Understanding White Sharks
EQuIP Rubric for Science Evaluation

Unit Name: Understanding White Sharks
Grade: 8
Date of Review: February 2019
Overall Rating (N, R, E/I, E): E
Category I: NGSS 3D Design Score (0, 1, 2, 3): 2
Category II: NGSS Instructional Supports Score (0, 1, 2, 3): 3
Category III: Monitoring NGSS Student Progress Score (0, 1, 2, 3): 3
Total Score (0–9): 8
Click here to see scoring guidelines

This review was conducted by the Science Peer Review Panel using the EQuIP Rubric for Science.

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

Summary Comments

Thank you for your commitment to students and their science education, evident by the quality of this unit. Reviewers were impressed with the overall unit connections made between the Disciplinary Core Ideas so seamlessly. Reviewers appreciated the thoughtful articles and resources provided and the strong teacher suggestions to not include different articles or videos without careful consideration. The structure of this learning sequence is very helpful for teachers, with the storyline and learning sequence overview document as well as the teacher notes before and within each lesson. The lessons are generally very engaging and are made relevant for students. The lessons integrate the three dimensions well and work to effectively elicit student ideas. As a result, this unit will be featured on the nextgenscience.org website as a resource for teachers and schools throughout the country.

This unit is specifically designed to be taught at the end of the instructional sequence in California, so teachers from other states who are interested in using this unit will need to be mindful about providing extra scaffolds to develop Science and Engineering Practices (SEPs) depending on their students' experience with the practices. For example, instead of assuming that students will be completely at grade

level for SEPs, it could be helpful to remind teachers that scaffolds may need to be provided when first using an SEP in the unit and gradually removed as the unit progresses.

Note:

- In the feedback below, black text is used for either neutral comments or evidence the criterion was met and purple text is used as evidence that the criterion was not met.
- Adjustments in the layout of the materials have led to minor changes in page numbers, handout titles, and step numbers. This alignment document highlights where those updated information should be in the EQuIP report.

I.A. Explaining Phenomena/Designing Solutions: Making sense of phenomena and/or designing solutions to a problem drive student learning.

i. Student questions and prior experiences related to the phenomenon or problem motivate sense-making and/or problem solving.
ii. The focus of the lesson is to support students in making sense of phenomena and/or designing solutions to problems.
iii. When engineering is a learning focus, it is integrated with developing disciplinary core ideas from physical, life, and/or earth and space sciences.

Rating for Criterion I.A Explaining Phenomena/Designing Solutions: Extensive

The reviewers found extensive evidence that learning is driven by students making sense of phenomena and/or designing solutions to a problem because investigative phenomena throughout the unit work together to help students construct a full explanation of the anchor phenomenon.

The unit materials are organized so that making sense of the idea that the public has a perception of increasing shark attacks drives student learning. All student learning across the three dimensions targeted by the unit is in the service of students figuring out everything they need to understand what is going on with shark populations so they can create a Public Service Announcement (PSA) to inform the public. Each lesson uncovers pieces of the science ideas required to explain the increase in shark sighting to help the public understand this issue and lessen the misunderstanding and/or panic. The DCI elements that are developed by students are both driven by questions about the anchor and investigative phenomena and are in service of figuring out the anchor phenomenon. Student knowledge is built through making sense of phenomenon. The investigative phenomena are carefully and purposefully selected to guide students in making-sense of the anchor phenomenon while building knowledge of the DCIs and CCCs and engaging in the SEPs. Materials provide structured support for teachers to draw out students' prior experiences regarding shark sightings and attacks, as well as questions from students, and use them to motivate student learning.

The "Learning Sequence Big Idea" chart provides guidance to the user of this resource on what big ideas related to the DCIs students should figure out with each phenomenon, and how they relate back to the anchor phenomenon.

In Lesson 8.1, students interact with an article and short video about recent shark sightings and then

discuss and share personal ideas and experiences. Students decide they need more information to have a reliable explanation, so they collect evidence from other sources and look for patterns. They create an initial explanation using these resources and then use their explanation to identify what information they still need to figure out.

Investigative phenomena throughout the unit work together to help students construct a full explanation of the anchor phenomenon. Examples of this include:

In Lesson 8.2, students explore fossilized shark teeth in attempt to find historical data on shark populations in order to determine if there are actually more sharks today then there were in the past. Students identify the limitations of using fossil data for this purpose, and still wonder what data can be used to answer this question about comparative population sizes.

In Lesson 8.4, students explore this more reliable method of collecting data on shark population size but are left to wonder if REMUS impacts white shark behavior.

In Lesson 8.5, students use this investigative phenomenon to learn both about the senses that white sharks rely on, how the REMUS creates electric and/or magnetic fields, and how white sharks detect these fields.

Each subsequent lesson helps students uncover a piece of a science idea and allows students to realize they have more questions that need to be answered. This culminates in Lesson 8.10 where students are educating the public about why the shark populations recovered, and that the sharks that are close are usually the age that eat fish and are not a threat to humans.

Suggestions for Improvement
N/A

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

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

Rating for Criterion I.B. Three Dimensions: Adequate

The reviewers found adequate evidence that the materials give students opportunities to build understanding of grade-appropriate elements of the three dimensions because each lesson engages students, purposefully, at the element level of the three dimensions to develop deep understanding of the anchor phenomenon.

