EQuIP RUBRIC FOR SCIENCE EVALUATION

Media Mayhem

DEVELOPER: Vivayic

GRADE: High School**|** **DATE OF REVIEW:** December 2023

Media Mayhem

EQuIP RUBRIC FOR SCIENCE EVALUATION

OVERALL RATING: E

TOTAL SCORE: 8

CATEGORY I: NGSS 3D Design Score	CATEGORY II: NGSS Instructional Supports Score	CATEGORY III: Monitoring NGSS Student Progress Score
2	3	3

Click here to see the scoring guidelines.

This review was conducted by NextGenScience using the EQuIP Rubric for Science.

CATEGORY I CRITERIA RATINGS			CATEGORY II CRITERIA RATINGS			CATEGORY III CRITERIA RATINGS		
A.	Explaining Phenomena/ Designing Solutions	**Adequate**	**A.**	Relevance and Authenticity	**Adequate**	**A.**	Monitoring 3D Student Performances	**Extensive**
B.	Three Dimensions	**Adequate**	**B.**	Student Ideas	**Extensive**	**B.**	Formative	**Extensive**
C.	Integrating the Three Dimensions	**Extensive**	**C.**	Building Progressions	**Adequate**	**C.**	Scoring Guidance	**Extensive**
D.	Unit Coherence	**Adequate**	**D.**	Scientific Accuracy	**Extensive**	**D.**	Unbiased Tasks/Items	**Adequate**
E.	Multiple Science Domains	**Adequate**	**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	**Adequate**
			G.	Scaffolded Differentiation Over Time	**Adequate**			

Media Mayhem

EQuIP RUBRIC FOR SCIENCE EVALUATION

Summary Comments

Thank you for your commitment to students and their science education. NextGenScience is glad to partner with you in this continuous improvement process. The unit is strong in many areas, including integrating the three dimensions, three-dimensional learning, and eliciting student ideas.

During revisions and/or use in the classroom, the reviewers recommend paying close attention to the following focus areas in order to strengthen materials:

- **Building Progressions:** Including information that explicitly explains how students' prior learning will be built upon, including an explanation of why the learning is progressing logically through the materials, would assist teachers in supporting students throughout the unit.
- **Coherent assessment rationale:** Assessment and scoring guidance is currently provided but the teachers are not provided with a purpose and rationale for how, when, and why student learning is measured across the materials. This would help teachers clarify their assessment practices throughout the unit.
- **Scaffolded differentiation over time:** Currently, scaffolding for the focal Science and Engineering Practice (SEP) elements is not reduced over time in a logical way that supports students in deepening their understanding or in using the elements more independently over the course of the unit. In addition, the bolding of terms used inconsistently throughout the unit could cause confusion. Including explicit scaffolds for students to build understanding of the focal SEPs over time would strengthen this unit.

Note that 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 doesn't support a claim that the criterion was met. The purple text in these review reports is written directly related to criteria and is meant to point out details that could be possible areas where there is room for improvement. Not all purple text lowers a score; much of it is too minor to affect the score. For example, even criteria rated as Extensive could have purple text that is meant to be helpful for continuous improvement processes. In these cases, the criterion WAS met; the purple text is simply not part of the argument for that Extensive rating.

Unless otherwise specified, page numbers in this document refer to the page numbers listed on each lesson's PDF.

CATEGORY I

NGSS 3D DESIGN

I.A. EXPLAINING PHENOMENA/DESIGNING SOLUTIONS

I.B. THREE DIMENSIONS

I.C. INTEGRATING THE THREE DIMENSIONS

I.D. UNIT COHERENCE

I.E. MULTIPLE SCIENCE DOMAINS

I.F. MATH AND ELA

Media Mayhem

EQuIP RUBRIC FOR SCIENCE EVALUATION

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	**Adequate** *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that learning is driven by students making sense of phenomena because most, but not all, learning is driven by lesson-level phenomena that help students better understand the broader topic of the overall impact dairy production has on the environment. The investigative phenomena for most modules support the unit driving question. The unit ends with a problem to solve in which students utilize the grade-appropriate science ideas.

Page 3 of the Media Mayhem Unit Guide includes information about the anchor phenomenon, "Students watch a video that shows people protesting the harmful impacts of the dairy industry and analyze a series of seemingly conflicting claims about the impact of dairy production on the environment. We wonder what is true – is dairy production helpful or harmful for the environment?" While analyzing media claims about the dairy industry's impact on the environment is not a phenomenon as identified by the NGSS, the reviewers believed this was more of a general topic used to hold the learning sequence together. Students return to this broader topic at the conclusion of each module throughout the unit to add layers of explanation based on lesson-level learning.

The unit begins with students being introduced to the overall unit topic of media claims about the environmental impact of the dairy industry. For example:

- Lesson 1: After engaging students in their prior knowledge about natural resources, the teacher asks, "What do you know about where your food comes from? Wait for student responses, which will vary. Then, share that some types of food production are controversial, such as dairy products like milk, cheese, butter, and ice cream. Ask students why they think the dairy industry might be a controversial topic. Build off student responses to share that in this unit, students will focus on a particular controversy in the dairy industry. Share that to get started trying to observe this controversy, students will look at what some people are saying about how the production of

dairy foods impacts the environment. Direct students to record what they notice the people in the video doing as they watch" (page 2).

- Lesson 1: "To help students make sense of whether the claims being made by the milk pourers are true, tell students they will now look more closely at what other claims are being made about the dairy industry to see if these claims are similar or different. Provide students access to the Media Claims Handout, which can be a physical copy or a digital copy. Working in small groups, students will begin discussing if they think the media claims are accurate or inaccurate or if they are unsure" (page 5). The focus of this lesson is students categorizing these claims as accurate, inaccurate, or undecided, which does not support sense-making of a phenomenon or problem as defined by the NGSS.

The broad topic of media claims about the environmental impact of the dairy industry is revisited throughout the unit in different modules. Related evidence includes:

- Lessons 2–6: Dairy Food System Module: The focus of this module is to understand the components of the dairy food system, including inputs, outputs and system boundaries. Students watch a video showing the dairy industry in the early 1900s and recent times, developing a model of these systems. Each subsequent lesson in this module builds upon this model to demonstrate the entire system. There is no identifiable phenomenon or problem associated with this lesson set and is designed to answer the wondering question, "How does the dairy system produce dairy products and get them to our table?" Students use their understandings of the dairy food system to evaluate media claims 1, 4, 8, and 13 (Unit Guide, page 4).
    - Lesson 2: "To begin the lesson and make the connection between the previous lesson and this one clear, return to the media claims list. Ask students, 'Which of these claims do we want to investigate first?' Student responses may vary. Guide the conversation to acknowledge that though many of the claims are interesting, we won't be able to figure out how to evaluate them until we know how dairy is made. Knowing how dairy is made can help us better understand its impacts on our health and the environment, including climate, pollution, and impacts on plants and animals. Next, as a class, revisit the questions in the Dairy Industry category on the Driving Question Board. Have the students read off selected questions to highlight student questions about how dairy is made, the steps in the process of creating a dairy product, or any other question that has to do with the dairy system or its pollution" (page 2).
    - Lesson 6: "Prompt students to consider where the class stands in explaining the Anchor Phenomenon. What has the class learned about the dairy system's impact on the environment? In student responses, listen for the following: We have created models of the dairy industry that show the inputs, outputs, and boundaries of the system. We have seen that the system was designed to bring products to our table, but it has several costs in the process. Some of these are impacts on the environment. Direct students' attention to their media claims from Lesson 1. Ask students how they think what they have figured out so far will help them re-evaluate these media claims. Listen for student responses that indicate

that students should have some new information now to evaluate the media claims about the dairy industry's health effects and pollution better" (page 2).

