure and purpose. Students have multiple opportunities for speaking and listening to peers in a variety of formats (e.g., 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 Lessons 8 and 14. Evidence was found in the claimed lessons. Examples include:

- Lesson 8, Connect, Step 3: "Have students read an article describing the current state of the watershed system and some accounts of the decisions made after the Elwha Dams were removed. Show slide G and distribute Together We Can: Restoring the Elwha River. Have students read the article in partners. Direct each group to underline the decisions made after the dams were removed, and circle the impact that each of these decisions had on the system. Give the students time to read, annotate the passage, and complete the summary table. After groups have finished the task, bring the class together for a discussion of the prompts on the slide." (Lesson 8, Teacher Guide)
- Lesson 14, Explore, Step 2: "Literacy Supports: Encourage students to include main ideas and key details in their summaries of the water problem in El Paso. Support students in making connections between the main ideas, and the way that those main ideas are supported by details in the text. This work supports RI.5.2 as students use text information to summarize the water problem in El Paso." (Lesson 14, 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 Lesson 6. Evidence was found in the claimed lessons. Examples include:

- Lesson 6, Explore, Step 2: "Literacy Supports: As students read [ES.L6.HO3], they encounter several different examples or accounts of effects to the Elwha Watershed system after the dams were built. Students read and annotate the text to figure out how the system changed after the dams became a part of the community. Encourage students to note what aspects of these events are similar and/or different to support this goal." (Lesson 6, 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 11. Evidence was found in the claimed lessons. Examples include:

- Lesson 11, Explore, Step 3, Literacy Callout: "Support students as they incorporate information obtained from the website into their models. Remind students how to use the menu to quickly locate information on the website that will support the development of their mode. Encourage students to use words and images from the website and their work on the Model Your Problem handout as evidence to support their explanations. This work supports W.5.9 and RI.5.7 as students draw evidence from informational texts to support analysis and research of water problems." (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 Lessons 2 and 12. Evidence was found in the claimed lessons. Examples include:

- Lesson 2, Explore, Step 3: "Obtain information about salmon. Display slide F and celebrate the sharing that students have done so far. Suggest that in order to figure out more about our watershed system it might be helpful to collect some evidence about how the system parts are affecting the salmon. Be sure to point out if students identified research or evidence about salmon in their Ideas for Investigation poster. Let the class know that you found five resources that we can use for evidence for how the system parts are affecting the salmon." (Lesson 2, Teacher Guide)
- Lesson 12, Explore, Step 3: "Literacy Supports: Support students with integrating information across several texts in preparation for considering methods for testing water solutions. Encourage students to rely on information and

quotes from Solutions for Drinking Saltwater and Unknown material with identifier: es.12.ho2 to support their thinking about different criteria and constraints that are worthy of consideration. Pulling quotations and information for these texts helps students provide evidence for their thinking and clearly communicate their ideas." (Lesson 12, Teacher Guide)

Writing

CCSS-ELA-LITERACY.W.5.2D Use precise language and domain-specific vocabulary to inform about or explain the topic. Claimed in Lessons 1, 4, and 7. Evidence was found in the claimed lessons. Examples include:

- Lesson 1, Connect, Step 2, Literacy Supports: "Students can gain practice using specific and precise parts of speech to share their observations of interactions between components using a verb to link their ideas. This supports students' communication of their science ideas using conventions of standard English grammar and precise language to inform or explain about a topic (W.5.2D, L.5.1)." (Lesson 1, Teacher Guide)
- Lesson 4, Connect, Step 6: "Literacy Supports: As students complete Modeling the path of water 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 4, Teacher Guide)
- Lesson 7, Synthesize, Step 5: "Literacy Supports: Students will use the terms atmosphere, hydrosphere, biosphere, and geosphere in their models to explain the impacts of a human decision on the Earth's spheres and their interactions. This connects with W.5.2D as students use precise language and domain-specific vocabulary to explain these concepts." (Lesson 7, 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 6 and 13. Evidence was found in the claimed lessons. Examples include:

- Lesson 6, Synthesize, Step 5: "Literacy Supports callout Peer review and feedback offers students the opportunity to develop and strengthen their explanations. This work supports W.5.5 and students gain practice revising and editing their explanations based on peer feedback." (Lesson 6, Teacher Guide)
- Lesson 13, Explore, Step 6: "In pairs, choose the feedback that will be used to optimize solutions. Display slide J and tell students to discuss the feedback that they think would be the most helpful in optimizing their plan for improving the water problem. If available, distribute highlighters or colored markers to help students visualize the feedback that they want to use. Ask students to highlight, circle, or underline the feedback that they are going to use. Ask them to use the column on Peer Feedback titled "How will you use this feedback to improve your design?" to capture their thoughts about how they will use that feedback to improve their plan." (Lesson 13, Teacher Guide)
- Lesson 13, Explore, Step 6: "Apply feedback to models to optimize the plan for the solution. Display slide K and ask students to refer back to their model explaining how they will improve the problem at the location they have been researching on Peer Feedback. Have them use the feedback they received and their notes about the feedback to apply the improvements to their plan. Students can choose to create an entirely new copy of their model or they can revise the one they already completed earlier in the lesson. If students are unsure if they should create a new model or revise the one they have, you can use any of the following prompts to help them decide:" (Lesson 13, Teacher Guide)

CCSS-ELA-LITERACY.W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. Claimed in Lesson 11. Evidence was found in the claimed lessons. Examples include:

- Lesson 11, Explore, Step 2: "Provide time for research. Distribute Research Your Problem and a device to each pair of students. Display slide D and tell students that they will be working in pairs to research the problem in their research location. Direct students to the Water Wanted and read the questions on Research Your Problem together. Tell students that they will work with their partner to research the problem at their location. At this point, students will first simply fill in their table as they research the problem at their location. They will model the problem in the next step." (Lesson 11, Teacher Guide)

Speaking and Listening

CCSS-ELA-LITERACY.SL.5.1B Follow agreed-upon rules for discussions and carry out assigned roles. Claimed in Lessons 1, 3, and 13. Evidence was found in the claimed lessons. Examples include:

- Lesson 1, Synthesize, Step 4: "Literacy Supports: Support students in discussions as they create a class consensus model. Encourage students to follow agreed-upon rules for discussions such as taking respectful turns and actively listening to their peers." (Lesson 1, Teacher Guide)
- Lesson 3, Explore, Step 3: "Discuss and assign group roles. Display slide E and share what the group roles are with the class. Assign roles to students based on your class routines and preferences. The ideal group size is 4 students." (Lesson 3, Slides E-F)
- Lesson 13, Explore, Step 5: "Assign students to a pair of students that have researched a different location than they have. Ask them to bring their model on Modeling our solution and their copy of Peer Feedback to the area that they will be working. Have the pairs of students exchange models and use Peer Feedback to help them think through how likely the solution will be to still improve the problem with the various changes that are possible. Make sure students are clear that they will be writing their feedback on the first three columns of Peer Feedback. The last column will be for the students who receive the feedback to complete in the next step. Give students time to review each others' models and provide feedback." (Lesson 13, 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 Lessons 2, 3, 5, 8, 10, 11, 12, and 14. Evidence was found in the claimed lessons. Examples include:

- Lesson 2, Synthesize, Step 4: "Literacy Supports: Students read articles that require them to make sense of how and when salmon interact with different components in the Elwha River system. Orally summarizing their article supports SL.5.2." (Lesson 2, Teacher Guide)
- Lesson 3, Explore, Step 4: "Literacy Supports: Encourage students to communicate and summarize key details that were observed in their river model videos. Reiterate that students can monitor their comprehension by pausing or rewinding the video. This will ensure that students can summarize all of the important events that happened" (Lesson 3, Teacher Guide)
- Lesson 5, Explore, Step 2: "Literacy Supports: In this lesson information is presented in diverse formats, including visually (e.g., photographs) and quantitatively (e.g., data set). Prompting learners to orally summarize the information presented in the visual and quantitative representations supports SL.5.2. (Lesson 5, Teacher Guide)
- Lesson 8, Explore, Step 2: "Literacy Supports: Encourage students to share and summarize important details they notice to compare and contrast the different sets of images. Reiterate that we can gain information from multiple sources including photographs, and people's personal experiences. Practicing summarizing information helps

students monitor their comprehension of different media as well as their understanding of the system before and after the dam removals (SL.5.2)" (Lesson 8, Teacher Guide)

- Lesson 10, Synthesize, Step 5: "Facilitate a discussion about what we noticed/wondered/ and felt about the amounts of water. Suggest that since we just did some individual thinking about the things we noticed, wondered, and felt about the calculations we reviewed, it is important to share those thoughts with each other. Present slide O and ask students to share some of the thoughts they had while they reviewed the total number of gallons of fresh water that the items we explored need to be produced everyday. Encourage students to use what they wrote on Notice/Wonder/Feel Table to help guide their discussion. Post a chart paper labeled "Amounts of fresh water needed: notice/ wonder/ feel" in a place that is visible to all students. Prompt students to share their noticings/wonderings/and feelings with the class. As students share, record their thinking on the chart." (Lesson 10, Teacher Guide)
- Lesson 12, Connect, Step 2: "Literacy Supports: Support student's oral language as they summarize what they saw and heard watching the Rainwater Harvesting Video. Prompting learners to orally summarize the information presented in the visual and auditory representations supports SL.5.2." (Lesson 12, Teacher Guide)
- Lesson 14, Connect, Step 3: "Literacy Supports callout Support students as they obtain information from the solution cards to prepare for comparing different solutions for El Paso's water problem. Encourage students to identify main ideas for each solution, as well as key details that support those ideas. Help students organize their thinking so that they are prepared to summarize and compare each solution. This work supports SL.5.2 as students summarize information presented in diverse media and formats." (Lesson 12, Teacher Guide)

CCSS-ELA-LITERACY.SL.5.4 Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace. Claimed in Lessons 5, 9, and 11. Evidence was found in the claimed lessons. Examples include:

- Lesson 5, Explore, Step 3: "Literacy Supports: As students think-pair-share, encourage them to include appropriate facts and relevant, descriptive details to support their understanding. Remind students that sharing their science ideas in an organized manner with descriptive details ensures that their thinking is understood and everyone can build on each other's ideas (SL.5.4)." (Lesson 5, Teacher Guide)
- Lesson 9, Navigate, Step 9: "Literacy Supports: As students discuss what they have figured out in the lesson and their new questions, encourage them to include appropriate facts and relevant, descriptive details to support their understanding. Remind students that sharing their science ideas in an organized manner with descriptive details ensures that their thinking is understood and everyone can build on each other's ideas (SL.5.4)." (Lesson 9, Teacher Guide)
- Lesson 11, Explore, Step 5: "Literacy Supports: As students discuss solutions with their partner, encourage them to include appropriate facts and relevant, descriptive details to support their understanding. Remind students that sharing their science ideas in an organized manner with descriptive details ensures that their thinking is understood and everyone can build on each other's ideas (SL.5.4)." (Lesson 11, Teacher Guide)

Language

CCSS-ELA-LITERACY.L.5.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. Claimed in Lesson 1. Evidence was found in the claimed lessons. Examples include:

- Lesson 1, Connect, Step 1: "Literacy Supports: Students can gain practice using specific and precise parts of speech to share their observations of interactions between components using a verb to link their ideas. This supports students' communication of their science ideas using conventions of standard English grammar and precise language to inform or explain about a topic (W.5.2D, L.5.1)." (Lesson 1, Teacher Guide)

CCSS-ELA-LITERACY.L.5.4B Use common, grade-appropriate Greek and Latin affixes and roots as clues to the meaning of a word (e.g., photograph, photosynthesis). Claimed in Lessons 3 and 5. Evidence was found in the claimed lessons. Examples include:

- Lesson 3, Synthesize, Step 5: "Literacy Supports callout If your students have been working to use common Greek and Latin affixes and roots as clues to the meaning of a word, discuss with the class how the affixes "bio-" (meaning "life"), "geo-" (meaning "land") and "-sphere" (meaning "round, ball-like shape") help us understand the meaning of biosphere and geosphere. (L.5.4B)" (Lesson 3, Teacher Guide)
- Lesson 5, Synthesize, Step 6: "Literacy Supports: If your students have been working to use common Greek and Latin affixes and roots as clues to the meaning of a word, discuss with the class how the affixes "atmo-" (meaning "air"), "hydro-" (meaning "water") and "-sphere" (meaning "round, ball-like shape") help us understand the meaning of atmosphere and hydrosphere. (L.5.4B)" (Lesson 5, Teacher Guide)

CCSS-ELA-LITERACY.L.5.4C Consult reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation and determine or clarify the precise meaning of key words and phrases. Claimed in Lesson 8. Evidence was found in the claimed lessons. Examples include:

- Lesson 8, Connect, Step 3: "Literacy Supports: In addition to consulting the glossary prior to listening to the Restoration Interviews, encourage students to use the glossary as a resource to support their comprehension of the interviews during and after listening. Students can pause the recording or return to the glossary to ensure they are prepared to share key takeaways from the interview with their classmates. This supports L.5.4C and helps students clarify the precise meaning of key words and phrases included within each interview." (Lesson 8, Teacher Guide)

Mathematics

Standards for Mathematical Practice

CCSS-MATH-Practice.MP1 Make sense of problems and persevere in solving them. Claimed in Lessons 9 and 10. Evidence was found in the claimed lessons. Examples include:

- Lesson 9, Explore, Step 5: "Acknowledge that yes, estimating amounts of water on earth in cubic units would better represent the amount of water on Earth than the areas we counted with squares." (Lesson 9, Teacher Guide)
- Lesson 10, Explore, Step 3: "Compare our predictions of water use amounts to the amounts listed on the data table. Display slide E and explain that you found a data table showing the typical water usage for each activity. Let students know that the information used to find an amount for the typical water usage is based on averages. They are estimates, which are valuable for comparison purposes but aren't exact amounts of water usage because every person is different and uses different amounts of water in their daily lives." (Lesson 10, Teacher Guide)

CCSS-MATH-Practice.MP2 Reason abstractly and quantitatively. Claimed in Lessons 10, 12, and 13. Evidence was found in the claimed lessons. Examples include:

- Lesson 10, Explore, Step 3: "Compare these amounts of water to the amounts that we predicted on our class water usage chart." (Lesson 10, Slide E)
- Lesson 12, Synthesize, Step 5: "While students are in the Scientists Circle, you have an opportunity to formatively assess learning goal 12. As students share their comparison tool development, ask them to provide explanations for how these ideas will help us compare and choose future water solutions" (Lesson 12, Teacher Guide)

- Lesson 13, Synthesize, Step 2: "In pairs, decide on two solutions to compare. Display slide B and let students know that they will now get a chance to choose two solutions for the water problem facing the community in the location that they have been researching that they would like to compare." (Lesson 13, Teacher Guide)

CCSS-MATH-Practice.MP3 Construct viable arguments and critique the reasoning of others. Claimed in Lessons 5, 10, 12, and 13. Evidence was found in the claimed lessons. Examples include:

- Lesson 5, Explore, Step 2: "Math Supports callout: Due to some of the precipitation measurements having partial values (decimals), students' placement of the bars' endpoint may differ slightly. Have students attend to the precision of their graphing by comparing their graphs with a partner and discussing and critiquing any slight differences in the placement of the bars' endpoints (MP3 and MP6). As students communicate about their placement choices, they will have an opportunity to self-assess the appropriateness and accuracy of their generated graph." (Lesson 5, Teacher Guide)
- Lesson 10, Explore, Step 3: "Math Supports callout: Students will engage in quantitative reasoning as they make predictions for the number of gallons of fresh water needed to produce different items. They will explain and critique their partner's explanation of their reasoning for the quantity of water needed during different steps of each item's production process." (Lesson 10, Teacher Guide)
- Lesson 12, Synthesize, Step 5: "Use our comparison tool to test different EPA water solutions. Distribute Lesson 12 Comparison Tool to each pair of students and show slide J. Direct partners use our Solution Checklist poster to write down the class' criteria and constraints. Partners should then use the comparison tool to record how the Step on it and Time it right solutions from EPA Water Conservation Poster addresses the criteria and constraints differently. Partners will need to discuss how they'd like to do this." (Lesson 12, Teacher Guide)
- Lesson 13, Synthesize, Step 2: "Distribute one copy of Lesson 13 Comparison Tool to each pair of students and tell them that after they and their partner agree on two solutions to compare, they should write those solutions on the top row of Lesson 13 Comparison Tool." (Lesson 13, Teacher Guide)

CCSS-MATH-Practice.MP4 Model with mathematics. Claimed in Lessons 5 and 9. Evidence was found in the claimed lessons. Examples include:

- Lesson 5, Explore Section, Step 2: Students are modeling the data in the table for the amount of precipitation during each month as a bar graph, a representation they have used in 2nd, 3rd, and 4th grade. After students have completed constructing the bar graph, have them interpret their results in the context of the situation and check whether the results make sense. Students can look for connections between the two different representations and explain what they noticed. Ask students about which representation was more useful and efficient for noticing patterns about the precipitation and why. (MP4)" (Lesson 5, Teacher Guide)
- Lesson 9, Explore, Step 2: "Math Supports callout: As students analyze and interpret the bar graph, have students attend to the different categories for the purposes of dams and support student annotation by asking the following questions: "What data landmarks do you notice?" "What patterns do you notice?", and "What questions do you have about the data?" Giving students time to ask and answer questions will help them to interpret the data in context and make conclusions about why people build dams." (Lesson 9, Teacher Guide)

CCSS-MATH-Practice.MP5 Use appropriate tools strategically. Claimed in Lesson 9. Evidence was found in the claimed lessons. Examples include:

- Lesson 9, Explore, Step 5: "Math Supports callout: In 3rd and 4th grade, students conceptualize area as the number of unit squares, lined up without gaps or overlaps, that can cover a given figure. In this activity, students will use their understanding of area and estimation as tools to calculate how much of the world map is covered by water." (Lesson 9, Teacher Guide)

CCSS-MATH-Practice.MP6 Attend to precision. Claimed in 5, 9, and 10. Evidence was found in the claimed lessons. Examples include:

- Lesson 5, Explore, Step 2: "Math Supports callout: Due to some of the precipitation measurements having partial values (decimals), students' placement of the bars' endpoint may differ slightly. Have students attend to the precision of their graphing by comparing their graphs with a partner and discussing and critiquing any slight differences in the placement of the bars' endpoints (MP3 and MP6). As students communicate about their placement choices, they will have an opportunity to self-assess the appropriateness and accuracy of their generated graph." (Lesson 5, Teacher Guide)
- Lesson 9, Explore, Step 6: "Math Supports callout: Support students in attending to precision by labeling the graph with a title and axes labels and using a consistent scale to count on the y-axis." (Lesson 9, Teacher Guide)
- Lesson 10, Explore, Step 3: "Discuss using a gallon as the standard unit of measurement for the amounts of water we use. Display slide F to provide a familiar benchmark of what a gallon is. If possible, have a physical item that represents 1 gallon to provide students with a 3 dimensional representation of what a gallon looks like. Tell students that since we are going to be talking about quantities of water using gallons as our unit of measurement, it would be really helpful if we all had a shared benchmark of how much 1 gallon of water really is! Facilitate a discussion to help students familiarize themselves with the idea of what a gallon represents." (Lesson 10, Teacher Guide)

CCSS-MATH-Practice.MP7 Look for and make use of structure. Claimed in Lesson 9. Evidence was found in the claimed lessons. Examples include:

- Lesson 9, Synthesize, Step 3: "Math Supports callout: Ask students to compare their estimated total to the total for dams not built for people's water usage to arrive at the conclusion that we build a lot of dams to get water for us to use, maybe as many or more than we build for flood control (MP7)." (Lesson 9, Teacher Guide)

Number and Operations in Base 10

CCSS-MATH-5.NBT.A.3a Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., $347.392 = 3 \times 100 + 4 \times 10 + 7 \times 1 + 3 \times (1/10) + 9 \times (1/100) + 2 \times (1/1000)$. Claimed in Lesson 5. Evidence was found in the claimed lessons. Examples include:

- Lesson 5, Explore, Step 2: "Math Support callout Use and encourage students to use precision of language (e.g., calling 17.4 as 17 and four tenths) when reading the decimals to support students in connecting decimals to their understanding of fractions (MP6 and part of 5.NBT.A.3.A). A decimal place value mat designed to build on students' understanding of fractions is available as a resource to support students in reading decimals using number names (See Decimal Place Value Mat)." (Lesson 5, Teacher Guide)

CCSS-MATH-5.NBT.B.5 Fluently multiply multi-digit whole numbers using the standard algorithm. Claimed in Lesson 10. Evidence was found in the claimed lessons. Examples include:

- Lesson 10, Explore, Step 4: "Math Supports callout: As students calculate the total amount of freshwater used to produce the number of items processed everyday, have students multiply multi-digit whole numbers using a strategy of their choosing (e.g., the standard algorithm, partial products, the area model, estimation). Remind students that the product calculated are estimates that will help us understand how much freshwater is being used to make different items. Ask students to reason about the unit of measurement used for each item (e.g., pieces of bread, servings of beef, number of cellphones), as well as how often the item is used or consumed, to make sense of the data in its context. For example, while we might eat several pieces of bread a day or some people eat beef multiple times a week, some people only get new phones occasionally." (Lesson 10, Teacher Guide)

- Lesson 10, Explore, Step 4: "Display slide L and tell students that they can work with a partner to calculate the amount of fresh water 3 items that we have been exploring would take to produce everyday. Remind them that the amount of freshwater it takes to produce one item and the number of items produced daily are on their information cards. Direct them to the space on How much water? Recording Sheet that they can use to record their thinking as they calculate the total number of gallons of freshwater used to produce their item everyday." (Lesson 10, Teacher Guide)

Measurement and Data

CCSS-MATH-5.MD.C.3a A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. Claimed in Lesson 9. Evidence was found in the claimed lessons. Examples include:

- Lesson 9, Explore, Step 4: "Use a cube to review the idea of volume. Display slide K and use a 3D model of a cube to help students recall that volume is the amount of space an object takes up. Point out that the water in oceans and rivers and ice takes up space, it's not just flat like the map, so we can measure its volume (instead of just its area). Remind students that we measure volume in cubic units." (Lesson 9, Slide K)

CCSS-MATH-5.MD.C.3b A solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units. Claimed in Lesson 9. Evidence was found in the claimed lessons. Examples include:

- Lesson 9, Explore, Step 4: "Use a cube to review the idea of volume. Display slide K and use a 3D model of a cube to help students recall that volume is the amount of space an object takes up. Point out that the water in oceans and rivers and ice takes up space, it's not just flat like the map, so we can measure its volume (instead of just its area). Remind students that we measure volume in cubic units." (Lesson 9, Teacher Guide)
- Lesson 9, Explore, Step 6: "Give students time to work on their graphs. Distribute the How much fresh water? handout, organize students into partners, and give them time to graph the information about where fresh water can be found on Earth." (Lesson 9, Handout How Much is Fresh Water?)

Criterion-Based Suggestions for Improvement: N/A

CATEGORY II

NGSS Instructional Supports

II.A. Relevance and Authenticity

EXTENSIVE

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

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

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

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

The reviewers found **extensive** evidence that the materials engage students in authentic and meaningful scenarios that reflect the practice of science and engineering as experienced in the real world of the phenomenon of the Elwha River Dams and the water problems of different areas in the U.S. Students experience phenomena or design problems as directly as possible through Google Earth, videos, texts, and images. Materials provide multiple opportunities to connect instruction to the students' home, neighborhood, community, and/or culture. Teachers are supported to cultivate student questions and ideas that connect to students' experiences and community.

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

- Lesson 1, Connect, Step 1: "Orient students to the river we will observe. Display slide B and introduce the Elwha River in Washington State. Show students the three maps on the slide. One map is of the United States of America, the other is a zoomed-in view of Washington State, and the third is a more zoomed-in-view of the Elwha River in Washington State…Read a book to learn more about the Elwha River. Display slide C and have Wonderful Waters: The Elwha River ready to display. Tell students that we have a book that we will read to help us figure out more about the Elwha River, its parts, and its history." (Lesson 1, Teacher Guide)
- Lesson 1, Explore, Step 3: "Make observations as a class of photos of the Elwha River. Tell students that we are now going to take a closer look at the Elwha River Dam by making observations of photos that were taken during and after the dam was built. Display the Notice and Wonder chart (refer to slide G)." (Lesson 1, Teacher Guide)
- Lesson 3, Explore, Step 3: "Discuss as a class how the river system model could be used to observe what might have happened on the Elwha River. Display slide C, and remind students that we are trying to figure out how the dam may have affected the movement of water, salmon, and sediment in and near the Elwha River. Ask students to consider what observations would be helpful to make to help us answer that question." (Lesson 3, Teacher Guide)
- Lesson 6, Synthesize, Step 4: "Construct an Elwha River model. Show slide I and tell students that now that we have our Gotta-Have-It checklist we are ready to create our Elwha River Models. Distribute at least five interaction cards found in Explanation Interaction Cards to each group. Groups will use these interaction cards to show the effects that occurred after the dams were built. On each interaction card, there is space for students to draw a picture and write a description for each interaction taking place. Groups should arrange these cards to show the effects that took place." (Lesson 6, Teacher Guide)
- Lesson 7, Explore 2: Make Observations: "Tell students that when we go outside, we will be looking for evidence of many human decisions that may impact the spheres. Display slide D and distribute Impact of Human Decisions. Tell students that while they are outside, they will record at least 3 human decisions that they find evidence for in

the table on their handout. Since the environments around many school communities are almost entirely modified by humans, it may be difficult for students to recognize evidence of human decisions. If you think that may be the case with your students, consider giving them a standard to measure the things they see against. You may consider asking them to consider if something they see would be present in the wilderness or in a big state park. If their answer is no, it is very likely that it is a human decision." (Lesson 7, 5.3 Lesson 7 Teacher Guide)

- Lesson 8, Connect, Step 3: "Become familiar with the people who are connected to the Elwha River. Show slide G and tell students that you have interviews from 6 different people who are connected to the Elwha River in some way. Suggest that we first get to know the people that have volunteered to share their stories. Navigate to Restoration Interviews and introduce the first person. Play both audio clips and point out the image as the interviewee shares a story about their favorite place. Repeat this process for the other 5 people." (Lesson 8, 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: "Community Connections Callout: Students may share traumatic experiences and stories where they or someone close to them was harmed by flooding or another type of river-related event. Use these three steps to guide the interaction to reduce threats and create a safe space to share: 1) Be Curious (e.g., what was that like for you?), 2) Validate (e.g., it makes a lot of sense why that would be scary.), and 3) Thank the Student (e.g., thank you for sharing with us.). Modeling this structure of responding creates a predictable routine that students will learn to expect. This supports engagement and provides boundaries for how to share personal experiences in a group discussion." (Lesson 1, Teacher Guide)
- Lesson 1, Connect, Step 6: "Discuss connections to the Elwha River dam phenomenon. Point out that the Elwha River may be far from where we live or really close, but either way, we've all probably seen or heard about some changes to natural things. Display slide N, and ask students to consider experiences they have had or things they have heard about where changes were made to natural things. Give students time to discuss their connections in small groups. Explain that thinking about other phenomena related to the Elwha River dam phenomena can help us think about many science ideas related to the one that we are figuring out together." (Lesson 1, Teacher Guide)
- Lesson 6, Connect, Step 7: "Connect to our communities. Show slide M and distribute Home Learning: Sharing Your Explanation. Instruct students to bring their stories home and share them with a trusted community member. After they tell their stories, record the thinking on Home Learning: Sharing Your Explanation and bring this back to school." (Lesson 6, Teacher Guide)
- Lesson 7, Explore, Step 2: "Prepare to go outside to observe evidence of human decisions in our community. Display slide C and ask students to consider what kind of impacts to the hydrosphere, geosphere, atmosphere, and biosphere they will be looking for when they go outside. Ask students to turn and tell a partner their thoughts. Then, ask students to share with the class." (Lesson 7, Teacher Guide)
- Lesson 9, Connect, Step 10: "Ask students to give you some examples of how they use water at school and discuss the units they might use to talk about the amount of water they use. For example, if students talk about drinking water, about how much water do they drink in a day? Some number of cups or water bottles (the little bottles or large refillable ones)? For washing hands, they might estimate a sinkful or a faucet running for 30 seconds." (Lesson 9, 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 4, Connect, Step 6: "Use an interactive map to track water in our community. Display slide S and ask students to consider where a drop of water that fell in our community would end up. Encourage students to discuss where the water would end up with their small groups. Invite a few students to share their thoughts with the class. Answers will vary depending on your location. Click on your community on the map and watch the simulation until you see where the water eventually ends up." (Lesson 4, Teacher Guide)
- Lesson 6, Community Connection, Step 1: Home Learning Sharing, students discuss their explanations with families and ask, "Do you know of any decisions in our local community that affect the Earth?" (Lesson 6, 5.3 Lesson 6 Community Connection 1 Home Learning Sharing).
- Lesson 10, Connect, Step 2: "Create a class list of the things we use water for. Display slide B, and ask students to recall the things that they use water for in their daily lives. Ask students to take out their How do we use water? and share the things that they used water for in their life. After students have had a chance to discuss what they used water for with their groups, tell students that we will create a class record of our water usage. Display slide C and a chart labeled "Our class water usage" and ask students to share what they and their group use water for. Record their responses on the chart." (Lesson 10, 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, and justify reasoning. The teacher has enough support to act as an expert facilitator to draw out individual student ideas and multiple perspectives. The support is specifically customized to the lesson materials. The students have opportunities to 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. 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 modeled. Supports are provided to guide constructive feedback to students from both the teacher and peers in the sense-making of the phenomenon.