Science and Engineering Practices (SEPs): Adequate

The reviewers found adequate evidence that students have the opportunity to use or develop the SEPs in this unit because students are purposefully engaged in sufficient SEP elements in order to make sense of phenomena throughout the unit. The elements students engage in are purposefully selected and used by students to engage with science content and construct deep understanding.

It is mentioned in the Unit Overview document that "As this is at the end of middle school, students should also bring a full breadth of understanding of the 6–8 grade band progressions for the Science and Engineering Practices (SEPs) and Crosscutting Concepts (CCCs)." and "As this is the end of middle school, students should be at middle school level proficiency for SEPs and CCCs, although this sequence will reinforce a few." This unit does a great job of engaging students in using grade-appropriate elements of the SEPs, but an extensive rating requires that not only are students using the SEPs, but there are also multiple specific SEP elements that students are developing

While it is mentioned that SEPs should already be developed by now, reviewers did see evidence of specific development of one element of **Constructing Explanations and Designing Solutions** as students work to find evidence to support a claim, determine quality of the evidence, revise the evidence and determine what other evidence is necessary to support their explanation throughout the entire learning sequence. Students also "*apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion*" (**Constructing Explanations and Designing Solutions**) several times throughout the storyline, showing increased sophistication in the element as students gain more data and evidence. In Lesson 8.1, students first build their Shark Encounter Claim Chart and code the strength of evidence based on how appropriate it is and how sufficient it is, and code reasoning based on adequacy. Students build more in Lesson 8.2 when they work on their Shark Encounter Claim Chart and identify information needed to strengthen the explanation. In Lesson 8.5, students explain how white sharks detect electromagnetic fields adding to their explanation again. Finally, students engage in this element in depth in Lesson 8.9 when they create a final explanation of the anchor phenomenon, using evidence gathered throughout the storyline.

An example of students using (not developing) SEP elements is that when students participate in a jigsaw activity to learn more about shark fossils in Lesson 8.2, they are "*critically reading scientific texts to determine the central ideas and obtain scientific information to describe patterns in evidence about the natural world"* (**Obtaining, Evaluating, and Communicating Information**).

However, for a unit of this size, additional specific SEP elements would need to be *developed* in student sense-making to move this criterion to Extensive. Reviewers found that use of the SEPs in the unit was somewhat formulaic, and based on the length of this unit, more development and varied use of the practices in students' learning throughout would be required for a rating of Extensive.

Disciplinary Core Ideas (DCIs): Extensive

The reviewers found extensive evidence that students have the opportunity to use or develop the DCIs in this unit. This storyline is a strong example of how DCI elements from Life Science, Physical Science, and Earth Science can be woven together in a logical and coherent way.

The creation of lesson-level performance expectations at the beginning of each section of a lesson clearly outline the element of each dimension being used by students in the upcoming activity. All elements are at the appropriate grade band except in Lesson 8.6 (page 1), where an element of the DCI is going past the appropriate grade level, and the unit explains the purpose and intent of this difference.

Examples of students building on their prior DCI learning include Lesson 8.2, when students revisit DCI elements that are assumed to be addressed earlier in the year. The authors of the unit explain that reintroduction of this DCI helps to solidify student understanding by applying it to this new context. When students explore fossils of shark teeth and the geologic time scale they are revisiting the understandings of **LS4.A**, "*the collection of fossils and their placement in chronological order is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth*," and of **ESS1.C**, "*the geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale*."

In Lesson 8.3, students address the **ESS3.C** element, "*typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise*" when they use fishery logs and graphs of data from fisher logs to begin to identify how human activities impact white shark populations. This ESS3.C element is revisited in Lesson 8.9 when students explore human impact on white sharks and legislation that protects fisheries and allows for the recovery of the white shark population in order to make the final explanation of the anchor phenomenon.

In Lesson 8.4, students begin to build the understanding of **PS4.C** element, "*digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information*" when they ask questions about the REMUS shark cam and how it helps scientists understand white shark populations by transmitting information. Student revisit and build strong understanding of this element in Lesson 8.7 when they explore the benefits and limitations of sending information through binary code and analog signals.

Crosscutting Concepts (CCCs): Adequate

The reviewers found adequate evidence that students have the opportunity to use or develop the CCCs in this unit because students are engaged in grade-appropriate CCCs for an appropriate amount of time during the unit progression.

An extensive rating requires that not only are CCCs being used, but there are also multiple specific CCC elements that are developed. While the reviewers recognize there are specific activities and routines the authors use that require students to focus on CCCs (specifically student use of H4a–g), it is mentioned in

the Unit Overview, "As this is at the end of middle school, students should also bring a full breadth of understanding of the 6–8 grade band progressions for the Science and Engineering Practices (SEPs) and Crosscutting Concepts (CCCs)." and "As this is the end of middle school, students should be at middle school level proficiency for SEPs and CCCs, although this sequence will reinforce a few."

Reviewers found evidence of students independently demonstrating knowledge of CCCs in several different lessons by using on-target elements from the Handout H4a–g (Crosscutting Concepts for Middle School Students). However, students are referring to this tool so often in order to use the lens of the CCC that it is unclear to reviewers how students are developing and using their understanding of the CCC when they are always using these questions to guide them.

In Lesson 8.8 (page 13), students are given questions to analyze for patterns and what predictions can be made from these patterns for a cause and effect relationship, which is a grade level appropriate element of the CCC of **Patterns**.