  - Lesson 6: "After students have shared, provided feedback, and noted areas of agreement and disagreement in their arguments, summarize the areas of disagreement to help students see that there is still more they need to figure out about how the dairy industry impacts the environment. Return to the class list of media claims from Lesson 1 and point out that we still placed several remaining claims in the unsure category, including those related to how the dairy system impacts climate" (page 7).

- Lessons 7–14: Greenhouse Effect and Carbon Cycling Module: Students watch a video of cows and learn that cow burps contain methane gas, a greenhouse gas, which acts as an investigative phenomenon that anchors the sense-making for most of the lessons in this module. Students engage in various readings and computer simulations to further refine their understanding of the role of methane in global warming. The module ends with students learning about the role other industries play in emitting carbon dioxide gas.
  - Lesson 14: "Prompt students to consider where the class stands in explaining the Anchor Phenomenon. What has the class learned about the dairy system's impact on the environment? Students can respond to this question in their Lesson 14 Student Guide Part 1: Our Motivation. In student responses, listen for the following: We have created models for how greenhouse gases, such as methane from cow burps and carbon dioxide from transit, are impacting the greenhouse effect. We have analyzed data about the quantities of greenhouse gas contributions from different industries. We have used a computational model to make predictions about global temperature change in the future. Direct students' attention to their media claims from Lesson 1. Ask students how they think what they have figured out so far will help them re-evaluate these media claims. Listen for student responses that indicate that students should have some new information now to evaluate the media claims about the dairy industry's impact on climate better" (page 3).
- Lessons 15–20: Biodiversity and Other Environmental Impacts Module: Students watch two videos: 1) clearing a forested area near a field, and 2) time-lapse video of a dairy barn being built. These two videos are identified as the investigative phenomenon by which students "wonder how the construction of dairy buildings and clearing of land might impact local wildlife" (Unit Guide, page 6). However, the relationship between what is seen in the videos and the focus of biodiversity is unclear in this module.
  - Lesson 15: "To introduce this module to students, return to the class list of media claims. Ask students what media claims seem the most pressing to investigate next. Build off student responses to point out the claims related to biodiversity" (page 2).
- Lessons 21–25: Engineering Solutions Module: Students review and evaluate various solutions for the environmental problems associated with the dairy industry. Using these evaluations and the understanding gained from the previous modules, students define a specific problem and develop a solution to be presented to relevant stakeholders.

- Lesson 21: "Remind the students that in the last lesson we saw that the class still had several questions remaining about how the dairy system can improve on its impacts on the environment. Share with students that they will set out to use an engineering approach to help solve some of these problems. This will help students understand how this lesson connects to what they were trying to figure out about the Anchor Phenomena" (page 2).

Students have some opportunities to feel as if they are driving the learning sequence. In some lessons, student questions or prior experiences related to the overall topic create a need to engage in the learning from the students' perspective. A Driving Question Board (DQB) is created in Lesson 1, Part 6 and while student questions are elicited, these questions are not always used to determine "next steps" in the lesson-level learning. Questions generated by students on the DQB are often chosen by the teacher in subsequent lessons as a "motivation" for the learning generated in the specific lesson. In addition, this lesson includes directives for teachers to elicit student questions. However, these directives appear generic, and the students seem to have little input about the direction of the discussion. Examples include:

- Lesson 1: "Building off the disagreements and uncertainties in this conversation, introduce the Driving Question for this unit, 'What is the impact of dairy production on the environment?' to students. You can say, 'It seems like there are many ideas out there about the impact that dairy production has on the environment, so we should continue to investigate it.' Students might still be unsure of an answer but should be reminded that throughout the unit, we will explore evidence for making an argument about our thoughts. Ask students to share what kinds of environmental impacts they think the dairy system is having. Students can base their responses on their own background knowledge and the claims they read. Facilitate the class conversation to agree that the dairy industry seems to be impacting the climate, impacting plants and animals, potentially causing pollution, and impacting the lives of people" (page 9). Teachers are given suggestions for what students can base their responses on. However, more specific guidance to elicit student questions is not provided.
- Lesson 2: "To begin the lesson and make the connection between the previous lesson and this one clear, return to the media claims list. Ask students, 'Which of these claims do we want to investigate first?' Student responses may vary. Guide the conversation to acknowledge that though many of the claims are interesting, we won't be able to figure out how to evaluate them until we know how dairy is made. Knowing how dairy is made can help us better understand its impacts on our health and the environment, including climate, pollution, and impacts on plants and animals" (page 2). The teacher is told to "guide" the conversation but is not provided with questions they could ask to allow the students to drive the "next steps" in the lesson.
- Lesson 3: "Finally, point to the Dairy Industry category of questions on the Driving Question Board. Share a few selected questions that align with what students will investigate in the upcoming lesson" (page 2). The Teacher Support callout box on page 3 states, "Remember that the sample questions are just examples when returning to the Driving Question Board. Use the questions that your students have asked instead of the sample questions." While guidance is

included, it does not support students to ask questions related to the upcoming lesson if there aren't any existing questions on the DQB.

- Lesson 4: "As a final step in this lesson, students will create a new list of questions that can help them determine what additional information they need to know to help them figure out the steps of the dairy system. They can write these questions on their Lesson 4 Student Guide Part 6: Asking New Questions. Add these questions to the Dairy Industry category of the Driving Question Board so they can continue to be referenced in the coming lessons. Build off student questions to share that students will next investigate the ways the dairy system impacts the environment and its other impacts outside of its boundaries" (page 12).
- Lesson 7: "As a final step in this lesson, students will create a new list of questions to help them determine what additional information they need to know to help them figure out how cow burps affect climate change. They can write these questions on their Lesson 7 Student Guide Part 5: Asking New Questions. Add these questions to the Greenhouse Gas and Climate category of the Driving Question Board so they can continue to be referenced in the coming lessons" (page 9).
- Lesson 9: "As a final step in this lesson, students will create a new list of questions to help them determine what additional information they need to know to help them figure out the Module Question: 'How could cow burps be influencing climate change?' They can write these questions on their Lesson 7 Student Guide Part 5: Asking New Questions. Add these questions to the Greenhouse Gas and Climate category of the Driving Question Board so they can continue to be referenced in the coming lessons" (page 7). This is a missed opportunity to provide teacher support on how to support students in creating questions related to the phenomena.
- Lesson 10: "Ask students to revisit the Class Consensus Model from Lesson 9. Ask students what they need to know to explain our Module Question, 'How could cow burps be influencing climate change?' that isn't present yet in their models. Build off student responses to share that we will now compare the effects of carbon dioxide and methane to better understand their relative contribution to the greenhouse effect. Finally, point to the Greenhouse Gas and Climate category of questions on the Driving Question Board. Share a few selected questions that align with what students will investigate in the upcoming lesson" (page 2). The teacher is instructing the students on the topic of the lesson before the students are given the opportunity to make connections to previous learning.
- Lesson 14: "Return to the class list of media claims from Lesson 1 and point out that we still placed several remaining claims in the unsure category, including those related to how the dairy system impacts biodiversity. Then, direct the class back to the Driving Question Board and point out the Biodiversity and Environment category of questions. Lead a class discussion for students to share what needs further investigation to truly assess environmental impact and address contradictions among their arguments" (page 9). The decision of what the next steps are is teacher-driven; it is not explicitly connected to or motivated by student questions.
- Lesson 18: The teacher is directed to "point to the Biodiversity and Environment category of questions on the Driving Question Board. Share a few selected questions that align with what

students will investigate in the upcoming lesson" (page 2). As the teacher is determining which questions will be answered, student questions are not driving the sense-making.