Student ideas are clarified, justified, and built upon

- Lesson 1, Synthesize, Step 5: "Create a class consensus model. Display slide L, and ask students to gather in a Scientists Circle. Make sure that the Elwha River Systems Components chart and the Notice and Wonder chart are displayed close by for students to reference during this discussion. Have one member of each small group bring their model to the scientist circle. Tell students that we already have small group models of how the dam affected the Elwha River, so we are now going to work together to create a class consensus model with all of our ideas included." (Lesson 1, Teacher Guide)

- Lesson 3, Explore, Step 4: "Discuss observations as a class. Display slide I and ask students to use their observations to share what they noticed about how the dam affected the sediment and water in your river model. Record student responses on a whiteboard or blank piece of chart paper as they share them." (Lesson 3, Teacher Guide)
- Lesson 6, Slide J: "After you hear the group's explanation, give feedback using the following sentence stems: I heard you say the effects of the dam were..., is that what you meant? I wonder if your explanation could... What evidence did you use when you decided on...? Return to your home groups and switch stayers/strayer roles." (Lesson 6, 5.3 Lesson 6 Slides)
- Lesson 11, Synthesize, Step 6: "Add our solutions to our water problem consensus model. Tell students that oftentimes when engineers are trying to solve problems, they share their ideas for solutions with others in order to get ideas and choose the best solution for the problem. Display slide K and tell students that we are going to gather in a Scientists Circle to share and organize our solutions." (Lesson 11, Slide K)
- Lesson 12, Synthesize, Step 4: "Leverage student language to emphasize that it seems some solutions are better for different areas. In order for us to determine which solution is best for the area we researched we need to find a way to compare different solutions. Hang a chart paper titled "Solution Checklist" that is split into two columns." (Lesson 12, Teacher Guide)

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

- Lesson 5, Navigate, Step 6: "Give students time to update their own Growing Ideas chart. Display slide M. Have students take out My Growing Ideas. Encourage students to answer the lesson question based on what they figured out in this lesson." (Lesson 5, Teacher Guide)
- Lesson 8, Navigate, Step 7: "Update My Growing Ideas Chart. Show slide P and encourage students to answer the lesson question based on what they figured out in this lesson. It may be helpful for students to revisit the sources of evidence from this lesson or the Elwha River System Model as they do this." (Lesson 8, Teacher Guide)
- Lesson 13, Explore, Step 5: Evaluate a Design: "Evaluate each others' solutions using Peer Feedback. Display slide H and distribute Peer Feedback to each pair of students. Tell students that they will be testing the solution of a peer under a range of different conditions and providing them feedback about how likely the solution is to improve the problem when changes occur. Have students use the chart of possible changes that just recorded as a guide for completing the column labeled "possible changes" on Peer Feedback. Consider using an example solution from slide F to do one row on Peer Feedback as an example, before assigning students to a pair to review." (Lesson 13, Teacher Guide)

Students receive feedback and revise their thinking accordingly.

- Lesson 2, Navigate, Step 5: "Collect Salmon Readings / Graphic organizers. Close the lesson by asking students to turn in their Salmon Lifecycle handout and tell them that you look forward to providing them with feedback. Consider leaving students written feedback and conferencing with students before Lesson 3 as they will use these handouts as evidence to make sense of how the dam could impact the salmon." (Lesson 2, Teacher Guide)
- Lesson 6, Synthesize, Step 5: "Show slide K and give students the opportunity to share the feedback they received as 'stayers' during the *Two Stay-Two Stray* protocol. Have students use this feedback to revise their explanations by either re-arranging or adding additional Explanation Interaction Cards. Students should use the two discussion prompts on the board to guide their revisions." (Lesson 6, Teacher Guide)
- Lesson 13, Explore, Step 6: "In pairs, choose the feedback that will be used to optimize solutions. Display slide J and tell students to discuss the feedback that they think would be the most helpful in optimizing their plan for improving the water problem. If available, distribute highlighters or colored markers to help students visualize the feedback that

they want to use. Ask students to highlight, circle, or underline the feedback that they are going to use. Ask them to use the column on Peer Feedback titled "How will you use this feedback to improve your design?" to capture their thoughts about how they will use that feedback to improve their plan." (Lesson 13, 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 materials explicitly state the expected level of prior learning students should have of all three dimensions for the core learning in the materials, but not at the element level. A progression of learning toward the targeted elements of all three dimensions is clearly described for teachers in each lesson's introduction, which includes a What We Do, What We Figure Out, and a Building Toward Standards section. Learning progresses logically throughout the materials.

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

Disciplinary Core Ideas:

Unit Front Matter: What ideas and experiences will students bring that can help them in this unit?

- **Water Interacting with the Land and Living Things**
  - "Students may have observed water causing changes to the land in their everyday lives. For example, students may have seen water move mud or other material. Some students will have had experiences with flooding or severe weather that causes changes to the shape of the land (e.g., hurricanes). Some students may be familiar with solutions for water moving and changing the shape of land, such as levees, dams, or sea walls. Students might also bring ideas from Land on the Move Unit about land changing shape, such as soil, rocks, etc. Ideas also might be brought from Fruit & Hazards Unit about weather and how it affects different systems. Students will also bring in many ideas and prior experiences related to how water impacts living things. Students will explore the ways water, and its flow, interacts with living things through reading books, newspaper articles, analyzing data, and a physical model." (Unit 5.3, Earth Systems Unit Front Matter) The Unit Front Matter does not identify specific elements of the three dimensions.
- **Human Impact on Earth Systems**
  - "Students will come to school with varied experiences and ideas about how people can impact the environment. In school, students begin to develop these ideas in Unit K.4: Do birds, other animals, and plants need people to help take care of them?, where they wonder about whether or not birds, other animals, and plants need people to help them live. They expand ideas in that unit about how people use resources for everyday things we do to meet our needs, like brushing teeth and wearing clothing. In Unit 4.2: How do we

power clocks and other devices? students investigated how people use Earth's resources to produce electricity and how that use affects the environment. Students may bring additional positive or negative ideas from media and/or experiences about how humans affect Earth's systems, such as planting pollinator gardens and protecting green spaces. Leverage these ideas as students investigate human impacts on systems like the Elwha River system." (Unit 5.3, Earth Systems Unit Front Matter)

- **Gravity**
  - "From past experiences, students may have encountered the mechanism of gravity and how things fall toward the ground when dropped or thrown. Students can likely elicit and then leverage these experiences to aid in their sense making in Lesson 5, where students are making sense of why water gets stuck behind the Elwha River dams." (Unit 5.3, Earth Systems Unit Front Matter) The Unit Front Matter does not identify specific elements of the three dimensions.
- **Designing Possible Solutions**
  - "Throughout their science work in prior grades, students defined problems and designed solutions. In fourth grade Unit 4.2: How do we power clocks and other devices?, students defined a problem concerning how to communicate time information across a classroom and then identified criteria and constraints for success. They then translated their design ideas into solutions to build and test them. If students have experienced Unit 5.2: How can we make water healthy for all living things? already this year, they will bring ideas from their work to generate and compare multiple solutions to different community water problems. Young learners also have intuitive ideas about problem-solving and recognize that some things work better than others. Students may come into the unit with the common idea that solutions are absolute, or unable to be changed. To support students, make connections to the work that students do to revise their Class Consensus Model; as we gather evidence, we revise our model to better explain the phenomenon we are investigating. We can do the same with our solutions: as we gather new evidence and feedback for how well a solution meets our criteria and constraints, we can revise and improve our designs. It may also be helpful to discuss how the classroom agreement 'We let our ideas grow and change' can help us in this work." (Unit 5.3, Earth Systems Unit Front Matter) The Unit Front Matter does not identify specific elements of the three dimensions.

Science and Engineering Practices:

- **Using Mathematics and Computational Thinking**
  - "Students will be able to connect to and use many ideas and practices from math class as they do the work of this unit. Students will rely on knowledge of standard units of measure for distances and volume/capacity, and use graphs to reveal relationships in data. Also take time to leverage and connect with everyday experiences students have had with measurement and graphing, such as the milk containers used in the cafeteria or how weather forecasts are communicated." (Unit Front Matter) The Unit Front Matter does not identify specific elements of the three dimensions.

Crosscutting Concepts:

- **Systems and System Models**
  - "From prior grades and everyday experiences, students may know that systems are made of parts that work together. They can likely think of many different examples of systems, which are elicited and then leveraged when systems are introduced in Lesson 2. Students will advance their understanding of systems by identifying parts as components (Lesson 3), the ways that those components are affected by the dams (Lesson 6), and

repeated opportunities throughout the unit to create system models of different water systems." (Unit 5.3, Earth Systems Unit Front Matter) The Unit Front Matter does not identify specific elements of the three dimensions.

- **Cause and Effect**
  - "From prior grades and everyday experiences, students may know that cause and effect relationships occur frequently. They can likely think of many different examples of cause and effect relationships, which could be leveraged when cause and effect relationships are introduced in Lesson 2. Students will advance their understanding of cause and effect relationships when they analyze precipitation and water flow data in Lesson 4." (Unit 5.3, Earth Systems Unit Front Matter) The Unit Front Matter does not identify specific elements of the three dimensions.

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

- In the 5.3 Earth Systems SEP-DCI-CCC-ELA-Math-Matrix document, there is a summary of how students will grow for each targeted element for each lesson of the unit. For example:
  - MOD-E2: "Students will work together to develop a class consensus model based on the textual evidence each group collects about the interactions between salmon and other components of the Elwha River system. This model helps students describe the relationships among the salmon and other animals, plants, and waters in the system as they grow through various stages of their lives and live in different parts of the river system."
  - CE-1: "This crosscutting concept is developed when students consider the relationship between the human decision and the changes this decision caused to the interactions of Earth's spheres. In this lesson students apply this concept to two new phenomena, one that is found in a place around their school and the other related to the addition of a lobster port."
  - ESS2.A-E1: "Though this lesson does not yet name the spheres, they will begin to name the spheres and the interactions between them in Lesson 3. Students will figure out that salmon interact with Earth's various spheres throughout their lives in the river by summarizing key ideas from articles. This lesson will not address the idea that "the ocean supports a variety of ecosystems, shapes landforms, and influences climate." The ocean supporting a variety of ecosystems will be further explored in Lessons 5, 6 and 8 of this unit. Students explored related ideas in prior grades: Unit 4.3: What causes land and things on it to change? How can we reduce the impacts on humans? and Unit 3.2: Why do plants only grow well in certain places, and how can we protect them?" (Unit 5.3, 5 5.3 Earth Systems SEP-DCI-CCC-ELA-Math-Matrix).
- 5.3 Earth Systems Unit Front Matter: "Students have multiple opportunities in this unit to consider the ways that the components of the Elwha River system interact. Students will begin the unit by exploring the ways that the interactions of the components of this system could change based on the addition of dams on the river. In Lessons 2 and 3, students work together to define the system and the components that it includes. They explain the effects of changes to the system in Lessons 6 and in lesson 7 explain the changes to systems of a different context, one in their community, and the addition of a lobster port. In the second lesson set, students also explore water systems in specific locations. They consider the components of these localized water systems and the ways that altering parts of the system can have an impact on the interactions of the components. Development of this crosscutting concept is supported by a pre-assessment opportunity in Lesson 1, formative assessment opportunities in Lessons 2 and 3, a key formative moment in Lesson 6, and summative assessments in Lessons 7 and 14. To support development of Systems and System Models, students have multiple opportunities to use the following element as the unit goes on. A system can be described in terms of its components and their interactions. (SYS-E2). This crosscutting concept is also intentionally developed in Unit 5.1: How does a nurse log help other things live and grow? when students use models to figure out how components interact in nurse log systems. Students have also used systems thinking in fourth grade in Unit 4.4: How do the structures and functions of living things' traits benefit them?" (Unit 5.3, Earth Systems Unit Front Matter).

- 5.3 Earth Systems Unit Front Matter: "This practice is intentionally developed across the unit as students read various types of grade-appropriate texts to obtain scientific information and use writing and drawings to communicate their science ideas. Texts used in this unit include books, articles, infographics, interviews, and a website, and students interact with these texts in a variety of settings (e.g., read aloud, partner reading, and individually). They combine information from these texts to explain interactions in the Elwha River system. At several points in the unit, students write and/or draw to communicate their ideas about how the river system works, how it was affected by the dams, and what design ideas they have to solve freshwater access problems. Development of this practice is supported by formative assessment opportunities in Lessons 2, 8, 11, and a summative assessment in Lesson 14. To support development of Obtaining, Evaluating, and Communicating Information, students use the following element in different ways with reduced scaffolding as the unit goes on. Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence (INFO-E1). Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem (INFO-E4). Students use this element periodically to support overall development of the practice. Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts (INFO-E5). Students have additional opportunities to practice Obtaining, Evaluating, and Communicating Information in each of the other fifth grade units, allowing them to use this practice in multiple different contexts. (Unit 5.3, Earth Systems Unit Front Matter).
- Lesson 1, Connect Section, Step 2: Gather Information from Media, Sys callout: "OpenSciEd Units 3.1, 3.4, 4.1, 4.4 and 5.1 introduce the cross-cutting concept of systems. Even if students have not experienced these units, this unit will build their understanding. Students name system components and identify system interactions. By the end of the unit, students will have practiced using systems thinking to explain the phenomenon of altering water flow and will show evidence of their understanding of interactions within systems on their final model." (Lesson 1, Teacher Guide).
- Lesson 1, Connect Section, Step 2, Gather Information from Media callout: "In this unit, students will develop, revise, and use a systems model to explain how changes in Earth's systems can affect components in other systems. In this Connect, students are only beginning to list what they think are components of the Elwha River system, based on what they have heard and read. In later lessons, it will be important to emphasize that systems models can be drawn or they can be physical and manipulated with our bodies to test how two or more components interact." (Lesson 1, Teacher Guide). This callout will help students avoid misconceptions.
- Lesson 3, Synthesize Section, Step 5: Develop a Model, MOD callout: "This is the first time in the unit that students are developing a model to explain the components and interactions between 'spheres.' The idea of a sphere is abstract and can be confusing for students. Support students in understanding that a sphere refers to a collection of components that can be spread out over many different locations." (Lesson 3, Teacher Guide).
- Lesson 3, Synthesize Section, Step 5: Develop a Model, SYS callout: "As students work with a partner, they will consider the different components of each sphere and how they interact. Additionally, students will consider how those interactions may have been impacted by the addition of the Elwha Dam. In lesson 5 students will add more components and interactions as they figure out more about the hydrosphere and the atmosphere." (Lesson 5, Teacher Guide).
- Lesson 4, Connect Section, Step 6, Connect with our Communities, MOD callout: "Students continue to engage in the work of this practice by considering which model best represents the cause of water ending up where it did after it fell onto an area of their community. As students progress through the unit, they will develop their own models to describe scientific principles in pairs and then on their own." (Lesson 4, Teacher Guide).

- Lesson 5, ExploreSection, Step 5, Gather Additional Evidence, Teaching Tip: "Students will figure out more about the water cycle and cloud formation in middle school. For the purposes of this unit, students should be focused on how the wind in the atmosphere moves clouds toward the Elwha River." (Lesson 5, Teacher Guide).
- Lesson 8, Connect Section, Step 3, Listen to Interviews, INFO callout: "One important element of this practice is combining information from multiple sources. As students listen to the various community members respond to the interview questions, students will identify the effects the removal of the dam had on the Elwha River system and community members. Later in the lesson, students will combine information from several sources, including these interviews, to determine the different ways that humans are helping to restore the Elwha River system." (Lesson 8, Teacher Guide).

Criterion-Based Suggestions for Improvement:

- Ensure the "[m]aterials 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." [Detailed Guidance, p. 24]

II.D. Scientific Accuracy

EXTENSIVE

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

The reviewers found **extensive** evidence that students do use scientifically accurate and grade-appropriate scientific information, phenomena, and representations to support students' three-dimensional learning. All science ideas and representations included in the materials — including content related to all three dimensions as well as content that is not included in the three dimensions of the standards — are accurate.