There is a strong line of **Cause and Effect** elements throughout the storyline, often coupled with elements of **Patterns**. In Lesson 8.1, when students begin the development of their White Shark encounters chart, they are beginning to explore the **Cause and Effect** element, *some phenomena may have more than one cause*. In Lesson 8.3, when students explore fishery logs and participate in literature circles, the "Cause and Effect Analyst" and eventually all students, use role cards to "analyze information for cause and effect relationships, and specifically the relationship between cause and correlation." This is building the element *Classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation*. Through literature circles, students also being to explore how *cause and effect relationships may be used to predict phenomena in natural or designed systems*. Students continue to use this **Cause and Effect** element in Lessons 8.5, 8.6, 8.7, and 8.8 by referring to the H4a–g CCC resource and asking questions from the "on-target" column. Students use this technique in 8.5 when they ask questions about how a white shark senses REMUS, and in 8.8 when they predict the behavior of light.

<u>Suggestions for Improvement</u>

SEPs

Even though this is at the end of the instructional sequence in California, these resources could be developed to be useful to teachers anywhere.

It was a bit confusing to see an element of the SEPs called out at the end of a portion of the 5E cycle in a lesson as it was unclear whether that was in the activity that just completed or in the next portion of the cycle. It might be helpful to highlight elements of the SEP in the lesson by highlighting the number or text in the activity to make it clearer to teachers where to make explicit connections in their instruction.

DCIs

N/A

CCCs

Even though this is at the end of the instructional sequence in California, these resources could be developed to be useful to teachers anywhere. For example, instead of relying on students being completely at grade level for CCCs, scaffolds could be provided when first using a CCC in the unit and gradually removed as the unit progresses. If a teacher knows their students have already developed these, they could choose not to use the scaffolds. It's easier for individual teachers to omit parts of a lesson than it is to develop pieces that are not there.

It was a bit confusing to see an element of the CCCs called out at the end of a portion of the 5E cycle in a lesson as it was unclear whether that was in the activity that just completed or the next portion of the cycle. It might be helpful if to highlight elements of the CCC in the lesson by highlighting the number or text in the activity to make it clearer to teachers where to make explicit connections in their instruction.

I.C. Integrating the Three Dimensions: Student sense-making of phenomena and/or designing of solutions requires student performances that integrate elements of the SEPs, CCCs, and DCIs.

Rating for Criterion I.C. Integrating the Three Dimensions: Extensive

The reviewers found extensive evidence that student performances integrate elements of the three dimensions in service of figuring out phenomena and/or designing solutions to problems because each lesson provides multiple opportunities for students to use grade-appropriate elements of the three dimensions to make sense of the unit phenomenon.

The grade-appropriate elements of the three dimensions are purposefully integrated throughout the storyline to help students make sense of phenomena. Examples of this are:

- In Lesson 8.3 (page 8), students generate questions (SEP), at least one of which is about a possible pattern (CCC) as it relates to **ESS3.C** (DCI).
- Students construct an initial explanation for how the white shark detects electric or magnetic fields, causing the shark to sense REMUS.
- Students carry out an investigation to determine the effect of electrical currents to produce magnetic fields.
- Students communicating their argument while citing evidence of the cause and effect that magnetic fields produced from the electrical currents from REMUS have on white sharks.

Suggestions for Improvement

N/A

I.D. Unit Coherence: Lessons fit together to target a set of performance expectations.

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

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

Rating for Criterion I.D. Unit Coherence: Adequate

The reviewers found adequate evidence that lessons fit together coherently to target a set of performance expectations because each lesson is purposefully planned to build on previous learning.

There is a daily routine built in that allows students to publicly chart and keep track of their constructed sense-making (C1 is used at the start of each lesson to revisit what they learned previously and at the end to record the new information/evidence they learned).

The Storyline Links in each lesson help make connections from previous learning to lesson level learning expectations, and where the current lesson connects to the next lesson.

Lesson 8.1 suggests charting the questions, but there is no reference back to these student questions throughout the storyline. In Lesson 8.2 there is a chart that is created for keeping questions, but it is unclear what happens to this chart as it is not mentioned again in the unit. Prior to each lesson in "Materials to get ready," it says to make sure C1 is visible, but not the questions.

Suggestions for Improvement

In Lesson 8.1 Part 3c (page 8), there is a conversation where students should be generating questions, including mention of four important ones. Instead of giving teacher prompts to help students come up with these questions, the materials direct the teacher to "specifically ask and chart the following if students don't generate these questions." Developers should consider providing guidance for teachers on how student questions can be displayed and used as a bridge between portions of the storyline. Having a permanent and public place to keep track of students' own questions is a powerful way to help create a culture where every student is part of the figuring out and to show all student ideas are honored and important. A suggested resource to consider: Questions and Classroom Routines

I.E. Multiple Science Domains: When appropriate, links are made across the science domains of life science, physical science and Earth and space science.

i. Disciplinary core ideas from different disciplines are used together to explain phenomena.
ii. The usefulness of crosscutting concepts to make sense of phenomena or design solutions to problems across science domains is highlighted.