- Lesson 18: Students revise their models from Lesson 15 to show the impact of biodiversity of the diary industry's construction, and how this change in biodiversity affects humans. Students will then "create a new list of questions to help them determine their next steps" (page 5). Students analyze data from two different environments to determine differences in biodiversity. At the end of the lesson, students are asked to create new questions that will help them determine what additional information is needed to determine how biodiversity is affected. After following the Question Formulation Technique, students add their questions to the DQB.
- Lesson 20: "Return to the Driving Question Board and point out any questions that students asked previously about the solutions the dairy system is pursuing to improve on the different environmental impacts students have identified throughout the unit. Share that students will next investigate how the dairy system is coming up with solutions to improve on its environmental impacts" (page 9). The decision of what the next steps are is teacher driven; it is not explicitly connected to or motivated by student questions.

The materials provide guidance for the teacher to support students in making connections between the phenomena and their prior experiences. For example:

- Lesson 2: "Students are presented with five dairy products in their Lesson 2 Student Guide Part 2: Sharing Our Life Experiences. Students can answer the questions that resonate the most with them. All students will have differing life experiences when it comes to dairy products. Be sure to allow students to share if they feel comfortable doing so. This is an opportunity to continue to build on the norm for this unit that we will value the different experiences and opinions that students bring to the classroom. Emphasize that students will grow their thinking by being exposed to the ideas and experiences of their peers" (page 3).
- Lesson 7: "To help connect the Module Phenomenon to students, you may facilitate a conversation to connect the topic of greenhouse gases and climate to students. Use this opportunity to connect this topic to students' homes, neighborhoods, communities, and cultures as appropriate. Seek out and use students' current funds of knowledge from their own experiences" (page 4).
- Lesson 12: "Ask students if they think cow burps and transit from the dairy industry are the only factors contributing to greenhouse gases in the atmosphere. Allow students to share any additional ideas from their background experience. Listen for students to share any ideas related to emissions from other industries, such as manufacturing, transit, or other agricultural sectors" (page 3).

In Lessons 21–25, design problems are presented, but students are only asked to apply their understanding rather than to learn new science ideas during the engineering engagement. The lessons state that students are "designing solutions" to problems that exist within the dairy industry. However, students are instead analyzing the teacher-chosen solutions to determine if they meet the design criteria and constraints created during the engineering design process.

Suggestions for Improvement

- Consider identifying an anchor phenomenon that is observable and can be explained using the three dimensions together.
- Consider providing explicit support for teachers to elicit student questions and prior experiences related to the phenomena and use those questions and prior experiences to drive student learning.
- In Lesson 21, Part 3, students may generate a problem not on the pre-created class list. Consider providing teachers with reliable websites they can go to locate solution options that could assist them in supporting students.
- The presentation of solutions to the problems within the dairy industry is conducted at the end of the unit. Consider introducing information about these solutions in each module so students can use the knowledge gained from the lessons to assist them in better understanding each solution. This could assist students in developing their understanding of science ideas while designing solutions to the engineering unit throughout the unit, instead of the engineering component only taking place at the end of the unit.

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** *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials give students opportunities to build understanding of grade-appropriate elements of the three dimensions. Although students have many opportunities to use all three elements, many times students are not developing the claimed targeted elements fully or developing them at a lower grade-level.

In the Media Mayhem Unit Guide document, an explanation is provided for how the elements are identified in each lesson. It states, “In each lesson teacher guide, we show the elements of the NGSS

that are targeted in that particular lesson. We use bolding in these elements to demonstrate what parts of the element's students have and have not yet built proficiency within each lesson. As the unit progresses, students will become more proficient in the targeted elements and more of the element will gain bolded language. This allows the teacher to build student proficiency of an element across the unit instead of all in one lesson" (page 16).

This document also clarifies the elements designated as focal elements for the unit. "In our design, we chose specific DCI, SEP, and CCC elements that students would develop proficiency in across the unit. This unit was designed to support teachers in building student proficiency in these targeted elements across the entire unit, not for mastery within individual lessons. Accordingly, the unit is designed such that students should be supported in developing proficiency in the unit-level targeted DCIs, SEPs, and CCCs, listed below. While a wide variety of additional SEPs and CCCs may also be utilized across the unit as supporting elements, student proficiency in these elements will not be fully built nor assessed" (page 16).

Science and Engineering Practices (SEPs) | **Rating: Adequate**

The reviewers found adequate evidence that students have the opportunity to use the SEPs in this unit. There are fifteen SEP elements called out in the unit and four are identified as "focal SEP elements." Although students use many SEPs during the unit, often students do not develop the whole focal element.

Asking Questions and Defining Problems

- *Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of the design.*
  - This is not a claimed focal element.
  - Lesson 24: Students participate in a gallery walk to share their solution presentations to receive feedback on how they can improve their design. Using the Look Fors sheet students are encouraged to create feedback that, "Includes questions to challenge their peers on their design choices and statements indicating if they agree with their design choices, describes if they think the presented solution is appropriate for the problem and relative to the identified criteria and constraints and addresses the specific improvements the presented solution will have on the system" (page 6).
- *Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations.*
  - This is not a claimed focal element.
  - Lesson 21: After students review their artifacts from the previous lesson, they use them to determine the benefits, cost, and risks of the dairy system. Then as a class they develop a list of problems. "After a short period of time, invite students to add what they have recorded in their Lesson 21 Student Guide Part 3: Costs and Benefits of the Dairy System to a class list of costs, benefits, and risks. After all students have had a chance to add their

ideas, with the class, refine the list to eliminate redundant items. Ask students which items they think should be combined or removed" (page 5).
    - Lesson 22: "Have students rejoin their problem groups of three from the previous lesson. Allow students time to generate a list of criteria that successful designs for their specific problem should meet and constraints that limit the solutions. Direct students to work with their group to record their list in the space provided in the Lesson 22 Student Guide. Encourage students to consider criteria and constraints that will best meet the needs of multiple stakeholders, such as dairy farmers, consumers of dairy products, and the environment" (page 3). While students identify the criteria and constraints, they are not defining the design problem.
- *Analyze complex real-world problems by specifying criteria and constraints for successful solutions.*
    - This is not a claimed focal element.
    - Lesson 22: "Have students rejoin their problem groups of three from the previous lesson. Allow students time to generate a list of criteria that successful designs for their specific problem should meet and constraints that limit the solutions. Direct students to work with their group to record their list in the space provided in the Lesson 22 Student Guide. Encourage students to consider criteria and constraints that will best meet the needs of multiple stakeholders, such as dairy farmers, consumers of dairy products, and the environment" (page 3).