- Lesson 2, Synthesize, Step 4: "Add "sediment" to the Word Wall. Point out that students said the salmon interacted with a component of the river system that has a name we can use to make it easier to talk about. Instead of saying "all the gravel and rocks and sand at the bottom of the river" we can say "sediment." Add this word to the Word Wall." (Lesson 2, Teacher Guide)
- Lesson 3, Explore, Step 2: "Acknowledge that several things make our model unlike the real Elwha River, scientists often call these kinds of differences in a model limitations. No model is without limitations, as we make our observations of our river model system, let's keep those limitations in mind." (Lesson 3, Teacher Guide)
- Lesson 3, Synthesize, Step 5: "Add biosphere and geosphere to the word wall. Return to the list of plants and animals and tell students that scientists refer to this group of components as the *biosphere-which refers to all of the living things on earth*. Label the list. Then shift to the list of sediment and tell students scientists call this group of components the *geosphere which refers to the rocky, solid parts of Earth*. Label the list and add both words to the word wall. Develop a system model with a partner to show the dam effects. Display slide K and suggest we use our new model setup to explain how the geosphere and biosphere interact and how the dam could impact those interactions." (Lesson 3, Teacher Guide)
- Lesson 4, Synthesize, Step 3: "Develop a model to explain. Display slide J and a chart labeled "Why does the water in the Elwha flow south to north?... Consider where "down is" Acknowledge that you are hearing people say that

gravity pulls things down. Display slide M and hold a marble against the top of the mountain on the chart paper. Ask students where they think it will go when it is dropped. When they respond that it will fall straight down, drop the marble. Ask students to turn and tell a partner why it fell straight to the ground." (Lesson 4, Teacher Guide)

- Lesson 4, Explore, Step 4, Teaching Tip: "When co-constructing the definition for gravity, leverage the thinking student's made sense during the *Building Understanding discussion*. The idea that gravity pulls not just down, but towards the center of the earth is important to unpack at this point. If students seem stuck go back and use the ruler with the binder clips to consider it further." (Lesson 4, Teacher Guide)
- Lesson 5, Synthesize, Step 6: "Update our Elwha River System Components and Interactions model. Display slide O and elevate, we were really focused on figuring out more about where the water came from which helps to keep the Elwha River flowing. Write the word river near the top of a blue piece of paper, leaving space for a title. Ask students to recall other components that are similar. Look for students to suggest the following: precipitation (rain, snow), clouds, ocean, other parts of the river (lake, tributaries, etc.). Point out that we figured out that there were parts in the air that were connected to the Elwha River system. Write the word air on a white piece of paper, leaving room at the top. Ask students to share other components that are similar to air. Look for students to suggest the following: wind, clouds. Add hydrosphere and atmosphere to the word wall. Return to the list of water components and tell students that scientists refer to this group of components as the *hydrosphere-which refers to all of the water on earth*. Label the list. Then shift to the list of air components and tell students scientists call this group of components the *atmosphere which refers to the air on Earth, including wind.*" (Lesson 5, Teacher Guide)
- Lesson 9, Explore, Step 6, Teaching Tip: "Because the sheer volume of water on Earth is so large and widely distributed, exact measurements of fresh and salt water are not available. A quick online search will show varying measurements for the distribution of water. We chose the US Geological Survey (USGS How Much Water Is There on Earth?) as the source for this lesson's information. Clarify with students that while these figures are more accurate than the estimates they made using the map, they are still only estimates." (Lesson 9, Teacher Guide)
- Lesson 10, Explore, Step 3, Teaching Tip: "Because the sheer volume of water on Earth is so large and widely distributed, exact measurements of fresh and salt water are not available. A quick online search will show varying measurements for the distribution of water. We chose the US Geological Survey (USGS How Much Water Is There on Earth?) as the source for this lesson's information. Clarify with students that while these figures are more accurate than the estimates they made using the map, they are still only estimates." (Lesson 10, 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 of guidance for teachers to support differentiated instruction because the materials explicitly clarify how they anticipate the needs of students who might struggle with any of the three dimensions within a particular activity. Sometimes the materials clarify how they anticipate the needs of students who might struggle with any of the three dimensions within a particular activity, and sometimes provide multiple and varied individualized learning strategies that support three-dimensional sense-making throughout the materials. Differentiation strategies explicitly clarify how they address the needs of multilingual learners, students with special needs, struggling readers, struggling students, and students with high interests. All groups are not necessarily supported in every activity, but they are supported when an obvious need arises. The materials provide examples and guidance that support reading, writing, listening, and speaking alternatives (e.g., translations, picture support, graphic organizers, non-linguistic, etc.). Supports such as multiple modalities are provided throughout the materials for students who are struggling to meet performance expectations or any one of the three dimensions, with some guidance on how to determine their understanding at that point in the lesson. While the unit provides robust scaffolds for access and support for struggling learners, the guidance for students who have already met the performance expectations is less frequent, often appearing as optional extensions rather than a systematic approach to deepening their understanding of the practices or crosscutting concepts throughout the unit.

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.

- Lesson 1, Connect, Step 2, Teaching Tip: "The title of the book and page 11 of the book contain Kllalm language. Play the audio for students and share with them that the word in Klallam means "Elwha River and the area at the mouth of it." (Lesson 1, Teacher Guide)
- Lesson 1, Synthesize, Step 4, Broadening Access: "Provide multiple means of action and expression by encouraging students to write in whatever languages (or combinations of written words and drawings) that allow them to comfortably express their ideas. Remind students of all the ways that they recorded their noticings of the river system components on the class chart, and that they can use those ideas and ways of expressing them in their models too." (Lesson 1, Teacher Guide)
- Lesson 2, Connect, Step 3, Broadening Access: "Before pairs begin reading, help all students access the articles by briefly previewing their structure—headings, images, and bolded words—so they know what to expect. Highlight or gesture key terms such as *spawn*, *migrate*, and *habitat*, and invite students to share translations or familiar words in their home languages. Offer optional reading supports like text-to-speech, partner reading, chunking the article into smaller parts, or using sentence starters to help students track ideas. Encourage multimodal annotation by allowing

students to underline, draw symbols, or color-code information about salmon, parts of the river, and important interactions." (Lesson 2, Teacher Guide)

- Lesson 3, Explore, Step 2: "Broadening Access: Provide multiple means of representation by offering alternatives to auditory information. As you work through planning the model, it may be helpful to use an example set of materials to demonstrate to students what objects they will use and the process listed in the procedures." (Lesson 3, Teacher Guide)Lesson 5, Explore, Step 2: "Co-constructing the meaning of precipitation. Show slide E and tell the students that you found some data about the weather in the Elwha River region. Highlight that in this data set we see the amount of precipitation during each month in the years 2018-2023. Before students start identifying parts between the seasons and months, take a moment to co-construct the meaning for the word precipitation using the prompts on the board. At this point, students should understand that *precipitation is rain, snow, hail, and/or sleet*. Add precipitation to the word wall." (Lesson 5, Teacher Guide)
- Lesson 5, Synthesize, Step 6, Broadening Access: "Provide multiple means of action and expression by encouraging students to write in whatever languages (or combinations of written words and drawings) that allow them to comfortably express their ideas. Remind students of all the ways that they recorded their noticings during the earlier investigation." (Lesson 5, Teacher Guide)
- Lesson 7, Explore, Step 3, Broadening Access: "Encourage students to share their thinking in a variety of ways, and validate all the ways we communicate our ideas, such as with gestures or body movements, pointing at the photos, drawings (if helpful), and words from any languages your students use." (Lesson 7, Teacher Guide)
- Lesson 9, Navigate, Step 1, Broadening Access: "Refer students to the photo on the slide, their own notes and drawings in their science notebooks, and the charts and artifacts you have around the classroom to help them share about the work they did last time. Encourage students to point to images, use gestures, and speak in languages they are most comfortable in." (Lesson 9. Teacher Guide)
- Lesson 10, Connect Section, Step 2, Connect to our Experiences, Broadening Access: "Consider drawing or having a student draw a visual that represents each water use next to the word or phrase that it represents. Not only does this provide students with auditory and visual inputs as they think about what the class uses water for, but it also helps students consider different ways that they might express their ideas. This will support all students in your class, including multilingual students." (Lesson 10, Teacher Guide)
- Lesson 11, Synthesize, Step 6, Broadening Access: "To support students in noticing all of the rich ways that their peers might share ideas during a discussion (e.g., using gestures, pointing to a solution, talking across different languages, etc.), it is important that students be seated in a way that helps them see and hear all of their classmates. Elevate alternative communication modes as needed, especially if you see that students are missing something that a peer is sharing. This is why the Scientists Circle seating arrangement is particularly helpful, as it allows students to orient to all their peers and the different ways their peers might communicate their thinking." (Lesson 11, Teacher Guide)
- Unit Front Matter, Unit Specific Strategies: "Consider ways to engage all students in science talks through the Scientists Circle. This is an opportunity for students to see and hear one another to build community learning across the class. During the Scientists 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. Throughout this unit, students collaboratively develop system models. There are many ways to encourage all students to participate in the development, such as assigning roles, obtaining information via jigsaw activities, and ensuring that sensemaking is accessible to students. The activities in this unit provide suggestions for ensuring that everyone participates in the

model development. This unit involves a great deal of obtaining information from text and other media about the Earth's spheres and how humans engineer solutions for problems in water systems. Be sure to use various tools as needed to help students access these texts and media, such as increasing font size, using screen readers, or turning on video captions." (Unit Front Matter, 5.3 Lesson Unit Front Matter)

Differentiation strategies address the needs of students when an obvious need arises: Emerging multilingual students learning English

- Lesson 8, Connect, Step 3, Broadening Access: "Inform students that their access to the information in these interviews can be supported and enhanced by turning on captions, varying the playback speed and/or providing students with the Interview Transcripts. If needed, take some time to model how to use these strategies. These strategies can be helpful for a variety of students, including multilingual students, students developing their literacy skills and practices, and students whose processing preferences are not auditory." (Lesson 8, Teacher Guide)
- Lesson 12, Synthesize, Step 6, Broadening Access: "As you record ideas on the charts, if possible also include visual representations of the ideas (e.g., drawings, photos). Additionally, ask a student to use the materials to demonstrate the ideas. Both strategies will benefit multilingual students, as well as all students, as they ensure that all students are able to share ideas and understand the ideas being shared." (Lesson 12, Teacher Guide)

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

- Lesson 4, Explore, Step 2, Broadening Access: "Consider having a student record the investigation to broaden students' access to the information figured out about how the water in our Elwha River model moved. The recorded video of students carrying out the investigation can be used as an alternative method for engaging in the investigation for students who were absent or have varying learning needs, and as a visual reference for specific observations during the discussion of the results. Additionally, the video can support students in building connections to what they might have experienced or done in the past with what they are doing in this and future lessons to generate new understandings." (Lesson 4, Teacher Guide)
- Lesson 9, Explore, Step 4, Teaching Tip: "Extension Opportunity: If you have a globe in the classroom, consider having students find their section on it and try pointing to a couple of their squares. This task can help students visualize how their various map sections all wrap together." (Lesson 9, Teacher Guide)
- Lesson 10, Explore, Step 3, Broadening Access: "To remove a barrier for students who are visually impaired and to support all students by offering multiple representations, gather items like a gallon of paint, a 5 gallon bucket, a half gallon of milk, etc. Invite students to hold and feel the items to help them conceptualize the idea of a gallon." (Lesson 10, Teacher Guide)

Learners reading below grade level

- Lesson 3, Synthesize, Step 3, Literacy Supports: "If your students have been working to use common Greek and Latin affixes and roots as clues to the meaning of a word, discuss with the class how the affixes "bio-" (meaning "life"), "geo-" (meaning "land") and "-sphere" (meaning "round, ball-like shape") help us understand the meaning of biosphere and geosphere. (L.5.4B)" (Lesson 3, Teacher Guide)
- Lesson 5, Explore, Step 2, Literacy Supports: "In this lesson information is presented in diverse formats, including visually (e.g., photographs) and quantitatively (e.g., data set). Prompting learners to orally summarize the information presented in the visual and quantitative representations supports SL.5.2." (Lesson 5, Teacher Guide)

- Lesson 11, Connect, Step 2, Literacy Supports: "Students will use information presented in diverse formats to better understand groundwater and how it is used. They will integrate information from visual (e.g., photographs) information on the infographic and quantitative data on the pie chart. Prompting learners to orally summarize the information presented in the visual and quantitative representations supports SL.5.2." (Lesson 11, Teacher Guide)

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

- Lesson 6, Synthesize, Step 5, Teaching Tip: "If students need more support beyond the sentences stems on the slide, refer them back to the Gotta-Have-It checklist and encourage them to use it to provide peers with feedback." (Lesson 9, Teacher Guide)
- Lesson 9, Synthesize, Step 3, Teaching Tip: "It may be obvious to students from their previous work with the stream tables how a dam can help to control flooding, but if students have questions about this, you might show photos from Lesson 3 or demonstrate again with a stream table how damming the river affects the water flow above and below the dam, and model how regulating the water flow helps prevent flooding." (Lesson 9, Teacher Guide)
- Lesson 10, Explore, Step 3, Teaching Tip: "You might choose to use a millions place value mat to support students in reading and conceptualizing the large quantities used in this lesson (See Decimal Place Value Mat). Likewise, you can use the volume of a local body of water in gallons as a conceptual and visual benchmark as support." (Lesson 10, Teacher Guide)
- Lesson 14, Synthesize, Step 4, Broadening Access: "Provide opportunities, as needed, for students to communicate their ideas through words, pictures, verbally, or using gestures. Encourage students to use their My Growing Ideas charts and our consensus model to help them think about the steps in the transfer task." (Lesson 14, 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.

The current extensions provide students with high interest additional tasks, but they do not provide clear guidance for students who have already met the performance expectations to develop a deeper understanding of the practices, disciplinary core ideas, and the crosscutting concepts.

- Lesson 3, Explore, Step 3, Teaching Tip: Extension Opportunity: If students finish their observations before the time, invite students to test a related question of interest with their river model materials. Examples of questions could include: What if the dam was in another place? What if there was less water? What if the amount of sand or logs changed?" (Lesson 3, Teacher Guide)
- Lesson 9, Explore, Step 2: "Extension Opportunity: The data on the graph are collected from the National Inventory of Dams (NID), a database established to support awareness of dams and support various agencies in developing dam safety policies. Students who are especially interested in dams and/or geography might enjoy exploring their local area with the tools and resources available in the NID." (Lesson 9, Teacher Guide)
- Lesson 9, Synthesize, Step 3: "Extension Opportunity: You may have questions on your DQB about other non-human animals such as beavers that create dams. This lesson's conversation about why humans create dams might be a good time to invite students to research the answers to those questions, as this unit will not address them." (Lesson 9, Teacher Guide)

- Lesson 10, Connect, Step 2: "Extension Opportunity: If students show interest in exploring how much water they and/or their family use, encourage them to use a water footprint calculator like the one found on Water calculator to find out more about their own personal water usage and ways they can lower it." (Lesson 10, Teacher Guide). This is not an extension because the students are doing more calculations, rather than applying learning in a new context.
- Lesson 10, Explore, Step 4: "Extension Opportunity: If students are interested and have additional time, encourage them to calculate the total number of gallons of fresh water needed to produce more than 3 of the items on How much water? Recording Sheet. Additionally, students can choose to research other common items and the amount of fresh water needed to produce them and share their findings with the class." (Lesson 10, Teacher Guide). This is not an extension because the students are doing more calculations, rather than applying learning in a new context.
- Lesson 14, Connect, Step 3, Teaching Tip: "Extension Opportunity: If time and interest allow, invite students to explore more solutions that have been put into place for preserving fresh water in El Paso. Alternatively, students could explore places that have used desalination or wastewater treatment to improve access to their fresh water." (Lesson 14, Teacher Guide)

Criterion-Based Suggestions for Improvement:

- Ensure that extensions are included for "[s]tudents who have already met the performance expectation(s) or who have high interest in the subject matter and are ready to develop deeper understanding in any of the three dimensions" [Detailed Guidance, p 28]
  - Consider revising suggestions in the Extension Opportunity callouts for Lesson 10 to have students apply their learning in a new context rather than doing more calculations.