Rating for Criterion I.E. Multiple Science Domains: Extensive

The reviewers found extensive evidence that links are made across the science domains when appropriate because the storyline builds and reinforces deep understanding of related DCIs in life science, physical science, and earth science. For example:

- In Lesson 8.2, students use their knowledge of **LS4.A** and apply knowledge of fossils to uncover a truth about fossils—that they are not always the best source of evidence—which leads students to consider what type of data they now need to gather.
- In Lesson 8.3, students address **ESS3.C** to consider the historical treatment of sharks and how their decline was a product of human impacts/unregulated fishing practices.
- In Lesson 8.4, students apply their understanding of **LS4.C** (adaptations and senses) as they also build toward **PS4.C** to understand that wave pulses of a digital signal are a more reliable way to send information, as they study REMUS.

Suggestions for Improvement

Purposeful reflection for students on how the CCC elements connect these domains of science would build a deeper understanding of the value of using CCCs to investigate phenomena.

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

Rating for Criterion I.F. Math and ELA: Extensive

The reviewers found extensive evidence that the materials provide grade-appropriate connections to the Common Core State Standards (CCSS) in mathematics, English language arts (ELA), history, social studies, or technical standards because all lessons are purposefully tied to engage students in activities that support sense-making utilizing a variety of media, and students are expected to read, write, and communicate for different purposes.

- Grade-appropriate CCSS in mathematics and ELA standards are purposefully incorporated into lessons with teacher support to help students make these connections.
- Reading materials go beyond textbooks and include news articles, journal articles, infographics, and websites of scientific entities.
- Students have multiple opportunities for high level verbal discourse in a variety of formats and scenarios (partners, small group, formal presentations, and technology-enhanced).
- Common Core standards are listed in the materials at the beginning of each lesson (for example,

Lesson 8.1, page 2; Lesson 8.2, page 3).

- Common Core State Standards connections along with scaffolds recommended for students can be found in Lesson 8.9 (page 13).
- Strategies from ELA (literature circles and reading roles) are "borrowed" as strategies to help students uncover meaning from complex texts (Lesson 8.3).

Suggestions for Improvement

N/A

Overall Category I Score (0, 1, 2, 3): **2**

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

Category II. NGSS Instructional Supports

Score: 3

II.A. Relevance and Authenticity: Engages students in authentic and meaningful scenarios that reflect the practice of science and engineering as experienced in the real world.

i. Students experience phenomena or design problems as directly as possible (firsthand or through media representations).
ii. Includes suggestions for how to connect instruction to the students' home, neighborhood, community and/or culture as appropriate.
iii. Provides opportunities for students to connect their explanation of a phenomenon and/or their design solution to a problem to questions from their own experience.

Rating for Criterion II.A. Relevance and Authenticity: Extensive

The reviewers found extensive evidence that the materials engage students in authentic and meaningful scenarios that reflect the real world because students are engaged with the phenomenon as directly as possible to generate compelling lines of student inquiry that come from their experiences.

- The opening lesson when students interact with the anchor phenomenon is structured in a way that lifts up students' own experience to connect to this phenomenon. Their own background knowledge is acknowledged and used to guide more learning.
- In Lesson 8.1, students engage with an article and a video then share their personal connections and ideas (page 8) about sharks.
- If this is not a phenomenon that is close to their students, in Lesson 8.9 teachers are encouraged to "Consider also finding recent news articles for your area that report on similar information..." (page 7).
- In Lesson 8.7 (page 4), connections are made to students' everyday lives while discussing wireless technology applications.

Suggestions for Improvement

Reviewers appreciated the video links to find videos to engage students who may not be close to this phenomenon. This unit is written for California schools, but it is recommended that the authors also include other resources to support implementation of this lesson in other parts of the country.

II.B. Student Ideas: Provides opportunities for students to express, clarify, justify, interpret, and represent their ideas and respond to peer and teacher feedback orally and/or in written form as appropriate.

Rating for Criterion II.B. Student Ideas: Adequate

The reviewers found adequate evidence that the materials provide students with opportunities to both share their ideas and thinking and respond to feedback on their ideas because feedback loops are well developed throughout the lessons to help students improve their understanding throughout the unit.

Student artifacts include elaborations (which may be written, oral, pictorial, kinesthetic, and modeling) of reasoning behind their answers, and show how students' reflective thinking has changed over time. The lessons provide supports to teachers for eliciting student ideas, and the teacher/students are engaged in multiple modalities of feedback: written/oral feedback from teacher and peers. Students are provided opportunities to then utilize their feedback to construct new learning. Finally, students all have a point of entry and have opportunities to revise their thinking. Students can compare various explanations and, using CCCs and SEPs, determine which solution is most accurate.

Throughout the lessons, and in teacher notes embedded in the lessons, there are suggestions for how teachers might help elicit student ideas. For example, in Lesson 8.6 (pages 6–7) as students are asked to model how sound travels, suggestions are given to teachers to elicit ideas and for what kind of phrases could help get students to include necessary components if the teachers are not seeing them. As a student, there is also an opportunity to see other models and compare and revise their own.

In Lesson 8.6, students provide peer feedback on team consensus models using color-coded sticky notes to ask for clarification of ideas, build on ideas, and agree with or praise ideas. In Lesson 8.3, students are provided the opportunity to discuss their feedback with peers and refine their work based on teacher feedback.

The focus of the unit is making sense of the anchor phenomenon, and even the final assessment seems to be the PSA created explaining the anchor. Students are not presented with the opportunity to expand their complete understanding to new phenomena outside of this scope.