Developing and Using Models

- *Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.*
    - This is a claimed focal element for this unit.
    - Lesson 2: "In groups, students will create an initial model that answers the Module Question: 'How does the dairy system produce dairy products and get them to our table?' They will create two models: One representing how dairy products were made in the past and one for how dairy products are made today. Share with the class that we will first model how dairy was produced in the past to agree on systems model conventions to use for class consistency" (page 4). In this activity, students are building towards the claimed high school element.
    - Lesson 4: "The class will now produce a new Class Consensus Model that shows how dairy foods get to consumers. Ask students to share their four-component models in order from the start to the end of the dairy production system" (page 8). In this activity, students are building towards the claimed high school element.
    - Lesson 5: "Students will now use the evidence gathered throughout this lesson to revise the Class Consensus Model from Lesson 4 Part 4: Create a Class Consensus Model to help us better understand our Driving Question: 'What is the impact of the dairy system on the environment?' Prompt students to use their graphic organizer from Lesson 5 Part 3: Obtaining Information from Texts to edit their model. The model must include all of the

identified social, economic, environmental, and geopolitical costs and benefits of the system. Costs and risks should be written in red and benefits in green. Groups can add to their existing models from Lesson 4 or draw a new dairy system model in the Lesson 5 Student Guide Part 4: Revise Your Dairy System Model" (page 5).

- Lesson 7: "Students will create an initial model that shows how they would currently answer the Module Question on their Lesson 7 Student Guide Part 3: Creating an Initial Model. Allow students time to create a model to show how they think cow burps influence the climate. As students start to work on their models, hold a class discussion to determine how students will define the system, the components of the system, and the boundaries of the system they are considering for this model. Share that just like in their models of the dairy system from module one, students can define the system and system boundaries here. Build on student responses to confirm that the components of the system can include the Earth, dairy cows, and transportation trucks" (pages 4–5).
- Lesson 9: "Students will revise their initial model that shows how they would now answer the Module Question: 'How could cow burps be influencing climate change?' As students work on their Lesson 9 Part 2: Revisiting Initial Models, circulate the room to formatively assess their models and provide feedback by asking questions about their models" (page 3).
- Lesson 10: "Share with students that, to investigate why carbon dioxide and methane have different residence times in the atmosphere, they will use a hands-on model showing what happens to carbon dioxide and methane when they are added to the atmosphere. Have all students start at the fossil fuels station to start the game. Tell students they will now model what happens to carbon dioxide after it is burned as a fossil fuel and enters the atmosphere. Working with a partner, students will roll the die to determine their flux to the next carbon pool. At each pool, students will act as various molecules that contain carbon as they move from pool to pool" (page 4).
- Lesson 11:" Share with students that they will now revise their models from Lesson 10 of how cow burps influence climate change. Remind students that they can show the movement of matter differently than the movement of energy by using different model conventions to show matter vs. energy (e.g., two different colors of arrows). Allow students time to revise their models. They can draw their new models on the Lesson 11 Student Guide Part 2: Revising Models of How Cow Burps May Be Influencing Climate" (page 3).

- *Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena and move flexibly between model types based on merits and limitations.*
  - This is not a claimed focal element.
  - Lesson 8: "At this point in the lesson, students will use three computer models to investigate the mechanism of how greenhouse gas emissions may lead to rising global temperatures. Provide students with the Lesson 8 Student Handout Computer Model Directions and introduce students to the three simulations. Our task in this activity is to identify the strengths and limitations of models that show the same process and use what we can find from the models to explain how greenhouse gas emissions may be related to changing global average temperatures" (page 6).

- Lesson 15: "Students will create an initial model showing how they think the construction of the dairy system impacts nearby plants and animals. They will also reflect on why this impact matters. Students may develop this model in any format they prefer in the space in their Lesson 15 Student Guide in Part 3. Students may choose different model formats, and the class will discuss the merits and limitations of each model type. Share with students that their models should begin by showing the phenomenon we are focusing on the construction of the dairy system. Then, the models should show how these impacts nearby plants and animals and biodiversity" (page 4). However, students are not moving flexibly between model types based on merits and limitations; they only identify the merits and limitations of the different models.

- *Use a model to provide mechanistic accounts of phenomena.*
  - This is not a claimed focal element.
  - Lesson 18: "Ask students to return to the model they created in Lesson 15, which shows how they think the construction of the dairy system impacts biodiversity and why it matters. Share that students will now revise these models, using the space provided in Part 2 of their Lesson 18 Student Guide, to show the impacts of the dairy system's construction on biodiversity and how this change in biodiversity affects humans. Students should also record an explanation of their models in words in the space provided" (page 3).
  - Lesson 19: "Next, share with students that they will create initial models to show how grazing could result in more biodiversity in a location than growing feed in a monoculture crop field does. Students will create a new concept map model to show their current ideas that answer the lesson question, "How can grazing change the biodiversity impacts of the dairy system?" Students can use the same model conventions for a concept-map model that they have used previously. Students should place the phenomenon in question in the center of their model – cattle graze using grazing" (page 6).

Analyzing and Interpreting Data

- *Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.*
  - This is not a claimed focal element.
  - Lesson 8: The students analyze climate change variables using the jigsaw method. "Next, the group will evaluate the impact of this new data on their working explanation of how cow burps cause climate change. They can record these answers in their Lesson 8 Student Guide Part 2: Analyzing Data on Human Activity and Climate Change. Ask students to look at the interpretations they drew from each of their data sets and consider if they still agree with the working explanation or if they would revise it considering this new evidence" (page 4).

Using Mathematics and Computational Thinking

- *Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.*
  - This is not a claimed focal element.

- Lesson 16: "Students will now create a computational model using the Lesson 16 Plant and Animal Counts in Different Fields spreadsheet to determine the differences in biodiversity as measured by Simpson's Index at each of the six samples of land at the two different locations. This will help them figure out how the biodiversity of the land changed when it was converted from undisturbed land to monoculture fields. Instructions for students to set up the computational model are in the Lesson 16 Handout Computational Model Directions, and they will set up the model in the template in the Lesson 16 Biodiversity in Different Fields Sheet. Open both files, read through the introductory steps with students, and show students a few examples of how to enter the different functions in the formula bar. Importantly, don't give away the exact way to set up the formulas and functions to calculate Simpson's Biodiversity Index" (page 3). However, students are given the formula and are expected to use the data input; therefore, they are not creating the model. This connects more closely to the Grade 6–8 **Mathematical and Computational Thinking** element, *"Apply mathematical concepts and/or processes (such as ratio, rate, percent, basic operations, and simple algebra) to scientific and engineering questions and problems."*
- Lesson 19: "Allow students to open their spreadsheet from Lesson 16. Students can use the spreadsheet functions that they used in this spreadsheet and make a new copy of the tab to revise the spreadsheet to fit this context. Alternatively, a new copy of the spreadsheet template is provided in the lesson folder. Because this is the second time students are doing a similar task, you may not want to give them access to the directions used to build the spreadsheet so that they can show their proficiency with this process. If you do want to provide these instructions, another copy is present in the lesson folder. Students are once again presented with three sample sites that were used to collect data on the types on number of organisms in the grazed field on the Lesson 19 Student Handout Grazed Field" (page 4). Students are not creating a computational model; they are using the same steps used in Lesson 16.