II.F. Teacher Support for Unit Coherence

EXTENSIVE

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

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

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

The reviewers found **extensive** evidence of teacher support for unit coherence. The materials support teachers in facilitating coherent learning experiences over time by providing routines that allow the students to make connections between lessons as the unit 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 for how to recognize what students figure out in a lesson, what questions are left unanswered, and what new questions could be answered in the next investigation. Frequent guidance or tools are provided to teachers to support linking student engagement across lessons. Strategies are provided to support the teacher 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 the Elwha River dam phenomenon or designing solutions to community water 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.).

The Navigation section on the Storyline contains a summary of how each lesson leads to the next using what students have figured out and new questions that arose. (5.3 Earth Systems Storyline)

- Lesson 1, Navigate, Step 7: "Display slide Q. Give students about 5 minutes to generate investigation ideas. Students can create a simple t-chart with the headings "Question" and "Investigation Ideas" on notebook paper, or they can use Investigation Ideas to record their investigation ideas." (Lesson 1, Teacher Guide).
- Lesson 2, Navigate, Step 1: "Recall where we left off. Ask students to consider where they left off from the previous science class. Show slide A and ask for a few volunteers to recap what was discovered in the previous science lesson. Remind students that they can look at the DQB, our consensus model, and/or investigation ideas to help them remember what we figured out in our last lesson. Ideas to listen and look for:" (Lesson 2, Teacher Guide)
- Lesson 3, Navigate, Step 1: "Facilitate a whole-class discussion of where we left off in our last lesson. Display slide A and facilitate a class discussion using the following prompt response box. What did we figure out about salmon in the last lesson? What did we decide that we wanted to figure out next? What ideas do you have for figuring out how the sediment might have been affected by the dam?" (Lesson 3, Teacher Guide)
- Lesson 7, Navigate, Step 6: "Prompt students to ask more questions. Present slide L and remind students that we have spent a lot of time figuring out how human decisions impact the spheres of the Earth in our unit so far. Let's review some of the decisions we explored and consider what wonderings we have about those decisions and their impacts. Ask students to share some examples of human decisions that have impacted the spheres that we have explored together. Ideas to listen and look for: Any local decision that was discussed with the class. The dams being built on the Elwha River. Creating a lobster fishing port." (Lesson 7, Teacher Guide)
- Lesson 9, Navigate, Step 1, Broadening Access: "Refer students to the photo on the slide, their own notes and drawings in their science notebooks, and the charts and artifacts you have around the classroom to help them share about the work they did last time. Encourage students to point to images, use gestures, and speak in languages they are most comfortable in." (Lesson 9, Teacher Guide)Lesson 14, Synthesize, Step 4: "Review the criteria and constraints of the problem. Tell students that now that they have gathered information about the problem and two solutions already in use, they will get a chance to compare solutions. Ask students what they will need to consider as they compare the solutions to the problem. Ideas to listen and look for: How much the solution costs; How much clean freshwater it can bring to the system; How it will impact other things; If they have the space for it." (Lesson 14, Teacher Guide)

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

- Lesson 2, Synthesize, Step 4: "Develop the Salmon/Elwha River System Interactions model. Display slide H and the "How do salmon interact with different parts of the river system?" chart paper. Point out that we have figured out a lot about how salmon interact with some of the parts of the river when we read an article and shared the information with another group, but as a class, we do not have all of the information. Hold a Building Understanding Discussion where students share what they read about how salmon interact with the Elwha River system during the stage in their life cycle that they read about. Encourage students to have their salmon article available for reference as they share. Explain that we will work together to develop a model that explains how the salmon interact with the parts of the Elwha River system. As each group shares, add the interactions to the part of the river they are explaining." (Lesson 2, Teacher Guide)
- Lesson 3, Synthesize, Step 5: "Set up a new system model. Move the How Do Salmon Interact with the Elwha River chart from lesson 2 and the How Did the Dam Affect the Elwha River? model from lesson 1 next to the list of

observations on the whiteboard that was just created. Elevate that we have a lot of ideas between the two models and our list of observations. Suggest that we take time to combine all of these ideas into 1 model so we can better see how the dam could be affecting the Elwha River system." (Lesson 3, Teacher Guide)

- Lesson 6, Synthesize, Step 3: "Constructing the class' Gotta-Have-It Checklist. Tell students that in a moment they will explain what happened after the dams were built in their groups. Before students construct these explanations, we will take a moment to build a class Gotta-Have-It Checklist. Use the three prompts on slide D to guide this discussion. Listen for the following ideas: What components are interacting with the salmon, sediment, and water? How did the building of the dams impact these new components? If you were explaining how the dams changed the watershed system, which components and interactions would be important to include? (Lesson 6, Teacher Guide)
- Lesson 7, Explore, Step 3, Developing and Using Models Callout: "Students have engaged in the practice of developing a system model individually, in small groups, and as a whole group several times throughout this unit. In this step they are getting the opportunity to practice developing this type of model with a partner around a new context. In the next step, students will work independently on Creating a Lobster Fishing Port to develop their own systems model. Working on this practice with a partner will help them further develop their understanding of how to develop a model that describes the impacts that decisions have on the spheres of the Earth around a context that is different than the anchoring phenomena." (Lesson 7, Teacher Guide)
- Lesson 13, Explore, Step 3: "Display slide D and have students create models for explaining how their proposed solution will address their water related problem. These models should also justify why the chosen solution is optimal, incorporating their analysis of the criteria and constraints from Lesson 13 Comparison Tool. Distribute one copy of Modeling our solution to each pair of students. Review what students should include and the resources they should use to guide their work with the class. Remind them that they can reference the checklists on their Modeling our solution while developing their model with their partner. Encourage students to develop their model using pencil, so they can revise it easily if they need to. See Unit 5.3: How does changing the flow of water impact Earth's systems, and how can humans help? to see the types of ideas students may incorporate into their models." (Lesson 13, Teacher Guide)
- Unit Front Matter, What unit-specific strategies are important for supporting equitable science learning in this unit?, Page 18:
  - Consider ways to engage all students in science talks through the Scientists Circle. This is an opportunity for students to see and hear one another to build community learning across the class. During the Scientists 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.
  - Throughout this unit, students collaboratively develop system models. There are many ways to encourage all students to participate in the development, such as assigning roles, obtaining information via jigsaw activities, and ensuring that sensemaking is accessible to students. The activities in this unit provide suggestions for ensuring that everyone participates in the model development.
  - This unit involves a great deal of obtaining information from text and other media about the Earth's spheres and how humans engineer solutions for problems in water systems. Be sure to use various tools as needed to help students access these texts and media, such as increasing font size, using screen readers, or turning on video captions.

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 gradually adjust supports over time so that students are increasingly responsible for making sense of phenomena and/or designing solutions to problems for most of the intentionally developed SEP elements. Teacher supports are provided to help all students, including those with special needs and abilities and emerging multilingual students, explicitly build an understanding and proficiency in specific elements of the SEPs over time through a variety of approaches over the course of 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. Teacher materials provide guidance for where and when to add and remove supports to move students toward independently knowing when to use and demonstrating proficiency with the SEPs.

MOD: Developing and Using Models

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

- Lesson 3, Explore, Slide B: "How can we use the materials we have to create an Elwha River System model to observe the impact the dams had on the sediment and water in the Elwha River?" (Lesson 3, Slides)
- Lesson 4, Synthesize, Step 3: "Develop a model to explain. Display slide J and a chart labeled "Why does the water in the Elwha flow south to north?" If time and space allow, consider leaving the investigation materials accessible and/or visible to students as they apply what they figured out from the investigation to modeling the way the Elwha River flows." (Lesson 4, Teacher Guide)
- Lesson 4, Connect, Step 6, Developing and Using Models callout: "Students continue to engage in the work of this practice by considering which model best represents the cause of water ending up where it did after it fell onto an area of their community. As students progress through the unit, they will develop their own models to describe scientific principles in pairs and then on their own." (Lesson 4, Teacher Guide)
- Lesson 5, Student Materials, Handout 4: "Use words and/or drawings to develop a model to explain the interactions between the atmosphere and the hydrosphere in the Elwha River System." (Lesson 5, 5.3 Lesson 5 Handout 4 Model of Hydrosphere)
- Lesson 5 Teacher Guide, Synthesize 6: Update our Model, DATA callout: "Students will individually develop a model to explain the interactions between two new spheres. In a previous lesson, students worked with a partner to develop a model and contributed to the revision of the class consensus model. With the removal of scaffolds students may need more support as they engage in the task individually. Support them by having them return to the work they did on their handouts in Lesson 3 and/or returning to the class Elwha River system model." (Lesson 5, Teacher Guide). This should be labeled as a MOD callout.
- Lesson 6, Synthesize, Slide I: "Then arrange these cards to: Create a model to explain the effects of the Elwha River dams on the Elwha River system" (Lesson 6, Slides)
- Lesson 7, Explore, Step 3: "In pairs, create a system model for one of the human decisions we observed. Display slide E and tell students that they will now work in pairs on Impact of Human Decisions to choose one of the human

decisions that they observed and create a system model showing the impact that decision had on the spheres and their interactions." (Lesson 7, Teacher Guide)

- Lesson 7, Explore, Step 3, Developing and Using Models callout: "Students have engaged in the practice of developing a system model individually, in small groups, and as a whole group several times throughout this unit. In this step they are getting the opportunity to practice developing this type of model with a partner around a new context. In the next step, students will work independently on Creating a Lobster Fishing Port to develop their own systems model. Working on this practice with a partner will help them further develop their understanding of how to develop a model that describes the impacts that decisions have on the spheres of the Earth around a context that is different than the anchoring phenomena." (Lesson 7, Teacher Guide)
- Lesson 13, Explore, Step 3, Developing and Using Models callout: "One important element of this practice is developing a model to show the process by which the students' design solution addresses their identified water related problem. As students work to develop this model, point out how their model can help us see the cause and effect relationships between the intended solution and interactions of the greater water system." (Lesson 13, Teacher Guide)
- Lesson 13, Explore, Step 3: "Develop a model to explain the solution to our problem. Suggest to students that we could use a model to help others understand why their chosen solution tested best. Ask students to consider what might be useful for us to include in our models to help show why it's best, especially to their peers who have been researching a different problem." (Lesson 13, Teacher Guide)

MATH: Using Mathematics and Computational Thinking

Claimed Element: **MATH-E3 Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems.**

- Lesson 5, Explore, Step 2, Math Supports callout: "Use and encourage students to use precision of language (e.g., calling 17.4 as 17 and four tenths) when reading the decimals to support students in connecting decimals to their understanding of fractions (MP6 and part of 5.NBT.A.3.A). A decimal place value mat designed to build on students' understanding of fractions is available as a resource to support students in reading decimals using number names (See Decimal Place Value Mat)." (Lesson 5, Teacher Guide)
- Lesson 5, Explore, Step 2, Math Supports callout: "Students are modeling the data in the table for the amount of precipitation during each month as a bar graph, a representation they have used in 2nd, 3rd, and 4th grade. After students have completed constructing the bar graph, have them interpret their results in the context of the situation and check whether the results make sense. Students can look for connections between the two different representations and explain what they noticed. Ask students about which representation was more useful and efficient for noticing patterns about the precipitation and why. (MP4)" (Lesson 5, Teacher Guide)
- Lesson 9, Explore, Step 4: "Plan for how to gather evidence of available water. Display slide F and ask students how this map could help us figure out how much water is available for us to use. Establish that we can make a rough estimate of the places on Earth that are covered with water (in various forms)." (Lesson 9, Teacher Guide)
- Lesson 9, Explore, Step 4: "Connect to finding area in math. If students did not already suggest it, connect to work they have done in math when they want to know how much space a shape covers. Recall counting squares or measuring in square units to find the area of a shape. Suggest that we can do the same with this map, but we will want to divide the work of counting squares because this is a big map." (Lesson 9, Teacher Guide)
- Lesson 9, Explore, Step 5, Math Supports callout: "As math support, use students' prior work with area to support their understanding of volume. Help students conceptualize volume by explaining that we measure volume, or the amount of space an object takes up, by determining the number of unit cubes that could be packed, without gaps or

overlaps, in the object. If you have access to centimeter or math cubes, demonstrate finding the volume of an open cube or rectangular prism in the classroom (e.g., bin, box, cubby, trashcan, tissue box) by counting the number of cubes needed to fill the object. (5.MD.C.3.A, 5.MD.C.3.B, and MP1)" (Lesson 9, Teacher Guide)

- Lesson 9, Explore, Step 6, Using Mathematics and Computational Thinking callout: "An important element of this practice is graphing quantities such as volume to address scientific questions; in this case, investigating our question of whether available fresh water is so limited that we would need to build dams to secure a reliable supply of it." (Lesson 9, Teacher Guide)
- Lesson 10, Explore, Step 3: "Compare our predictions of water use amounts to the amounts listed on the data table. Display slide E and explain that you found a data table showing the typical water usage in gallons for each activity. Let students know that the information used to find an amount for the typical water usage is based on averages." (Lesson 10, Teacher Guide)
- Lesson 11, Connect, Step 2, Broadening Access: "Building Prerequisite Understandings. Students may have little or no previous experience with pie charts, but they do have experience reasoning about quantities as part of a whole with fraction and decimal concepts. Since percentages are a sixth-grade concept, encourage students to discuss the amount of space (area) each portion of the pie chart takes up and to build on their prior work and understanding with unit fractions – ⅓, ¼, ½ – in third grade and decimals – 0.25, 0.50, 0.75 – in fourth grade. Ask them to share what they are noticing about the graph and how this tool can help us make sense of the water sources." (Lesson 11, Teacher Guide)

INFO: Obtaining, Evaluating, and Communicating Information

Claimed Element: **INFO-E1 Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.**

- Lesson 1, Connect, Step 2, Obtaining, Evaluating, and Communicating Information callout: "Obtaining, evaluating, and communicating information is fundamental to science as scientists must be able to clearly communicate their ideas to others and must be able to gather and evaluate ideas across a variety of sources and media. Throughout the unit, emphasize to students that books and videos and other media are important tools scientists use, in addition to investigations, to help them gather evidence that will help them explain phenomena." (Lesson 1, Teacher Guide)
- Lesson 2, Connect, Step 3: "Introduce students to the salmon articles. Display slide E and tell students that you have articles that will help us figure out more about how salmon interact with the various parts of the Elwha River and the things living in or near it. Figuring out about how salmon live their lives in the river will help us figure out if they need to access all of its parts in order to survive. Tell students that they're going to work in pairs to read the articles." (Lesson 2, Teacher Guide)
- Lesson 6, Explore, Step 2: "After students have had time to read and annotate the handout, distribute System Effects from the Dams to each student and show slide G. Direct partners to think about the question: How and why did the Elwha River system change after the dams were built? Next, students should discuss which components are interacting with the salmon, sediment, and water. Have students work to identify these interactions, and record them and their effects on System Effects from the Dams." (Lesson 6, Teacher Guide) - This leads to the Gotta Have It Checklist.
- Lesson 8, Connect, Step 3: "Listen to people share experiences related to the dam removal. Tell students that each person has answered a series of questions that will help us gather evidence about the changes to the Elwha River system. Tell students that they will form 4 groups and each group will focus on one question." (Lesson 8, Teacher Guide)
- Lesson 8, Connect, Step 3, Obtaining, Evaluating, and Communicating Information callout: "One important element of this practice is combining information from multiple sources. As students listen to the various community members respond to the interview questions, students will identify the effects the removal of the dam had on the

Elwha River system and community members. Later in the lesson, students will combine information from several sources, including these interviews, to determine the different ways that humans are helping to restore the Elwha River system." (Lesson 8, Teacher Guide)