Suggestions for Improvement

If this is completed in the California sequence, then students are expanding on areas from other learning. However, this will be posted to be used in areas around the nation, so this may be an introduction to the learning in other areas.

The unit could be improved by providing scaffolds to help students support others through discourse.

Authors could build toward an extensive rating by providing students with the opportunity to demonstrate their proficiency in all three dimensions through a transferable task making sense of a similar, but different phenomenon.

II.C. Building Progressions: Identifies and builds on students' prior learning in all three dimensions, including providing the following support to teachers:

i. Explicitly identifying prior student learning expected for all three dimensions
ii. Clearly explaining how the prior learning will be built upon.

Rating for Criterion II.C. Building Progressions: Adequate

The reviewers found adequate evidence that the materials identify and build on students' prior learning in all three dimensions because materials make clear the expected level of proficiency students should have with all three dimensions for the core learning in the unit.

- The developers state that the unit is at the end of the Grade 8 year and cites all grade level proficiency understanding should be present. Suggestions for instruction if students are lacking the needed learning are provided in teacher notes boxes within the lessons.
- In Lesson 8.1 (page 3), "As this is the end of the middle school, students should also bring a full breadth of understanding of the 6–8 grade band progressions for the SEPs and CCCs."
- Teacher notes are given in boxes in lessons to provide support for lacking or scaffolding SEP skills (for example, Lesson 8.3, page 7).
- The Narrative and Introduction provides "Learning Sequence Usage and Progressions for each Dimension." In this resource, the authors of the unit outline what knowledge is being built and what knowledge is being used by students related to each dimension for each lesson in the unit and break down the SEP and CCC components.

Suggestions for Improvement

Developers should consider providing suggestions for adaptation if students are already above the proficiency level of the performance expectations.

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

Rating for Criterion II.D. Scientific Accuracy: Extensive

The reviewers found extensive evidence that the materials use scientifically accurate and grade appropriate scientific information because all science ideas included in the materials are accurate and there is strong support for teachers to clarify potential alternate conceptions that they (or their students) may have.

- The materials include suggestions for discussion prompts, etc., for when students have alternate conceptions.
- References are cited to ensure accurate information is shared (Lesson 8.2, page 21).
- In Lesson 8.8, steps 7a and 7b address what to do if students are not considering how certain components are actually interacting when they are creating an explanatory model (page 6).
- In Lesson 8.6, pages 5 and 6 have teacher note boxes that address what to do if students are not including certain components in their models, and there are also discussion prompts to help the

teacher get students to pull out the important ideas during discussion before creating their model.

- Teacher notes in Lesson 8.8 help give teachers the additional accurate and grade appropriate science background knowledge (page 11).

Suggestions for Improvement

N/A

II.E. Differentiated Instruction: Provides guidance for teachers to support differentiated instruction by including:

i. Appropriate reading, writing, listening, and/or speaking alternatives (e.g., translations, picture support, graphic organizers, etc.) for students who are English language learners, have special needs, or read well below the grade level.
ii. Extra support (e.g., phenomena, representations, tasks) for students who are struggling to meet the targeted expectations.
iii. Extensions for students with high interest or who have already met the performance expectations to develop deeper understanding of the practices, disciplinary core ideas, and crosscutting concepts.

Rating for Criterion II.E. Differentiated Instruction: Adequate

The reviewers found adequate evidence that the materials provide guidance for teachers to support differentiated instruction because extra supports, including access to phenomena and opportunities to represent thinking through a variety of modalities, are evident throughout the unit to support sense-making for all students.

The unit materials include supports to differentiate for several different groups of students including English language learners (ELs), struggling students, students below reading level, and high-interest students that have already met the performance expectations. There are also extra supports in the form of multiple/alternate modalities provided for students who are struggling to meet performance expectations.

Generic accommodations, including suggestions to skim an article before reading for key vocabulary, working in groups, using sense-making science notebooks, using sentence frames, and watching videos multiple times are included at the end of each lesson in the unit. The general accommodations sections give supports for low literacy and language learners in reading, speaking, listening (Lesson 8.7, page 14) and writing (Lesson 8.2, page 21).

In Lesson 8.3, “Teacher Note: Roles can be differentiated based on students’ interests and abilities. Cause and Effect Analyst and Pattern Pro are roles that all students should feel comfortable with and be able to contribute to the group. Legislative Analyst is a role that takes a more critical eye and someone that can understand how and why government plays a part. The most challenging role is that of the Nature of Science Guru because of its asks the student to be well versed in both the science and a big picture of what we do and why” (page 10).

Specific accommodations are also included to meet the needs of various student groups:

- For students struggling with the modeling process, suggest they add a story of what is happening to accompany the work they are able to do (like a narrative). If able, encourage them to use this story to inspire ideas of things they can add to the model and vice versa (Lesson 8.8). This lesson also suggests, "Instead of showing students R1 (Tweet from the CSULB Shark Lab) and discussing the implications of using a target for size comparisons, this section could also be used to challenge students, especially the more motivated or engaged, to come up with their own way to determine an accurate length of a white shark before introducing them to the solution that others came up with. Once students have determined a solution, they could compare the two to determine which idea would provide the most accurate estimation of length and what the limitation of each solution might be to help the public be aware of the size of sharks in the water" (page 12).
- The recommendation that ELs write about topics in their notebooks before discussion in order to support speaking tasks and teacher guidance on which word wall words are best for struggling and advanced students is suggested in Lesson 8.7.
- Lesson 8.1 suggests sentence frames for low literacy and second language learners and the use of graphic organizers to help struggling students manage notebook work" (page 18). This lesson also suggests various, more challenging investigation topics for highly engaged students.
- There are few instances where differentiation is provided for students who have already met PEs and may be able to develop a deeper understanding of the SEPs, DCIs, and CCCs. In Lesson 8.5, "If a student in the room already knows how to do this, allow this student to introduce the idea. If possible, have these materials at each team so each may build the circuit" (page 11).