- *Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.*
  - This is not a claimed focal element.
  - Lesson 13: "To better understand how changes to human activities can impact future changes to average temperatures, students will engage with a computational model, the En-ROADS Simulation. Have students open the simulation and give students instructions for setup for their activity. Students should view graphs on CO_2 emissions, CH_4 emissions, population growth, and GDP growth. Students can manipulate variables in the 'Transport' category and the 'Methane and Other Gases' category, among others. Give student pairs time to use their directions to engage with the En-ROADS computer model to develop a scenario to decrease global average temperatures to under 2°C" (page 4).

Engaging in Arguments from Evidence

- *Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions.*
  - This is a claimed focal element.
  - Lesson 1: After students observe the anchor phenomenon video, they are asked if they agree or disagree with what the people in the video are saying. "Allow a handful of students to share their ideas. Students will share a variety of opinions and have strong beliefs, and that is okay. You want to hear both sides and do not need a uniform class opinion. For this Anchor Phenomenon, we intend for students to have differing opinions, reactions, or feelings toward the video. Students will likely not agree with their peers. We hope to elevate these disagreements across this lesson to help students see that, based on their background understanding, there are conflicting viewpoints on this issue" (page 4).
  - Lesson 1: A SEP callout box states, "In this lesson, we are providing a pre-assessment opportunity to assess how students engage in this element. Students will likely have differing opinions, and we will ask them to confront each other's differing opinions with evidence throughout the unit. We will also try to build students' proficiency in engaging in respectful argumentation throughout the unit. Here, we do not expect that students have fully developed proficient argumentation skills. Consider this a pre-assessment of the above element, including students' ability to engage in argumentation respectfully with their peers" (page 4).
  - Lesson 1: Students decide if the media claims are accurate or inaccurate and sort them into two groups. While they are discussing their justifications, the teacher circulates and listens to their claims. A SEP callout box states, "Here, students are engaged in the below argumentation SEP and will be receiving critiques on their scientific arguments. To begin supporting students in developing respectful argumentation, define and establish norms for discussion based on the level of support your students need. Here are a few things to remind students of as they begin discussing their different views. Students should responsibly and respectfully discuss with their peers. All students in the group should be given time to think, respond, and ask questions. Feedback should be about the ideas presented and not about the individual. Differences in opinion do not equal deficits or inadequacies" (page 6).
  - Lesson 1: Students then present their media claim sort to the group. "Encourage students to record areas of agreement and disagreement to enrich group discussion. This activity aims for students to see the variety of ways the class organized the media claims, which may stimulate further discussion and argumentation as to which claims are most accurate" (page 7). Then students engage in a whole group discussion. "Facilitate a whole-class discussion to have students share the areas of agreement and disagreement they noticed in each other's claim organization charts. The purpose of this conversation is for students to realize that even though they have some areas of agreement, they organized the claims in many ways

across the class. Accordingly, students should see that there is a wide variety of opinions on whether they think the dairy industry is or is not harmful to the environment" (page 8).

- Lesson 14: Students revisit the claims and evaluate them for their validity. However, they are not critiquing scientific arguments.
- Lesson 20: "After students have written their arguments, instruct them to share their arguments with their peers and provide respectful critiques of their peers' ideas using the protocol below. Once again provide the Look Fors for students to review prior to beginning the task. Students can use these Look Fors to guide their responses. Students can capture their critiques that they will later share with their partner on their Lesson 20 Student Handout Part 4 Critique Notes" (page 7).
- Evidence of students developing the last part of the element (*determine additional information required to resolve contradictions)* was not found.

- *Construct, use, and/or present an oral and written argument or counterarguments based on data and evidence.*
  - This is a claimed focal element.
  - Lesson 5: Students return to the media claims from Lesson 1, Part 4 and revise their written argument based on the evidence they gathered within this module.
  - Lesson 6: Using gathered evidence from this module, students construct a new argument. "Provide students with the Lesson 6 Written Argument Rubric: Part 3 Task Look Fors, read them together, and again allow them to use the Look Fors to guide their responses. Allow students time to individually construct a new argument based on their new understandings from this module. Students can record their new argument in Lesson 6 Student Guide Part 3: Construct a Written Argument. Then, have students share their written arguments in pairs and provide a respectful critique of the ideas of their peers" (page 5).
  - Lesson 6: A SEP callout box states, "In this task, students will only be assessed on their written arguments in this task. In upcoming modules, students will progress their work with this SEP to include how to write a counter-argument[sic] using evidence. Students will also be supported in developing proficiency in providing respectful critiques of their peers' arguments to progress students' proficiency in ARG-H3" (page 7). However, students do not write a counterargument.
  - Lesson 12: The title of the activity is "Develop an initial Argument about Greenhouse Gas Emissions Across Sectors." However, students are not developing an argument in this lesson, only a claim. After creating an initial claim and analyzing greenhouse data on greenhouse emissions, students participate in a Four Corners Routine to share with peers. Step 4 then states students should share their argument. "Hold a brief, whole-class discussion for students to share their argument supporting why they picked this corner with the whole class and to counter-argue why their corner is more accurate than those chosen by other students" (page 3). However, students are sharing the claims they created, not an argument. Page 4 then states, "At this point, students do not necessarily need to reach a consensus, so let students discuss their claims and any reasoning they have as you see fit. Students should capture their initial claim on their Lesson 12 Student Guide Part 2: Develop

an Initial Argument About Greenhouse Gas Emissions Across Sectors." The students are discussing their claim and evidence, not reasoning; therefore, this is not an argument.

- Lesson 14: Students identify a list of industries that emit greenhouse gases that they would compare with the dairy industry. "Based on the list of industries, allow students time to work on writing an initial claim" (page 3). Students are then told, "share your initial argument in the space below" (page 1). "Hold a brief, whole-class discussion for students to share their argument…with the whole class and to counter-argue why their corner is more accurate" (page 3). As students do not have data from which to draw, this is neither a scientific argument nor counterargument as defined by the NGSS, but student speculation as demonstrated in the Teacher Guide.
- Lesson 14: Students return to a previously written argument, which is titled, "Lesson 14 Part 3: Construct a Written Argument." However, students have not written an argument in this lesson yet. After analyzing a set of greenhouse gas emissions by sector data set, students "evaluate the initial claim they made in the lesson….they will now return to the initial claims they made, update them, and use the evidence they have gathered to support their new claims" (page 5). Students share their argument with the whole class and counter-argue why their argument is more accurate. Page 6 states, "Next, ask students to return to their argument from Lesson 6 about what they thought the overall impact of dairy production is on the environment. Students will now revise their arguments to try to come up with a holistic view of the dairy system based on what they learned in both module one and module two of this unit. Allow students time to individually revise their arguments based on their new understandings from this module. Students can record their new argument in Lesson 14 Student Guide Part 3: Constructing a Written Argument."
- Lesson 20: "Next, ask students to return to their argument from Lesson 14 about what they thought the overall impact of dairy production is on the environment. Students will now revise their arguments to try to come up with a holistic view of the dairy system based on what they learned in modules one through three of this unit. Ask students to gather their resources from the module, including models, data sets, and texts from the unit so far" (page 6).