- Lesson 9, Explore, Step 4, Obtaining, Evaluating, and Communicating Information callout: "One important element of this practice is combining information from multiple sources. As students listen to the various community members respond to the interview questions, students will identify the effects the removal of the dam had on the Elwha River system and community members. Later in the lesson, students will combine information from several sources, including these interviews, to determine the different ways that humans are helping to restore the Elwha River system." (Lesson 9, Teacher Guide)
- Lesson 11, Connect, Step 2: "Gather information about groundwater by analyzing an infographic. Show slide C and distribute 2 copies of the Groundwater Infographic to each group. Give groups 5 minutes to analyze the infographic, looking for information to help them answer their groundwater questions. After the time concludes, ask groups to share what they obtained." (Lesson 11, Teacher Guide)
- Lesson 11, Explore, Step 3, Obtaining, Evaluating, and Communicating Information callout: "If students are still developing their research skills or are not yet ready to independently engage in the full demands of this task, consider having them work with a partner or in small groups. Collaborative research can provide important scaffolding, allowing students to share strategies, build confidence, and continue progressing toward proficiency with SEP 8. Be sure to check in with groups to support their understanding of the website, how to make sense of what they find, and how to communicate their findings clearly." (Lesson 11, Teacher Guide)
- Lesson 11, Navigate, Step 7, Teaching Tip: "Students will continue working on researching and choosing a solution to the problem they started researching in this lesson in Lessons 12 and 13. They will refer back to the Model your problem handout in later lessons, and in Lesson 12, students will be adding another resource that they will need in Lesson 13. Make a plan for how you would like students to keep these resources organized and accessible. If students are already using a science notebook, they could store all of their resources for this engineering task there. Alternatively, you could collect and redistribute the resources when needed or give each pair a folder to keep the resources for this task." (Lesson 11, Teacher Guide)
- Lesson 12, Explore, Step 3, Literacy Supports: "Support students with integrating information across several forms of media, including infographics, in preparation for considering methods for testing water solutions. Pulling quotations and information for these sources helps students provide evidence for their thinking and clearly communicate their ideas. This supports RI.5.9 as students gain practice integrating information from several texts on the same topic to speak knowledgeably about that subject." (Lesson 12, Teacher Guide)
- Lesson 14, Explore, Step 2, Literacy Supports: "Encourage students to include main ideas and key details in their summaries of the water problem in El Paso. Support students in making connections between the main ideas, and the way that those main ideas are supported by details in the text. This work supports RI.5.2 as students use text information to summarize the water problem in El Paso." (Lesson 14, Teacher Guide)

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

- Lesson 2, Connect, Step 3, Obtaining, Evaluating, and Communicating Information callout: "While reading the salmon articles, students obtain information that they will use to explain how salmon interact with various components of the Elwha River system. Students will combine the information they read in their article with the information their classmates read in theirs to explain how salmon interact with all of the parts of the Elwha River system." (Lesson 2, Teacher Guide)

- Lesson 6, Explore, Step 2, Obtaining, Evaluating, and Communicating Information callout: "As the partners record their thinking in System Effects from the Dams, prompt students to identify what evidence they have for the various interactions they state. Asking students to track where they obtain their information will support their development in this practice." (Lesson 6, Teacher Guide)
- Lesson 6, Synthesize, Step 6, Obtaining, Evaluating, and Communicating Information callout: "Students develop this practice when they share their explanations using the *Two Stray/Two Stay* protocol. This practice is further developed as part of Home Learning: Sharing Your Explanation, where students go home and share their explanations with a trusted member of their community. These explanations will be told orally, but supported with images and pictures created by the students." (Lesson 6, Teacher Guide)
- Lesson 14, Connect, Step 3, Literacy Supports: "Support students as they obtain information from the solution cards to prepare for comparing different solutions for El Paso's water problem. Encourage students to identify main ideas for each solution, as well as key details that support those ideas. Help students organize their thinking so that they are prepared to summarize and compare each solution. This work supports SL.5.2 as students summarize information presented in diverse media and formats." (Lesson 14, Teacher Guide) This does not allow for a reduction in scaffolding and a more independent use of this element.
- Lesson 14, Explore, Step 2: "Read El Paso Searches for Answers to Its Water Problems in pairs. Display slide C and remind students that they suggested finding out more about the problem in El Paso before considering how to help improve it. Tell them that they can work with a partner to read about the water problem in El Paso using El Paso Searches for Answers to Its Water Problems. Ask students to record the key ideas they figure out about the problem on Understanding El Paso's Water Problem." (Lesson 14, Teacher Guide) This does not allow for a reduction in scaffolding and a more independent use of this element.

Criterion-Based Suggestions for Improvement:

- Consider reducing the scaffolding provided in Lesson 14 so that students are using the INFO-E4 element more independently.

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 the tasks are focused on sense-making and use scenarios that are rich and based on puzzling events and problems to solve. The tasks focus on eliciting the major intent of the targeted DCIs. There's a close match between 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 sense-making or problem solving in varied ways.

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

In Lesson 7, teachers are prompted to assess student performance by administering a transfer task where students develop a model that describes ways a lobster fishing port could impact Earth's spheres and their interactions. In Lesson 14, teachers are prompted to assess student performance by administering a culminating transfer task that asks students to design a solution to a water problem for a community in El Paso, TX.

- In Lesson 7, Synthesize, Step 5: "Develop a model that describes the impact of creating lobster fishing port. Display Slide L. Tell students that now that we have explored this decision together, we are going to help Pilar by using our knowledge of the interactions of the Earth's spheres to develop a model that describes the ways that creating a lobster fishing port can have an impact on those spheres and the interactions between them." (Lesson 7, Teacher Guide)
- Lesson 14, Explore, Step 2: "Introduce the water problem in El Paso. Present slide B and remind students that there are many areas in the United States that are facing water related problems. We have worked hard at generating and comparing solutions for some of those water problems, but today we are going to get a chance to use what we figured out from that experience to work on thinking about ways to improve a water related problem in another community, El Paso, TX. Tell students that El Paso is a city in Texas that is also facing a water related problem. Ask students where we should begin if we are going to help improve this problem." (Lesson 14, Teacher Guide)

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

- Lesson 4, Handout 2, Modeling the Path of Water: Students select a model and are asked to "[s]upport your claim with evidence and reasoning: Explain why the model you chose represents what caused the water that fell in your community to end up where it did. How did the evidence you collected during the investigations support you in making your claim?"(Lesson 4, 5.3 Lesson 4 Handout 2, Modeling the Path of Water). Targeted Learning Objective: **Support an argument with a model** that explains how **gravity causes water to be pulled toward the center of the Earth** and flow to the lowest point. (**MOD-E3. PS2.B-E3. CE-.E.1**)
- Lesson 7, Synthesize, Step 5: "Develop a model that describes the impact of creating lobster fishing port. Display Slide J. Tell students that now that we have explored this decision together, we are going to help Pilar by using our knowledge of the interactions of the Earth's spheres to develop a model that describes the ways that creating a lobster fishing port can have an impact on those spheres and the interactions between them. Distribute Creating a Lobster Fishing Port to each student and allow students time to individually complete it. Remind students that they can use the notice and wonder chart we just created and any other charts in our classroom that might help them

create their model." Targeted Learning Objective: **Develop a model** that describes the ways that a human decision can **impact the spheres of the Earth** and the **interactions between them**. (**MOD-E4**, **SYS-E1**, **ESS2.A-E1**)

- Lesson 7, Student Materials, Student Assessment 1: "Develop a model that shows the way the interactions between the atmosphere, biosphere, hydrosphere, and geosphere are impacted by creating a lobster fishing port." (Lesson 7, Student Assessment 1 Creating a Lobster). Targeted Learning Objective: **Develop a model** that describes the ways that a human decision can **impact the spheres of the Earth** and the **interactions between them**. (**MOD-E4**, **SYS-E2**, **ESS2.A-E1**)
- Lesson 8, Synthesize, Step 6: "Revise the Elwha River system model. Show slide N and use a Consensus Discussion to update the Elwha River system model based on the evidence that students collected from the interviews and cards." (Lesson 8, Teacher Guide). Targeted Learning Objective: **Obtain and combine information to explain how human conservation efforts** (**cause**) **led to the recovery** (**effect**) **of the Elwha River system.** (**INFO-E4**, **CE-E1**, **ESS3.C-E1**)
- Lesson 11, 5.3 Lesson 11 Handout 2 Model your problem: "Use words, drawings, and/or arrows to explain your ideas about: How is the community's use of water changing the local hydrosphere? Make sure you explain: Where does the water come from? How does the water source refill? What are humans using water for? How is this affecting the hydrosphere?" (Lesson 11, Handout 2, Model your problem) **Read and comprehend an online text** in order to **research a problem** related to **changes** in **the hydrosphere at a specific location.** (**MOD-E4. ESS3.C-E1**. **SC-. E2**)
- Lesson 13, Explore, Step 6: "Apply feedback to models to optimize the plan for the solution. Display slide K and ask students to refer back to their model explaining how they will improve the problem at the location they have been researching on Peer Feedback. Have them use the feedback they received and their notes about the feedback to apply the improvements to their plan. Students can choose to create an entirely new copy of their model or they can revise the one they already completed earlier in the lesson. If students are unsure if they should create a new model or revise the one they have, you can use any of the following prompts to help them decide:" (Lesson 13, Teacher Guide). **Respectfully provide and receive feedback from peers** about the **design for a solution to a freshwater** access problem **caused by human activity**. (**ARG-E3**, **CE-E1**, **ETS1.B-E3**)
- Lesson 13, Handout 2: Modeling our Solution, students integrate the three dimensions when they create a model of an engineering design solution to mitigate human impact issues. The targeted learning objective elements integrated are **CCC CE-E1 Cause and effect relationships are routinely identified, tested, and used to explain change, DCI ESS3.C-E1 Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments,** and **MOD-E3 Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.**

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

- Lesson 3, Handout 3, Model of Geosphere and Biosphere Interactions: "Use words and/or drawings to develop a model to explain the interactions between the geosphere and biosphere and how the dam may have changed those interactions. Use the evidence that we gathered during our model river investigation. Use your research about salmon from Lesson 2." (Lesson 3, Handout 3, Model of Geosphere and Biosphere Interactions, Student Materials)
- Lesson 4, Connect, Step 6: "Choose a model to explain why the water ended up where it did. Display slide T and tell students that they will have a chance to record where the water started and where it ended up and make a claim using a model that best explains what caused the water to end up there on Modeling the path of water. Explain that this

will be an opportunity for them to consider what they have figured out about gravity's impact on water flow in their community on their own. Encourage students to use resources in the classroom and on Investigating the direction gravity pulls as a reference and use evidence from their investigations to support their claim. Distribute Modeling the path of water and give students time to complete it on their own." (Lesson 4, Teacher Guide)

- Lesson 5, Synthesize, Step 6: "Develop a system model individual to show the interactions. Display slide P and suggest we take some time to gather ideas on how we can update our model to explain how the hydrosphere and atmosphere interact. Tell students that they will work individually and use the evidence that we gathered in this lesson and in Lesson 4 to develop their models. Distribute a copy of the Model of Hydrosphere and Atmosphere Interactions handout to each student. Point to the space in between the spheres and tell students that is there for them to model the interactions between them. Give students 10 minutes to work on their models. Circulate as student work and use the following prompts to probe their thinking. How can you add ideas about what we figured out from the precipitation and flow graphs? How can your ideas about what we saw in the cloud animation? How do the atmosphere and hydrosphere work together to keep the Elwha River flowing?"(Lesson 5, Teacher Guide)
- Lesson 9, Explore, Step 6: "Give students time to work on their graphs. Distribute the How much fresh water? handout, organize students into partners, and give them time to graph the information about where fresh water can be found on Earth." (Lesson 9, Teacher Guide)
- Lesson 11, Explore, Step 3: "Develop a model that explains the water problem. Display slide D and share with students that we have some information about 3 different communities in the United States and their water use. Read the names of the locations to students, and use the map on slide D to show students where the communities are located. Share with students that in a moment, they are going to research one of these communities to figure out the impact of their water use. Give students a moment to choose one of the locations." (Lesson 11, Teacher Guide)
- Lesson 13, Synthesize, Step 2: "Display slide C and tell students that now that they have their two solutions chosen, they can use Lesson 13 Comparison Tool to guide them through using the criteria and constraints to compare the solutions and choose the one that best improves the problem that they have been researching. Together, work through adding the criteria and constraints that we agreed upon in Lesson 12 to Lesson 13 Comparison Tool." (Lesson 13, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

III.B. Formative

EXTENSIVE

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

The reviewers found **extensive** evidence that the materials include opportunities for formative assessment that are called out explicitly and that occur several times within each lesson. Formal formative assessment opportunities are accompanied by clear guidance for the teacher on how to modify instruction based on varied student responses using an Instructional Guidance Tool. 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 attend to issues of student equity and access regularly 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.

Formative assessment opportunities are highlighted for each lesson, with connections to all three dimensions indicated in separate colors. These include a "How can I use the information I gather from this assessment?" section in the assessment instructions at the beginning of each lesson, often in a clear if-then format. For example,

- Lesson 1, Lesson Assessment Guidance: "You can also use these ideas to develop support around the cross-cutting concept of Systems in Lessons 2-5. As students progress throughout the unit and gather evidence through investigations of impacts on the watershed system, they will consider how that evidence supports or contradicts their initial ideas about how the dams impacted the river and the things in and around it." (Lesson 1, Teacher Guide)
- Lesson 5, Lesson Assessment Guidance: "This is a formative assessment opportunity where you can check in on students' data analysis. The Earth's atmosphere drives the water flowing through the hydrosphere. You can support the development of students' mathematical thinking by referring back to the images of the dam on slide H or the mountains on slide L. If students need more support, have them focus on comparing one season at a time. Ask students to focus on how the amount of precipitation compares to the amount of water flowing through the dam. If accessible, return to the physical river model from Lesson 3 and allow students to observe different amounts of water being poured into the model. Have students point to the graph to show what that might look like in the real Elwha River System." (Lesson 5, Teacher Guide)
- Lesson 8, Assessment Guidance: "This is a formative assessment opportunity where you will check in on students' progressing sensemaking. Various human activities can have a negative impact on the Earth's systems. But their decisions can also help to protect or restore these systems. You can support the development of their explanations by reviewing students' individual responses to the group notecatcher as they relate to the key ideas presented in the interviews. As students are updating the class consensus model ask them to share how they determined the idea they are adding to the model." (Lesson 8, Teacher Guide)
- Lesson 11, Lesson Assessment Guidance: "Use this formative assessment opportunity to see if students need more support in understanding how the human activity of overusing freshwater is causing a problem at their specific location. Students will be using criteria and constraints to choose the best solution for this problem in later lessons, so having a clear understanding of what the problem is will be critical. As students are creating their models with partners, circulate the room and check on their progress. If students are having a hard time creating their model, guide them through the text describing their problem on the website and/or the answers to the questions they recorded on Research Your Problem. Additionally, as you are creating the class consensus model of the core water problem, reinforce/review any ideas that you noticed students were not understanding when they were creating their individual models." (Lesson 11, Teacher Guide)

Key formative assessments are labeled separately from other formative assessment opportunities, and include more specific support in the Assessment Overview document, as well as more support in the Teacher Guide for that lesson. For example:

- Lesson 4, Connect, Step 6, Assessment Opportunity: "Key formative assessment: Students' Modeling the path of water and the surrounding discussions provide an opportunity to gather evidence about Learning Goal 4, with the purpose of providing feedback to students and guiding instruction in upcoming lessons. Encourage students to support their claim with evidence about why the model they chose best represents what caused the water to end up where it did. Refer to the Instructional Guidance for Modeling the Path of Water tool and the Assessment Guidance at the beginning of the lesson.." (Lesson 4, Teacher Guide)
- Lesson 6, Synthesize, Step 4, Assessment Opportunity: "Key Formative Assessment: The components and interactions that students are recording on System Effects from the Dams provide an opportunity to gather evidence about learning goal 6 with the purpose of providing feedback and guiding determining student readiness before

they take a summative assessment in the next lesson. Refer to the Instructional Guidance for Lesson 6 tool and the Assessment Guidance at the beginning of the lesson." (Lesson 6, Teacher Guide)

- Lesson 9, 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 9, Teacher Assessment Tool Instructional Guidance)
- Lesson 13, Explore, Step 3, Assessment Opportunity: "In this assessment moment for Learning Goal 13.A look for evidence that students represent and connect their ideas about how their chosen solution impacts the existing water system. If you notice students struggling to conceptualize their ideas, assist students in referencing and adding on to the model of their problem that they created in Lesson 11. Press students to justify their chosen solution by developing ways to represent how the solution addresses the established criteria and constraints." (Lesson 13, 5.3 Lesson 13 Teacher Guide)

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

Each formative assessment includes a three-dimensional learning goal, what the teacher can look for in student responses, and ideas on how to use the assessment information.