Suggestions for Improvement

Developers may want to consider providing more detailed differentiation strategies for ELs using the most current research: *English Learners in STEM Subjects*.

To move to extensive, developers should consider providing guidance on how student understanding is determined at the point in the lesson where differentiation supports are embedded and add how these suggested supports will help students demonstrate progress towards understanding the Performance Expectations.

It could also be helpful to provide additional supports for students who have already met the PEs, to allow them to further extend their understanding in one or more of the three dimensions.

II.F. Teacher Support for Unit Coherence: Supports teachers in facilitating coherent student learning experiences over time by:

i. Providing strategies for linking student engagement across lessons (e.g. cultivating new student questions at the end of a lesson in a way that leads to future lessons, helping students connect related problems and phenomena across lessons, etc.).
ii. Providing strategies for ensuring student sensemaking and/or problem-solving is linked to learning in all three dimensions.

Rating for Criterion II.F. Teacher Support for Unit Coherence: Adequate

The reviewers found adequate evidence that the materials support teachers in facilitating coherent student learning experiences over time because all students are engaged with phenomena that are meaningful and relevant, and supports are provided for all students through the application of targeted grade-appropriate SEPs, CCCs, and DCIs as the central component of learning.

- Connections are explicitly made from the previous lesson to the current lesson and then to the next lesson in all lessons' front matter. Additionally, strategies are given to teachers to help facilitate learning in the classroom without "giving answers."
- In Lesson 8.2 (pages 9–12), the jigsaw strategy is explained for teachers unfamiliar with this activity. In Lesson 8.9 (pages 20–21), the I^2 strategy is explained with examples to help teachers facilitate the learning with their students. There are routines built in such as returning to the explanation chart and using science notebooks that focus on constructing knowledge over time.
- One teacher note box gives the warning, "Throughout the entire learning sequence, articles, videos, and websites have been carefully chosen so as not to 'tell' information students will later discover so that students can develop ideas over time. The engage, especially, is designed to have references that provide incomplete information so students can better engage in SEPs and CCCs. If other references are preferred, it is recommended that the teacher review the entire learning sequence to get a sense of what students will be making sense of over time before replacing."

Suggestions for Improvement

It may be helpful to provide more information for teachers on how student questioning can be harnessed to drive learning. Sometimes it seems like students ask questions, but then the teacher tells them what they will be doing next or what question they will be answering. Sample student questions and strategies for how to relate student questions to next steps may help guide teachers.

Developers should consider adding supports for teachers in developing aspects of the SEPs.

II.G. Scaffolded differentiation over time: Provides supports to help students engage in the practices as needed and gradually adjusts supports over time so that students are increasingly responsible for making sense of phenomena and/or designing solutions to problems.

Rating for Criterion II.G. Scaffolded Differentiation Over Time: Adequate

The reviewers found adequate evidence that the materials support teachers in helping students engage

in the practices as needed and gradually adjust supports over time because students are expected to already be at grade level for all SEPs and CCCs so there isn't expected differentiation over time. With a few small exceptions, students are engaging in the SEPs only in service of learning the DCIs.

- Each SEP is being used at more or less the same level of student independence throughout the learning sequence.
- While accommodations are included at the end of each lesson, they are broad, and do not show specifics on how students with diverse needs can be supported throughout the unit. Since this is a unit designed for 8th graders at the end of the year, the authors make the claim that many of the elements of the SEPs have already been developed and are being used here to make sense of the phenomena and gain understanding of the DCIs.
- In Lesson 8.6 (page 6), students are asked to draw a quick model. The class discusses features needed and then engage in a peer feedback session on their model. A teacher note is given to help students work through the important features, ideas for facilitating a discussion on common symbols as a class and then release students to create independent models. In Lesson 8.8 (page 6), students are just told to build a model, without teacher scaffolds as in Lesson 8.6.
- Asking questions appears in almost all the lessons, but in 8.1, the teacher provides guidance on refining questions. By Lesson 8.9, students independently ask questions to identify and clarify evidence as the premise of an argument
- In the final lesson, scaffolds are suggested for the CER explanation, but these are not given anytime earlier in the unit.

Suggestions for Improvement

The developers may consider including scaffolds to writing explanations earlier in the unit and then expecting students to refine them in the final lesson.

Developers may want to consider how the CCC resource is used by students and teachers to build understanding over time. It is recommended that there be guidance for teachers in how to use this resource to support students with varying abilities.

Even though this is at the end of the instructional sequence in California, these resources could be developed to be useful to teachers anywhere. Instead of relying on students being completely at grade level for SEPs, the unit could provide scaffolds when first using an SEP and gradually remove these as the unit progresses. If a teacher already knows their students have developed these SEPs, they could choose not to use the scaffolds. It is easier for individual teachers to omit parts of a lesson than it is to develop pieces that are not there.