- *Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g., economic, societal, environmental, ethical considerations).*
  - This is not a claimed focal element.
  - Lesson 23: "Share with students that they will use an Engineering Design Matrix to evaluate their solutions using the criteria and constraints decided on in Lesson 22 and recorded in the Lesson 22 Student Guide Part 3: Developing Specific Criteria and Constraints. These tools will help students figure out which solution they may want to implement. Direct students' attention to the Engineering Design Matrix found in Lesson 23 Student Guide Part 3: Evaluating Possible Solutions. Share that this is a tool used to systematically compare how well different solutions to a problem meet the criteria for the design. After students have finished analyzing the suitability of their solutions using the Engineering Design Matrix,

students will use the results of their Engineering Design Matrix to identify which solution they will choose to move forward with. Share with students that they will now select a solution that they think is best to implement" (page 7). However, the reviewers believe that this lesson is more aligned with the 6–8 grade element: *"Evaluate competing design solutions based on jointly developed and agreed-upon design criteria."*

Obtaining, Evaluating and Communicating Information

- *Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible.*
  - This is a claimed focal element.
  - Lesson 1: "To help students make sense of whether the claims being made by the milk pourers are true, tell students they will now look more closely at what other claims are being made about the dairy industry to see if these claims are similar or different. Provide students access to the Media Claims Handout, which can be a physical copy or a digital copy. Working in small groups, students will begin discussing if they think the media claims are accurate or inaccurate or if they are unsure. The purpose of this activity is to expose students to the variety of seemingly contradictory claims that are being made about the dairy production industry. By sorting the claims, students share their current thinking about whether they think the dairy industry is helpful or harmful to the environment. This process will also expose students to some of the Module Phenomena they will explore in each module" (page 5). This lesson is labeled as a pre-assessment for this element; therefore, students don't have an opportunity to build understanding of it before being evaluated in Lesson 6.
  - Lesson 6: "For the first assessment task item, give students access to Media Claims 1, 4, 8, and 13 from the Lesson 1 Media Claims. Ask students to use the new information they gathered in their models and the rest of the evidence throughout the module to re-sort these media claims into the three categories shown on their Lesson 6 Student Guide Part 2: Evaluate Claims. Students can work in groups to discuss and sort these claims. When groups have finished sorting the claims, students should work independently to assess the validity of a single media claim of their choice. Share the Lesson 6 Written Argument Rubric: Part 2 Task Look Fors with students and read them together. Share that students can use these Look Fors as a guide on how to achieve proficiency on the task" (pages 3–4).
  - Lesson 14: "For the first assessment task item, give students access to Media Claims 2, 5, 6, 7, 9, and 10 from the Lesson 1 Media Claims. Ask students to use the new information they gathered in their models and the rest of the evidence throughout the module to re-sort these media claims into the three categories shown on their Lesson 14 Student Guide Part 2: Evaluate Claims. Students can work in groups to discuss and sort these claims. When groups have finished sorting the claims, students should work independently to assess the validity of a single media claim of their choice. Share the Part 2 Task Look Fors with students and

read them together. Share that students can use these Look Fors as a guide on how to achieve proficiency on the task" (pages 3–4).

- Lesson 14: Teacher support states, "This is now the second time students have evaluated the validity of the media claims. In Lesson 6, you supported students in choosing a claim and deciding if the claim was accurate, misleading, or inaccurate. Here, to progress students' proficiency with this SEP, you may want to support students in selecting and using evidence that is relevant to deciding if the claim is accurate, inaccurate, or misleading. You can ask students to generate a few different pieces of evidence and guide them through how to decide which piece of evidence would be best to support or refute the media claim. You can also have a conversation about how some claims can be misleading by only telling part of the story, which is particularly relevant to these media claims about the dairy system and climate" (page 5).
- Lesson 20: "For the first assessment task item, give students access to Media Claims 11 and 12 from the Lesson 1 Media Claims. Ask students to use the new information they gathered in their models and the rest of the evidence throughout the module to re-sort these media claims into the three categories shown on their Lesson 20 Student Guide Part 2: Evaluating Media Claims. Students can work in groups to discuss and sort these claims. When groups have finished sorting the claims, students should work independently to assess the validity of a single media claim of their choice. Share the Lesson 20 Task Rubric Part 2 Look Fors with students and read them together. Share that students can use these Look Fors as a guide on how to achieve proficiency on the task" (page 4).

- *Compare, integrate, and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.*
  - This is not a claimed focal element.
  - Lesson 3: Students are given cards with text and websites to visit that give more information about the components of the dairy system. Students are not comparing, integrating, or evaluating these sources of information.
- *Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.*
  - This is not a claimed focal element.
  - Lesson 17: Students work in groups to complete a chart that gathers information from four articles. Then they answer questions to determine the usefulness from each source. SEP support is included in this article. "To engage in the SEP for this lesson, students will both read the articles and evaluate the relevance of the evidence they find and assess the usefulness of the sources. The graphic organizer in the Student Guide will help guide the students to engage in this practice" (page 4). Students are not provided with the opportunity to evaluate the scientific information contained in the articles.
- *Communicate scientific and/or technical information or ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).*

- This is not a claimed focal element.
- Lesson 24: "Share with students that they will now share their Solutions Presentations with their peers to receive feedback on how they can improve their presentations. Direct students to set up a Gallery Walk by displaying their group's Presentations (from Lesson 24 Student Guide Part 2: Proposing Solutions) around the classroom. If students have digital presentations, have them set up a device set to presentation mode to allow other students to move through the group's presentation slides. If students have a physical poster, hang them on the wall. To the side of each presentation, hang a blank piece of chart paper" (page 6).
- Lesson 25: "After students have implemented their revisions, each of the problem groups should choose one or more local stakeholders with which to share their presentations. Local stakeholders could include Dairy Herd Managers, Crop Farmers, Soil Management Engineers, Environmental Engineers, Large Animal Veterinarians, or Dairy Co-Op Owners. Look for persons involved with making decisions within the dairy system. Students will share their presentations with the class and with local stakeholders, either in person or digitally. Organize the presentation session as is most appropriate for the local-school context. This may mean students invite the stakeholder into class for the presentation, presentations occur in a digital video conference, via email or a video sent to the stakeholder, or by going to a community meeting to share the presentation" (page 4).

Disciplinary Core Ideas (DCIs) | **Rating: Extensive**

The reviewers found extensive evidence that students have the opportunity to use or develop the DCIs in this unit. There are three focal DCI elements out of the ten total elements in the unit and students have many opportunities to use and develop these DCI elements. However, for some non-focal elements, students do not have opportunities to develop or use all parts of the element.