- Lesson 8, Lesson Assessment Guidance
  - **Three-Dimensional Learning Goal: Obtain and combine information to explain how human conservation efforts (cause) led to the recovery (effect) of the Elwha River system.**
  - **Where to Check for Understanding:** In the **Synthesize** (**slides N and O**), when students update the consensus model
  - **What to look and listen for:** Students drawing, writing, verbally explaining, acting out, and/or gesturing ideas about
    - **how removing the dams (cause) led to the recovery (effect) of the Elwha River system.**
    - **how removing the dams (cause) led to the recovery (effect) of the salmon population.**
    - **how planting trees (cause) led to the recovery (effect) of the Elwha River system.**
    - **how installing log jams (cause) led to the recovery (effect) of the Elwha River system.**
  - **How can I use this assessment information?:** This is a formative assessment opportunity where you will check in on students' progressing sensemaking. Various human activities can have a negative impact on the Earth's systems. But their decisions can also help to protect or restore these systems. You can support the development of their explanations by reviewing students' individual responses to the group notecatcher as they relate to the key ideas presented in the interviews. As students are updating the class consensus model ask them to share how they determined the idea they are adding to the model. (Lesson 8, Teacher Guide)

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

- Lesson 3, Lesson Assessment Guidance: "Evidence of students' ideas may be expressed in words, drawings, written or spoken descriptions, movement, and/or gestures." (Lesson 3, Teacher Guide).
- Lesson 7, Explore, Step 3: Broadening Access: "Encourage students to share their thinking in a variety of ways, and validate all the ways we communicate our ideas, such as with gestures or body movements, pointing at the photos, drawings (if helpful), and words from any languages your students use." (Lesson 7, Teacher Guide)

- Lesson 9, Lesson Assessment Guidance: "Evidence of students' ideas may be expressed in words, drawings, written or spoken descriptions, movement, and/or gestures. Refer to the Instructional Guidance for Lesson 9 tool for detailed information." (Lesson 9, 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 all major assessment opportunities include scoring or feedback guidance for teachers but did not always include examples of what students might write, gesture, or say. Every lesson has a Lesson Assessment Guidance and Assessment Opportunity section that provides teachers with the three dimensional learning goal and what to look and listen for from students for the lesson. However, a variety of student responses or feedback ideas that support the growth in proficiency for individual students is not consistently provided. Scoring guidance tools provide the teacher with enough information to modify instruction and provide targeted feedback to individual students. A range of student responses, not just exemplar responses, and interpretation guidance are not always provided to support teachers. Explicit guidance is provided for teachers to interpret student progress and for students to interpret their own progress in relation to both the instructional materials (e.g., the activity) as well as the standards, elements, parts of elements, and learning performances that are targeted as learning objectives.

Support for planning instruction

- Lesson 4, Assessment Guidance: "This is a key formative assessment opportunity where you will take stock of students' progressing sensemaking. [Add on more information as needed] Refer to the Instructional Guidance for Modeling the Path of Water for instructional guidance suggestions based on students' current sensemaking." The Instructional Guidance document contains specific suggestions for planning instruction based on student responses. (Lesson 4, Teacher Guide)
- Lesson 6, Assessment Guidance: "This is a key formative assessment opportunity where you will take stock of students' progressing sensemaking. Use the ideas that they modeled on the Explanation Interaction Cards handout to determine if students would benefit from small group discussions or modeling to explain ideas before the whole class Consensus Discussion, and circulate to support and assess their current thinking and representations. See the Instructional Guidance for Lesson 6 tool for instructional guidance suggestions based on students' current sensemaking." The Instructional Guidance document contains specific suggestions for planning instruction based on student responses. (Lesson 6, Teacher Guide)
- Lesson 9, Assessment Guidance: "This is a key formative assessment opportunity where you will take stock of students' progressing sensemaking. By the end of this lesson, students should be secure in graphing the distribution of water in various reservoirs on Earth, and then using the data they made sense of as evidence to describe the amounts of fresh water and salt water on Earth. In the next lesson, the class will continue to consider the scale and quantity of the water we use, and you can follow up with individual students as needed during that lesson. Refer to the Instructional Guidance for Lesson 9 tool for specific feedback suggestions based on students' current

sensemaking." The Instructional Guidance document contains specific suggestions for planning instruction based on student responses. (Lesson 9, Teacher Guide)

- Lesson 13, Assessment Guidance: "This is a key formative assessment opportunity where you can take stock in the students' progress in developing models and engineering solutions to problems. You can support the development of students' models by calling back to the models of their problems that they created in Lesson 11. See Instructional Guidance for Lesson 13, for additional guidance." The Instructional Guidance document contains specific suggestions for planning instruction based on student responses. (Lesson 13, Teacher Guide)

Support for ongoing feedback

- In addition to the support for planning instruction provided in the Key Formative Assessments detailed above, the Instructional Guidance document includes support for ongoing feedback.Lesson 2, Assessment Guidance: "What to look and listen for: Students drawing, writing, verbally explaining, acting out, and/or gesturing ideas about: Interactions between different components of the Elwha River system (for example, labeled arrows indicating nutrients from dead salmon help trees grow or showing shade from trees cooling the water in the river) Students identifying accurate information about the interactions between the biosphere, hydrosphere and geosphere from the article represented on the model." (Lesson 2,Teacher Guide)
- Lesson 2, Navigate, Step 5: "Collect Salmon Readings / Graphic organizers. Close the lesson by asking students to turn in their Salmon Lifecycle handout and tell them that you look forward to providing them with feedback. Consider leaving students written feedback and conferencing with students before Lesson 3 as they will use these handouts as evidence to make sense of how the dam could impact the salmon.
- Lesson 3, Lesson Assessment Guidance: "What to look and listen for: Students drawing, writing, verbally explaining, acting out, and/or gesturing ideas when students model to explain: how the dam affected interactions between the salmon and the sediment. How the dam blocked salmon from accessing all parts of the river. How the sediment and logs provide a place for salmon to lay eggs and rest. (interaction) Evidence of students' ideas may be expressed in words, drawings, written or spoken descriptions, movement, and/or gestures." (Lesson 3, 5.3 Lesson 3 Teacher Guide). Examples of what students might draw, gesture, or spoken language are not included.
- Lesson 5, Lesson Assessment Guidance "This is a formative assessment opportunity for you to check in with students' understanding of how the hydrosphere and atmosphere interact to keep the Elwha River flowing. If students need more support in making the connection that snow melt is a significant source of water for the river consider the following supports: focus their attention on comparing just the summer months. Ask students to describe what low bars on the precipitation graph means. Ask students to describe what high bars on the flow graph means. Return to the winter and summer images and ask students to make claims about where the snow that was in the mountains could have gone." (Lesson 5, Teacher Guide).
- Lesson 7 Assessment Tool: Scoring Guide for Creating a Lobster Fishing Port provides teachers with an analysis of which elements of the three dimensions are addressed by each question. It also provides a scoring rubric with sample response descriptions (Lesson 7, 5.3 Lesson 7 Teacher Assessment Tool Scoring Guide for Creating a Lobster Fishing Port).
- Lesson 9, Lesson Assessment Guidance: "What to look and listen for: Graph the amounts of fresh water in various reservoirs to provide evidence about the distribution of water on Earth. Describe the amounts of salt water and fresh water in various reservoirs on Earth. Evidence of students' ideas may be expressed in words, drawings, written or spoken descriptions, movement, and/or gestures. Refer to the Instructional Guidance for Lesson 9 tool for detailed information. See additional ideas to look and listen for in the discussion prompts provided in the lesson." (Lesson 9, Teacher Guide) Examples of what students might write, gesture, or spoken language are not included.

- Lesson 9, Teacher Assessment Tool Instructional Guidance, Students needing additional support in creating bar graphs: "Set up similar graphing examples to practice with, such as graphing the amounts of water used to produce various items in Lesson 10." This next step indicates to move forward to the next lesson rather than supports needed to help students in creating bar graphs.
- Lesson 12, Lesson Assessment Guidance"This is a formative assessment opportunity where you can take stock in the students' progress in engineering solution evaluation. When engineering solutions to society's problems, engineers must test their proposed solutions against the success criteria and the constraints. You can support the development of students' arguments by calling back to the solution analysis on slide J have students focus on one criteria or constraint at a time and talk through how one solution may be better than another. Use students responses on their Comparison Tool Self-Reflection handout to facilitate conferences or provide additional feedback." (Lesson 12, Teacher Guide)
- Lesson 12, Synthesize, Step 7: "Self-reflect using the Comparison Tool Self-Reflection. After groups have had enough time to evaluate the solutions, show slide M and distribute Comparison Tool Self-Reflection. Ask students to take a moment to reflect on their experience using the Lesson 12 Comparison Tool. You can choose to collect this document to assess how well students see themselves using the Lesson 12 Comparison Tool." (Lesson 12, Teacher Guide)
- Lesson 14, Lesson Assessment Guidance: "What to look and listen for: Evidence of students' ideas may be expressed in words, drawings, written or spoken descriptions, movement, and/or gestures. See the Scoring Guide for Lesson 14 Transfer Task tool to support your evaluation of students' assessments." (Lesson 14, Teacher Guide)
- A detailed Scoring Guide is provided for each summative assessment (Lesson 7 and Lesson 14) which include descriptors for student responses that are Beginning, Developing, or Secure performance level.

Criterion-Based Suggestions for Improvement:

- Consider providing a "range of student responses, not just exemplar responses, and interpretation guidance … to support teachers. This could include sample student work [e.g., models, drawings, etc.] or expected student responses." [Detailed Guidance, p 41]
- Consider providing ideas for helping students struggling to create a bar graph.

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 assessment opportunities throughout the unit use methods, vocabulary, representations, and examples that are accessible for all students. Tasks use multiple modalities to present information to students in meaningful ways. 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 for sharing orally). The materials include at least one significant task that provides students with a choice of responses across multiple modalities.

Multiple modes of communication

- Lesson 3, Synthesize, Step 5: "Develop a system model with a partner to show the dam effects. Display slide K and suggest we use our new model setup to explain how the geosphere and biosphere interact and how the dam could impact those interactions. Tell students that they will work with a partner and use the evidence that we gathered in this lesson and in Lesson 2 to develop their models. Distribute a copy of the Model of Geosphere and Biosphere Interactions handout to each pair, and show students how the model is similar to the papers we started together." (Lesson 3, Teacher Guide)
- Lesson 5, Navigate, Step 8: "Give students time to update their own Growing Ideas chart. Display slide R. Distribute My Growing Ideas to each student. Encourage students to answer the lesson question based on what they figured out in this lesson. Make clear that the Growing Ideas chart is their space to write and draw their own thoughts and science ideas, not to copy from the teacher or classmates. ." (Lesson 5, Teacher Guide)
- Lesson 7, Synthesize, Step 5: Share noticings and wonderings about Boats leaving port. Present slide I and ask students to turn and tell a partner what they noticed and wondered about the lobster fishing port. You may consider leaving the video playing while students are sharing, so that they can reference it." Students watch a video to introduce the new phenomenon for assessment and are presented with text and an image to introduce the phenomenon and to provide directions for the task. (Lesson 7, Teacher Guide)

Supports success for all students

- Lesson 5, Synthesize, Step 5, Broadening Access: "Provide multiple means of action and expression by encouraging students to write in whatever languages (or combinations of written words and drawings) that allow them to comfortably express their ideas. Remind students of all the ways that they recorded their noticings during the earlier investigation.." (Lesson 5, Teacher Guide)
- Lesson 6, Synthesize, Step 5: "Construct an Elwha Watershed explanation. Show slide E and tell students that now that we have our Gotta-Have-It checklist we are ready to create our Elwha Watershed explanations. Distribute four interaction cards found in Explanation Interaction Cards to each group. Groups will use these interaction cards to show the effects that occurred after the dams were built. On each interaction card, there is space for students to draw a picture and write a description for each interaction taking place. Group should arrange these cards to show the effects that took place. Encourage students to discuss the interactions they are choosing to include on the cards and they order they will place them. Remind students that the interactions are being recorded on cards so that they can move them around if they want to test out different orders or if they change their minds about the placement of an interaction." (Lesson 6, Teacher Guide)
- Lesson 6, Synthesize, Step 5, Assessment Opportunity Callout: "Formative assessment: This is the formative assessment opportunity for Learning Goal 8. Look for students using evidence they gathered from the interviews and cards to identify the components and interactions in the Elwha River system that could benefit from the removal of the dam as well as other restoration activities. Collect student handouts and use the guidance at the beginning of the lesson to provide students with written feedback and/or oral feedback before they engage in this practice again in lesson 11." (Lesson 6, Teacher Guide)
- Lesson 11, Explore, Step 3: "Share models with partners. Once students have completed their models, display slide F and ask students to share their models with a student who researched a different location. Have students exchange and review each other's models. As students review the model for another community's impact on the hydrosphere, they should look for the similarities and differences between the two locations. Recommend that students annotate their models using a check in areas where they are similar, and an X where they are different. Give students time to review each other's models and discuss what they noticed. Encourage students to ask each other questions if they are unsure what is happening with the local hydrosphere." (Lesson 11, Teacher Guide)

Multiple modalities and student choice

- Lesson 3, Lesson Assessment Guidance "Evidence of students' ideas may be expressed in words, drawings, written or spoken descriptions, movement, and/or gestures. Refer to the Instructional Guidance for Lesson 3 tool for detailed information." (Lesson 3, Teacher Guide)
- Lesson 5, Explore, Step 2: "Ask for a show of hands for who mostly used the data table as they looked for patterns and who mostly used the graph. Ask how making a graph or using the table helped us to notice patterns in the precipitation. Accept all answers. Note that there were some people who used each, so that is one reason why it's important to have different ways to represent data." (Lesson 5, Teacher Guide)
- Lesson 12, Synthesize, Step 7: "Teaching Tip: Students can opt to record using qualitative or quantitative methods. This is an opportunity to provide some students choice in how they represent their thinking. In some instances, it may be helpful for groups to devise a key showing what different symbols, numbers, or descriptions mean. A sample comparison tool can be found: Sample Comparison Tool." (Lesson 12, Teacher Guide)
- Lesson 13, Explore, Step 6: "Apply feedback to models to optimize the plan for the solution. Display slide L and ask students to refer back to their model, explaining how they will improve the problem at the location they have been researching on Peer Feedback. Have them use the feedback and their notes about the feedback to make improvements to their plan. Students can choose to create an entirely new copy of their model, or they can revise the one they completed earlier. If students are unsure if they should create a new model or revise the one they have, you can use any of the following prompts to help them decide." (Lesson 13, Teacher Guide)