Overall Category II Score (0, 1, 2, 3): 3

Unit Scoring Guide – Category II
Criteria A-G:
3: At least adequate evidence for all criteria in the category; extensive evidence for at least two criteria
2: Some evidence for all criteria in the category and adequate evidence for at least five criteria, including A
1: Adequate evidence for at least three criteria in the category
0: Adequate evidence for no more than two criteria in the category

Category III. Monitoring NGSS Student Progress

Score: 3

III.A. Monitoring 3D student performances: Elicits direct, observable evidence of three-dimensional learning; students are using practices with core ideas and crosscutting concepts to make sense of phenomena and/or to design solutions.

Rating for Criterion III.A. Monitoring 3D Student Performances: Extensive

The reviewers found extensive evidence that the materials elicit direct, observable evidence of students using practices with core ideas and crosscutting concepts to make sense of phenomena and/or design solutions because evidence of three-dimensional learning is visible throughout the unit.

Throughout the unit, students are constructing an explanation supported by evidence to engage in argument about the cause of recent increases in white shark encounters. To do this, they engage in other three-dimensional performances. For example, in Lesson 8.7 (page 7), students complete their exploration by *considering limitations of their data* (Analyzing and Interpreting Data) through the lens of Cause and Effect (CCC Category).

Opportunities for students to create evidence of three-dimensional learning exist:

- When students continuously add to, modify, and work on their shark encounter claim chart throughout the unit;
- when students develop initial and final models of their understanding in Lessons 8.6 and 8.8;
- when students explain the anchor phenomenon through the creation of a PSA in Lesson 8.10; and
- when students work as a team to write a CER in Lesson 8.9 to answer the question from the anchor phenomenon, “Are there really more shark encounters now than in the past?”.

Suggestions for Improvement

N/A

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

Rating for Criterion III.B. Formative: Adequate

The reviewers found adequate evidence that the materials embed formative assessment processes throughout that evaluate student learning and inform instruction because materials include explicit, frequent, and varied supports for formative assessment processes.

Ideas for formative feedback are given throughout the lesson and notated with small flag symbols; they are also found in the teacher note boxes throughout the lessons. These formative assessment opportunities are varied and address learning in all three dimensions. Some additional supports are given to teachers to help them change instruction in response to what students are showing they understand.

For example, in Lesson 8.2 (page 18), formative assessment flag notes, "Have a brief discussion with students to see what their thoughts are, if students reveal in the discussion that they aren't understanding this important point, adjust instruction." Another flag notes, "When students are finished, take time to read notebook responses and leave sticky note feedback. Return notebooks to students and ask them to review the feedback and, if helpful, to discuss questions they may have with their team. After discussing, ask students to consider the feedback and refine their work. Ask students to identify their revisions in some way so that you can check again to see their progress" (page 19).

On page 20, the teacher note states, "...Formative Feedback: using a method of "sticky note feedback" is a way to encourage students to modify thinking, given input from a teacher or peer. Feedback should be constructive to give students a "pulse" on their progress and can give direction where they are on target as well as how to improve. Using a sticky note (rather than writing directly on the student notebook page) sends a signal that the teacher or peer respects that the notebook work is the student sense-making space and belongs to the student."

In Lesson 8.3 (page 6), guidance is given to "use students responses as an opportunity to reinforce more accurate scientifically-aligned ideas that students share and use probing questions directed to the class to help students that may have confusion."

Often, where a formative assessment flag is noted, guidance will be "adjust instruction if students don't understand." There is little guidance on what to listen for in student responses to gauge whether students understand and there is often no guidance on how to adjust instruction.

Suggestions for Improvement

Consider providing more explicit guidance for teachers on what to look for and what to do in the case where more support is needed for students.

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

Rating for Criterion III.C. Scoring Guidance: Adequate

The reviewers found adequate evidence that the materials include aligned rubrics and scoring guidelines that help the teacher interpret student performance for all three dimensions because the activities that have scoring guidelines provided are good tools for assessing three-dimensional involvement by students. However, there are not many scoring guidelines for teachers to reference.

- The unit provides feedback "look fors" denoted in formative assessments and rubrics are given for the summative assessment task.
- Lesson 8.5 includes a four-point rubric with clear guidance regarding the specific learning targets to guide the scoring of written scientific arguments (page 32). Lesson 8.6 (page 17) also includes

a four-point rubric with clear guidance regarding the specific learning targets to score constructing explanations using a model that students develop.

- In Lesson 8.4 (page 5), expected student responses are given to help guide teachers' evaluation of student work. Teacher guidance on feedback and grading is given in Lesson 8.2 (page 19–20).
- In Lesson 8.10 (pages 19–20), all three dimensions of the NGSS are included in the rubric.

Suggestions for Improvement

One suggestion to consider is to clearly mark suggested responses, or things to look for, in another color or font so it is easier for the teacher to differentiate from lesson instructions.

It may be beneficial to provide samples of student work (from pilot classes) or anticipated student responses to large tasks. This will provide teachers with more concrete guidance on what they should be looking for in student products while using the scoring guidelines.

It would be helpful if the unit included more guidance for teachers on what "explicitly using the CCC of cause and effect" looks like in student work.