ESS2.D: Weather and Climate:

- *Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.*
  - This is a claimed focal element for this unit.
  - Lesson 7: "Introduce the Cow Burps Video by telling students, 'We noticed a lot of confusing claims about the dairy industry's impact on climate from Lesson 1. We had a lot of questions on our Driving Question Board about how climate change was related to the dairy industry. Let's look at this connection in a short video and see what we observe'. After this conversation, introduce the term greenhouse gases to refer to gases in the atmosphere, such as methane, linked to climate change. Share with students that methane is a gas molecule that has the chemical formula CH_4, which we will sometimes use as a shorthand to refer to it" (pages 3–4). After a discussion, students create a model to showcase their understanding.
  - Lesson 8: Students receive data featuring various climate change variables. During group work students are asked, "What do you think this trend has to do with climate change?

What overall patterns do you see in this data? How can these data help us determine the causes of climate change?" (page 3). After working in groups to analyze data sets, they develop a working explanation of how cow burps contribute to climate change. "At the end of this activity, the revised working explanation should have indications that: Methane from cow burps is one kind of greenhouse gas, and there are others, such as carbon dioxide. Carbon dioxide comes from factories, transit, and other industrial sources, Human greenhouse gas emissions have increased since the Industrial Revolution, and the overall atmospheric average temperature has as well, Dairy production and consumption have increased over time, but emissions from the dairy industry have remained stable or decreased" (page 5).

- Lesson 9: "Ask students if it makes sense at this point to only show cow burps in our models based on what they've learned. Listen for responses indicating that there are other parts of the model they now need to include based on what they know about how different kinds of greenhouse gases can produce the greenhouse effect. Build on student responses to agree that, to show a comparison of their effects, we can include a second source of greenhouse gasses: carbon dioxide from factories and transit in the dairy system. Based on this reasoning, students will add to their existing model or include a second model panel to compare emissions from cow burps and emissions from transit for comparison" (pages 2–3).
- Lesson 11: "Share with students that they will now revise their models from Lesson 10 of how cow burps influence climate change. Remind students that they can show the movement of matter differently than the movement of energy by using different model conventions to show matter vs. energy (e.g., two different colors of arrows). Students revise their greenhouse effect models to illustrate the interactions between components of the Earth system as carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere, which can influence the buildup of carbon in the atmosphere and the greenhouse effect" (page 3).
- Lesson 12: "Share with students that, to make progress on figuring out how emissions from the dairy industry compare to those of other industries, students will analyze data on greenhouse gas emissions by sector. Ask students how they can use the lens of scale, proportion, and quantity to investigate this question. Listen for student responses that indicate that students can compare the quantities of emissions from industries to see which industry contributes the most greenhouse gasses to the atmosphere. Share the Lesson 12 Student Handout Greenhouse Gas Emissions by Sector. Instruct students to record the analysis of the current trends of greenhouse gas emissions from each industry on their Lesson 12 Student Guide Part 3: Analyzing Data on the Greenhouse Emissions by Industrial Sector. Students should also include their initial thoughts about human impact and greenhouse gases to consider if human activity changes in the various industries discussed" (page 4).
- Lesson 14: "Ask students to look back at the Greenhouse Effect Model they created in this module. Ask students to discuss as a group how their system models can help inform how they will help evaluate the validity of the media claims representing the dairy industry's

impact on the environment. Share these questions with the group to help facilitate the discussion: What new knowledge have you gained to answer the Driving Question, 'How does dairy production impact the environment?' What new evidence did you gain about how dairy production might impact the climate?" (page 4).

- *Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere.*.
  - This is not a claimed focal element.
  - Lesson 13: "To better understand how changes to human activities can impact future changes to average temperatures, students will engage with a computational model, the En-ROADS Simulation. Students will need the Lesson 13 Student Handout En-ROADS and Lesson 13 Student Guide. Additional teacher supports can be found in the Lesson 13 Student Handout En-ROADS Key. Before they begin, show students the main screen of the simulation and share that the simulation is meant to predict future temperature changes based on a variety of human activities. You can slide a few sliders back and forth and observe the changes that happen to future temperature predictions. Share that the simulation can make these temperature predictions because it is coded with a variety of mathematical formulas that take the input data and make predictions. The mathematical formulas encoded in the simulation are based on real-world data collected. Ask students to reflect on the previous discussion about the merits and limitations of computational models from earlier in the module. Ask them to briefly discuss the following question with an elbow partner, 'The predictions output by a computer simulation are only as good as the assumptions built into them'" (page 4). Students do not discuss the ways in which human-generated greenhouses gases are absorbed by the ocean and biosphere.

ESS3.A: Natural Resources

- *All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. ~~New technologies and social regulations can change the balance of these factors~~*.
  - This is a claimed focal element for this unit.
  - Lesson 5: After students summarize previous knowledge about the parts of the dairy system, they read scientific text describing the economic, social, environmental, and geopolitical impacts of the dairy system, as well as their costs, risks, and benefits. After discussing the articles, they revise their models. "Once they complete their models, students will reflect on the overall tasks the dairy system was designed for and the unintended consequences of the design. Allow students time to reflect on the tasks the dairy system accomplishes and its unintended consequences. Students will focus their reflection on how the system was created to optimize production and what impacts that optimization has on components outside of the system. In their reflection, students should describe why it would be

important for us to consider the economic, social, environmental, and geopolitical costs and risks as well as benefits to the model and explain why we need to consider the boundaries of the dairy system. Prior to having students begin, engage in a short discussion about why it is important to identify these costs and benefits and the boundaries of the dairy system" (page 5).

- Lesson 6: Students construct a written argument using their original writing from Lesson 1 and the new knowledge they have gained from this module. Students are told to use the Task 1 Look Fors to help them construct their written argument. In these Look Fors students are prompted to include the economic, social, environmental, and geopolitical costs, risks and benefits.
- Lesson 14: Students re-evaluate the claims from Lesson 1 using the information they have gained in the module. Then they return to their argument written in Lesson 6 before revising it using information from both modules 1 and 2. The student Look Fors include a description of the tasks(s) of the dairy system that are relevant to the argument and the possible unintended consequences of the way the dairy system was designed; the costs and benefits of the dairy system overall, including economic, social, environmental, and/or geopolitical: Dairy system, pollution, and health, Dairy system and climate.
- Lesson 20: Students use information gathered in modules 1–3 to re-evaluate their claims and re-write their argument from Lesson 14. The rubric includes a description of the tasks(s) of the dairy system that are relevant to the argument and the possible unintended consequences of the way the dairy system was designed; the costs and benefits of the dairy system overall, including economic, social, environmental, and/or geopolitical: Dairy system, pollution, and health, Dairy system and climate.
- Lesson 21: "Ask students to review their artifacts from previous lessons in the unit and use them to determine the benefits, costs, and risks present in the dairy system as a whole" (page 4). After recording these in their student guide, students "label each of the benefits, costs and risks you described as economic, social, ethical, environmental, or geopolitical" (page 2).
- Lesson 24: Students prepare a solution presentation that will address a problem associated with the dairy system. The solution should include "how the solution maintains the benefits of the diary system and improve on its costs and risks. Student names these as economic, social, environmental, and/or geopolitical" (Presentation Look Fors Lesson 24).