Criterion-Based Suggestions for Improvement: N/A

III.E. Coherent Assessment System

EXTENSIVE

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

The reviewers found **extensive** evidence that teachers are supported to understand how student performance in each assessment fits together to reflect student learning across the unit. All four of the 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 phenomenon and/or solve problems. The assessment of the three dimensions proportionally matches up with the learning objectives. The assessment purpose and rationale are coherent across the materials and 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 3, Lesson Assessment Guidance: "**Construct an explanation for the effects dams have on certain Elwha Rivers system parts (like water, sediment, and salmon)**" Students accurately use their observations of the river model and the data they collected about salmon in the previous lesson to construct an explanation of how the dam impacted the sediment and the salmon in the Elwha River. (Lesson 3, Teacher Guide)

- Lesson 4, Lesson Assessment Guidance: "**Use physical quantities from constructed graphs to support an argument** for how **changes to Earth's atmosphere affect the amount of water flowing through the Elwha River**." Students use the precipitation graphs as evidence to support arguments being made in the Winter and Summer. (Lesson 4, Handout Supporting an Argument)
- Lesson 5, Synthesize, Step 5: "**Use patterns from data collected by a physical model to convey** how **gravity's downward pull of water and the steepness of slopes prevents water in the Elwha River from flowing around a dam**. Explaining the flow of snow melt. Show slide L and distribute Explaining Water's Flow. Highlight the image showing the land near the Glines Canyon dam found in the image on the slide. Direct the students to use this image and the patterns uncovered in the Gravity model Investigation to explain why the snow melt gets stuck behind the dam. Students may use words and/or images to support their explanation. You can collect this explanation to individually assess students' sensemaking." (Lesson 5, Teacher Guide)
- Lesson 7, Lesson Assessment Guidance: **"Develop a model** that describes the ways that a human decision can **impact the spheres of the Earth** and the **interactions between them**. Develop a model that shows the way the interactions between the atmosphere, biosphere, hydrosphere, and geosphere are impacted by creating a lobster fishing port." (Lesson 7, Teacher Guide)
- Lesson 9, Lesson Assessment Guidance: "**Describe and graph** the **amounts** of **salt water and fresh water in various reservoirs to provide evidence** about **the distribution of water on Earth**. Use the evidence you have gathered on the How much fresh water? handout to evaluate students' progress toward Assessment Statement 9. Use the Unknown material with identifier: e9.l8.tat1 to provide feedback to students and plan your upcoming instruction. (Lesson 9, Teacher Guide)
- Lesson 11, Lesson Assessment Guidance: "**Read and comprehend text** in order to **research a problem** related to a **change** in **freshwater accessibility in a specific location.** Develop a model that explains the water problem. Let students know that sometimes it helps us understand and explain a problem if we can see how it works visually. Display slide E and distribute Model your problem where they will develop a model that explains how the overuse of freshwater has caused changes to their freshwater system. Remind students that we are using evidence from the research we did on our problems to support the ideas we are explaining in our models." (Lesson 11, Teacher Guide) Lesson 14, Lesson Assessment Guidance: **"Obtain and combine information** about ways the El Paso **community is using science ideas to protect their water system**. Look for evidence that students have used and combined information that they gathered from Splashing into Solutions: Water Problem in El Paso and El Paso's new facility to turn waste water into drinking water and The World's largest inland desalination plant is in El Paso videos to explain how the solutions for protecting the water system in El Paso." (Lesson 14, Teacher Guide)

Pre-, formative, summative, and self-assessment

Pre-Assessment

- Lesson 1, Lesson Assessment Guidance: "This is a pre-assessment opportunity. Do not take a grade or score. Instead, use the information to uncover students' initial ideas about the changes that can happen to interactions between Earth's systems caused by human impacts. Use the class initial consensus model as a collective record of student ideas. Also, refer to students' "After Dam" Initial Model handout for a record of students' initial ideas. The ideas students write and/or draw can be used later to connect to concepts and Word Wall words students will develop in later lessons." (Lesson 1, Teacher Guide)
- Lesson 1, Lesson Assessment Guidance: "You can also use these ideas to develop support around the cross-cutting concept of Systems in Lessons 2-5. As students progress throughout the unit and gather evidence through investigations of impacts on the Elwha River system, they will consider how that evidence supports or contradicts

their initial ideas about how the Elwha Dam affected the river system. When students brainstorm investigations later in this lesson, consider how you can support them in later lessons to connect their investigation ideas to the evidence they will gather. For more information about students' incoming ideas and alternative conceptions related to concepts learned in this unit, please see About the Science." (Lesson 1, Teacher Guide)

Formative Assessment

- Formative Assessment opportunities can be found in each lesson. Key formative assessments are detailed on the 5.3 Earth Systems Assessment System Overview document, in the Lesson Assessment Guidance, and the Assessment Opportunities callouts. Each Key Formative Assessment provides an Instructional Guidance document. Lesson 4 illustrates how each Key Formative Assessment is described for lessons 6, 9, and 13. Note that Key Formatives are provided in the lesson preceding each Summative (Lessons 7 and 14), which allows an opportunity for feedback on all dimensions.
- Lesson 4, Connect, Step 6: "Key formative assessment: Students' Modeling the path of water and the surrounding discussions provide an opportunity to gather evidence about Learning Goal 4, with the purpose of providing feedback to students and guiding instruction in upcoming lessons. Encourage students to support their claim with evidence about why the model they chose best represents what caused the water to end up where it did. Refer to the Instructional Guidance for Modeling the Path of Water tool and the Assessment Guidance at the beginning of the lesson." (Lesson 4, Teacher Guide)
- 5.3 Earth Systems Assessment System Overview: "As students engage in these lessons, there are multiple opportunities to gather formative evidence of students' ongoing and developing sensemaking. This evidence can be used to support students by providing individual and group feedback and/or making minor instructional modifications as suggested in unit materials. Ongoing formative assessment opportunities related to class discussions, handouts, and other student work are described in the front matter of each lesson and noted in the teacher guide with a yellow "Assessment Opportunity" box where they happen in the lesson.
  - Lesson 8, Synthesize, Step 6, Assessment Opportunity: "Formative assessment: This is the formative assessment opportunity for Learning Goal 8. Look for students using evidence they gathered from the interviews and cards to identify the components and interactions in the Elwha River system that could benefit from the removal of the dam as well as other restoration activities. Collect student handouts and use the guidance at the beginning of the lesson to provide students with written feedback and/or oral feedback before they engage in this practice again in lesson 11." (Lesson 8, Teacher Guide)

Summative Assessment

- Unit Assessment Overview: "In Lesson 7, use the Scoring Guide for Creating a Lobster Fishing Port teacher assessment tool to support your evaluation of students progress in the first lesson set. Students will complete Creating a Lobster Fishing Port using the video Boats leaving port. Consider using the rubric to provide feedback to students to revise their explanations and to plan your upcoming instruction. Use the range and breadth of students' responses to gauge if any key ideas need to be revisited before building on them in Lesson Set 2." (5.3 Lesson Assessment System Overview (ES))
- Unit Assessment Overview: "Lesson 14 provides opportunities for a final summative assessment via the Comparing Solutions to El Paso's Water Problem, on which students generate and compare solutions to a new water related problem. Use the Scoring Guide for Lesson 14 Transfer Task to support evaluation of students' three-dimensional progression through the unit. Consider giving students an opportunity to revise their comparison tool using the feedback provided to them." (5.3 Lesson Assessment System Overview (ES))

Self Assessment

- Lesson 5, Navigate, Step 8: "Give students time to update their own Growing Ideas chart. Display slide R. Distribute My Growing Ideas to each student. Encourage students to answer the lesson question based on what they figured out in this lesson. Make clear that the Growing Ideas chart is their space to write and draw their own thoughts and science ideas, not to copy from the teacher or classmates. Throughout the unit, students will have more chances to add to the My Growing Ideas chart. It will show them how their understanding has grown over time." (Lesson 5, Teacher Guide)
- Lesson 5, Navigate, Step 8, Teaching Tip: "These moments for self-reflection are important for students to synthesize information in ways that make sense to them, while also practicing how to communicate that information, even if it is for their own use. We suggest that if you choose to review students' Growing Ideas charts, you only use them to see where your students are in their sensemaking, rather than using them as a graded assessment." (Lesson 5, Teacher Guide)
- Lesson 12, Synthesize, Step 7: "Self-Reflection: In this assessment moment for Learning Goal 12 look for evidence that students can provide explanations for how the comparison tool will help us compare and choose future water solutions. Be sure to encourage students to share where their ideas came from. If you notice students struggling to rationalize their ideas, ask students to point out examples from Solutions for Drinking Saltwater or EPA Water Conservation Poster. See the Assessment Guidance table at the beginning of this lesson for details." (Lesson 12, Teacher Guide)

Coherent three-dimensional assessment system rationale is clearly described.

- 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" (5.3 Lesson Assessment System Overview (ES))
- Draft Elementary Teacher Handbook, Assessment: "All OpenSciEd elementary curriculum units have assessment opportunities woven throughout the lessons to support teachers in being responsive to students' ideas and to support students in building their science understandings. There are four main assessment opportunities in OpenSciEd elementary units: (1) formative assessment (including pre-assessment); (2) summative assessment; (3) self-assessment; and (4) peer assessment." (Teacher Handbook, Draft Elementary Teacher Handbook)

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 with their understanding of disciplinary core ideas and crosscutting concepts and receive feedback. These pieces of evidence support the rating because the materials provide students with multiple opportunities to demonstrate their growing proficiency toward the end of unit targeted learning objective. Students engage in multiple performances, with each as an opportunity for them to use various SEPs to demonstrate learning in DCIs ESS2.A-E1, ESS3.C-E1, and ETS1.C-E1, and showcase sense-making using CE-E1 throughout the unit. Students receive multi-modal feedback from their teacher and peers that supports their learning process. Students have opportunities to use their feedback to construct new learning and improve their performance in preparation for the final assessment opportunity.

Multiple, interconnected opportunities over time

- Lesson 3, Lesson Assessment Guidance: "This is a formative assessment opportunity for you to check in with students' understanding of the effect of a dam on the Elwha River had on the salmon population, and sediment in the Elwha River." (Lesson 3, Teacher Guide)
- Lesson 3, Explore Section, Slide B: "How can we use the materials we have to create an Elwha River System model to observe the impact the dams had on the sediment and water in the Elwha River?" (Lesson 3, Slides)
- Lesson 6, Synthesize Section, Slide I: "Then arrange these cards to: Create a model to explain the effects of the Elwha River dams on the Elwha River system" (Lesson 6, Slides)
- Lesson 7, Lesson Assessment Guidance: "This assessment is a formal opportunity to gather summative individual information about your students' progress. Students have had multiple opportunities in this unit to explore the impacts that [the] dams on the Elwha River have had on the spheres of the Earth, so the Creating a Lobster Fishing Port can be used as a summative assessment opportunity to gain an understanding of student understanding of the interactions between the spheres and the ways that human decisions can impact those interactions." (Lesson 7, Teacher Guide)
- Lesson 7, Explore Section, Step 3: "In pairs, create a system model for one of the human decisions we observed. Display slide E and tell students that they will now work in pairs on Impact of Human Decisions to choose one of the human decisions that they observed and create a system model showing the impact that decision had on the spheres and their interactions." (Lesson 7, Teacher Guide)
- Lesson 13, Explore Section, Step 3: "Develop a model to explain the solution to our problem. Suggest to students that we could use a model to help others understand why their chosen solution tested best. Ask students to consider what might be useful for us to include in our models to help show why it's best, especially to their peers who have been researching a different problem." (Lesson 13, Teacher Guide)
- Lesson 13, Lesson Assessment Guidance: "This is a key formative assessment opportunity where you can take stock in the students' progress in developing models and engineering solutions to problems. You can support the development of students' models by calling back to the models of their problems that they created in Lesson 11. See Instructional Guidance for Lesson 13, for additional guidance." (Lesson 13, Teacher Guide)

Lesson 3, Learning Goal 3: "**Develop a model to explain the effects a dam can have on the interactions between certain parts of the Elwha River system (like sediment, and salmon).**"

- Students create a **model to explain** how the dam **affected interactions between the salmon and the sediment, blocked salmon from accessing all parts of the river, and how the sediment and logs provide a place for salmon to lay eggs and rest. (interaction)**

Lesson 7, Learning Goal 7: "**Develop a model** that describes the ways that a human decision can **impact the spheres of the Earth** and the **interactions between them.**"

- Students create a **model that describes** multiple relevant **interactions** between all 4 of the **Earth's spheres**.
- Students choose a person to agree with and explain why the **interactions** between 4 of **the Earth's spheres** that they **modeled** support their choice.

Lesson 13, Learning Goal 13.A: **"Develop a model that explains** how a solution will **cause** a problem related to the **human use of Earth's freshwater to improve.**"

- Students create a model to explain **representations of connections** between the **human activity** in the location and the water related problem it is **causing** and between the **chosen solution** and **improvement** of the problem.

Multi-modal feedback loops

- Lesson 5, Synthesize Section, Step 6, Update our Model, Assessment Opportunity callout: "Use the Lesson Assessment Guidance at the beginning of the lesson to provide written and/or oral feedback to students." (Lesson 5, Teacher Guide).
- Lesson 6, Synthesize Section, Step 5: "Show slide K and give students the opportunity to share the feedback they received as 'stayers' during the *Two Stay-Two Stray* protocol. Have students use this feedback to revise their explanations by either re-arranging or adding additional Explanation Interaction Cards. Students should use the two discussion prompts on the board to guide their revisions." (Lesson 6, 5.3 Lesson 6 Teacher Guide).
- Lesson 7, Navigate Section, Step 1: "Class discuss what we figured out about the way the dams on the Elwha River impacted the Earth's spheres. Display slide A and remind students that in our last lesson we were using our Elwha River System Model to think through the impacts that the dams on the Elwha River had on the Earth's spheres and the interactions between them." (Lesson 7, Teacher Guide)
- Lesson 8, Synthesize Section, Step 6, Revise our Model to Explain, Assessment Opportunity callout: "Formative assessment: This is the formative assessment opportunity for Learning Goal 8. Look for students using evidence they gathered from the interviews and cards to identify the components and interactions in the Elwha River system that could benefit from the removal of the dam as well as other restoration activities. Collect student handouts and use the guidance at the beginning of the lesson to provide students with written feedback and/or oral feedback before they engage in this practice again in lesson 11." (Lesson 8, Teacher Guide).
- Lesson 11, Lesson Assessment Guidance: "Use this formative assessment opportunity to see if students need more support in understanding how the human activity of overusing water is causing a problem at their specific location. Students will be using criteria and constraints to choose the best solution for this problem in later lessons, so having a clear understanding of what the problem is will be critical. As students are creating their models with partners, circulate the room and check on their progress. If students are having a hard time creating their model, guide them through the text describing their problem on the website and/or the answers to the questions they recorded on

the Model Your Problem handout. Additionally, as you are creating the Class Consensus Model of the core water problem, reinforce/review any ideas that you noticed students were not understanding when they were creating their individual models." (Lesson 11, Teacher Guide).

- Lesson 13, Explore Section, Step 3: Cause and Effect Callout "Cause and Effect: As students consider how human activity is contributing to the problem and how the solution solves the problem, they are engaging with cause and effect relationships. Look for evidence on their model that indicates they are considering causal relationships." (Lesson 13, Teacher Guide)

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