III.D. Unbiased tasks/items: Assesses student proficiency using methods, vocabulary, representations, and examples that are accessible and unbiased for all students.

Rating for Criterion III.D. Unbiased Task/Items: Adequate

The reviewers found adequate evidence that the materials assess student proficiency using accessible and unbiased methods, vocabulary, representations, and examples because the materials use developmentally appropriate text and provide tasks that do not assume all students know culturally-specific knowledge.

- Vocabulary (science and non-science) is grade level appropriate and the amount of text in tasks/items is grade appropriate. Representations or scenarios are culturally neutral and support teachers to be aware of the limitations of the scenario for reaching all students. The unit provides potential scaffolds to make sure that students have the background they need to be successful with the task. The tasks/items provide a variety of ways for students to convey their answers (e.g., talking about their learning, creating visual representations, writing short and more complex answers).
- In Lesson 8.1 (page 7), "For classes with little prior knowledge on white sharks, this is a video clip to set the context without revealing information students will learn later in the learning sequence…"
- While this unit is written for a California program, the authors do a great job of ensuring all students have access to the knowledge gained and are not limited by their prior knowledge of the local area. Videos to engage students and direct experience with phenomena support this.
- While this storyline and phenomenon are interesting to all students, it does not provide the opportunity for ALL students to make connections to their lives beyond the classroom, which

would move this category to extensive.

- Students are given choice of their target audience in the summative assessment.

Suggestions for Improvement

Allow more opportunity for student choice in student products. While there are multiple modalities represented in the tasks that students complete, they are prescribed to certain activities (for example, modeling in Lessons 8.6 and 8.8).

Provide students with more opportunities to choose how to present their learning.

III.E. Coherent Assessment system: Includes pre-, formative, summative, and self-assessment measures that assess three-dimensional learning.

Rating for Criterion III.E. Coherent Assessment System: Adequate

The reviewers found adequate evidence that the materials include pre-, formative, summative, and self-assessment measures that assess three-dimensional learning because most or all tasks and items are multi-dimensional, there are significant numbers of tasks, and the measurement of the three dimensions proportionally matches up with the learning goals.

In Lesson 8.10, self-evaluations ask students to score themselves on the rubric and two areas they could improve on.

Reviewers could find no evidence of pre-assessments in the unit, although probing of prior knowledge is done in all lessons through question and answer discussions in the "Engage" portion of the 5E learning cycle. However, no change in instruction is given based on students' prior knowledge coming in.

Suggestions for Improvement

It is suggested that the authors map the rationale of each assessment to the dimensions to provide teachers with guidance on how various assessment tasks can inform future instruction.

III.F. Opportunity to learn: Provides multiple opportunities for students to demonstrate performance of practices connected with their understanding of disciplinary core ideas and crosscutting concepts and receive feedback

Rating for Criterion III.F. Opportunity to learn: Extensive

The reviewers found extensive evidence that the materials provide multiple opportunities for students to demonstrate performance of practices connected with their understanding of core ideas and crosscutting concepts because the performances expected from students are done in multiple iterations throughout the lessons.

The unit provides several opportunities for students to develop and revise their performance based on

new evidence and changes in their thinking. Students revise their initial explanation throughout the unit based on peer and teacher feedback, and personal reflection is built into the summative assessment.

Suggestions for Improvement

It is recommended that the authors consider including more opportunities for students to show their learning in multiple ways throughout the unit. Though students have the opportunity to model, write, speak, and create a video PSA, these are assigned at certain points of the unit, as opposed to students having choices in how they represent their learning throughout.

Overall Category III Score (0, 1, 2, 3): 3

Unit Scoring Guide – Category III
Criteria A–F: **3**: At least adequate evidence for all criteria in the category; extensive evidence for at least one criterion **2**: Some evidence for all criteria in the category and adequate evidence for at least five criteria, including A **1**: Adequate evidence for at least three criteria in the category **0**: Adequate evidence for no more than two criteria in the category

Overall Score

Category I: NGSS 3D Design Score (0, 1, 2, 3): 2
Category II: NGSS Instructional Supports Score (0, 1, 2, 3): 3
Category III: Monitoring NGSS Student Progress Score (0, 1, 2, 3): 3
Total Score: 8
Overall Score (E, E/I, R, N): E

Scoring Guides for Each Category
Unit Scoring Guide
Category I (Criteria A–F): **3:** At least adequate evidence for all of the unit criteria in the category; extensive evidence for criteria A–C **2:** At least some evidence for all unit criteria in Category I (A–F); adequate evidence for criteria A–C **1:** Adequate evidence for some criteria in Category I, but inadequate/no evidence for at least one criterion A–C **0:** Inadequate (or no) evidence to meet any criteria in Category I (A–F)
Category II (Criteria A-G): **3:** At least adequate evidence for all criteria in the category; extensive evidence for at least two criteria **2:** Some evidence for all criteria in the category and adequate evidence for at least five criteria, including A **1:** Adequate evidence for at least three criteria in the category **0:** Adequate evidence for no more than two criteria in the category
Category III (Criteria A–F): **3**: At least adequate evidence for all criteria in the category; extensive evidence for at least one criterion **2**: Some evidence for all criteria in the category and adequate evidence for at least five criteria, including A **1**: Adequate evidence for at least three criteria in the category **0**: Adequate evidence for no more than two criteria in the category

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