ESS3.C: Human Impacts on Earth Systems

- *The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources*.
  - This is not a claimed focal element.
  - Lesson 21: After students create a cost, benefits, and risk list for the dairy system, students identify problems and then place them into categories. Then students work in groups to complete the Problem, Mechanism, and Impact Analysis for the problem they chose.

Students are not asked to make connections between sustainability, biodiversity, and responsible management.

- Lesson 23: "Students will continue to work in their original problem groups to further investigate the solutions that align with the dairy production problem they chose in Lesson 21. Remind students that the goal of designing a solution in engineering is to find a solution that will improve on the costs and risks of the dairy food system while maintaining or improving on the benefits. Give student problem groups the Lesson 23 Student Handout Solution Texts that correspond to the problem their group chose. Allow students time to read each text together with their group or individually as you think appropriate. As students read, they should annotate each article to help them understand what the solution is that is being proposed and how it functions to solve the problem each group chose. Once students have assessed the benefits, costs, and risks, they should each answer the following question in the space provided in their Lesson 23 Student Guide: Overall, how do you think these solutions increase or maintain the benefits of the dairy system, while decreasing its costs and/or risks of the problem your group is focusing on?" (pages 3–4). Because it's not clear which problem students may choose, there is currently no evidence that this element is addressed in this lesson.
- Lesson 25: Problem groups present a solution to a problem identified within the dairy system. Students summarize the benefits and costs/risks for each of the provided solutions. There is no evidence that this element is met; nor included in the "Written Argument Rubric Look Fors."

LS4.D: Biodiversity and Humans:

- *Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus, sustaining biodiversity so that ecosystem functioning, and productivity are maintained is essential to supporting and enhancing life on Earth. ~~Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value~~.*
  - This is a claimed focal element for this unit.
  - Lesson 15: Students observe two videos to introduce the lesson-level phenomena and engage in a discussion on how they think the dairy production system impacts biodiversity. Then, students create initial models using the information gained from the videos about the effects of the dairy system on biodiversity. In this activity, students are building towards the claimed high school element.
  - Lesson 16: Students use Simpson's Biodiversity Index to determine the biodiversity level on two different fields. "Ask students why the results they found are significant and why they were trying to figure this out. Build off student responses to confirm that these biodiversity changes could be happening when land for growing feed for dairy cows is converted to monoculture crops" (page 6). However, students do not discuss how biodiversity is essential to enhancing life on Earth.

- Lesson 17: Students read three of four articles to determine what is changing the biodiversity of land and why these changes matter. Based on these readings, students "summarize what you now think about how the diary system impacts biodiversity and why it matters" (page 3). However, students do not discuss how biodiversity is essential to enhancing life on Earth.
- Lesson 18: After revising a model demonstrating the impact of human activity on biodiversity, students "explain how your model shows how the losses of biodiversity due to construction of the dairy system can impact humans" (page 2).
- Lesson 19: Students explore the effect of rotational grazing on the biodiversity of the environment through calculations and text. Students then develop a model and construct an explanation of "how adding cattle to a pasture with grazing can increase biodiversity and how that can help humans" (page 4). However, students do not discuss how biodiversity is essential to enhancing life on Earth.
- Lesson 20: After re-evaluating their claims from Lesson 1, students construct a written argument using information gathered from modules 1–3. Students use the Lesson 20 rubric to assist them in writing their argument.

ETS1.A: Defining and Delimiting Engineering Problems

- *Design criteria and constraints, which typically reflect the needs of the end-user of a technology or process, address such things as the products or system's function (what job it will perform and how), its durability, and limits on its size and cost. Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them*.
  - This is not a claimed focal element.
  - Lesson 22: "Have students rejoin their problem groups of three from the previous lesson. Allow students time to generate a list of criteria that successful designs for their specific problem should meet and constraints that limit the solutions. Encourage students to consider criteria and constraints that will best meet the needs of multiple stakeholders, such as dairy farmers, consumers of dairy products, and the environment. Explain to the students that there are various types of criteria and constraints. They can be categorized as scientific, social, cultural, economic, or environmental. Using the table in the Lesson 22 Student Guide, ask students to classify their updated list of brainstormed criteria and constraints into the appropriate categories" (pages 4–5). In addition, students are not supported to develop the idea that criteria and constraints should be quantified to the extent possible.
- *Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities*.
  - This is not a claimed focal element.
  - Lesson 1: Students are introduced to the unit through the anchoring video and media claims. "Ask students what kinds of natural resources they depend on in their lives. Listen

for student responses such as food, water, materials for building, materials for making things, landscapes and wildlife for natural beauty, and clean air. Student responses may vary. Follow up by asking students if they think all people have access to these resources or if they're difficult for people in their community or any global community to obtain. Build off student responses to indicate that some resources are not easy to obtain for all people and that providing enough resources for everyone in the future is a challenge humanity faces" (page 1). There is no evidence of students engaging in ideas about the major global challenges described in this element, nor with ideas about manifestations of global challenges in local communities.

ETS1.B: Developing Possible Solutions

- *When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability, and aesthetics and to consider social, cultural, and environmental impacts.*
  - This is not a focal element, but it is claimed to be fully developed.
  - Lesson 22: Students are not evaluating solutions in this lesson, they are determining criteria and constraints and then categorizing them as scientific, social, cultural, economic, or environmental.
  - Lesson 23: "Give student problem groups the Lesson 23 Student Handout Solution Texts that correspond to the problem their group chose. Each problem identified in Lesson 21 has a set of three short readings about three different potential solutions. As students read, they should annotate each article to help them understand what the solution is that is being proposed and how it functions to solve the problem each group chose" (page 3). Then students choose one solution and complete the engineering design matrix to evaluate their solutions using criteria and constraints identified in Lesson 22.

ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World

- *Modern civilization depends on major technological systems, including those related to agriculture, health, water energy, transportation, manufacturing, construction, and communications.*
  - This is not a claimed focal element.
  - Lesson 2: "In groups, students will create an initial model that answers the Module Question: 'How does the dairy system produce dairy products and get them to our table?' They will create two models: One representing how dairy products were made in the past and one for how dairy products are made today. Share with the class that we will first model how dairy was produced in the past to agree on systems model conventions to use for class consistency" (page 4). Although students work in small groups to model how dairy products are made today and how they make it to our table, an explicit connection is not made for modern civilization depending on the technological advances made in the dairy industry.
  - Lesson 3: Students work in groups to summarize information about the parts of the dairy system using cards. "Each card gives information about the inputs, outputs, and functions of

the different components of the dairy system. Each card has content and links to more information or videos about the dairy system component" (page 4). Then students come to a consensus on the inputs, outputs, and boundaries included in the dairy foods system. However, an explicit connection between the dairy system today and how we depend on these technological advances isn't made.

- Lesson 4: After sequencing the dairy system components, making a two-part and then four-part component model, students communicate about the dairy product of their choice. "Individually students will select one dairy product that they would like or know about. Students will construct a detailed explanation of how this product gets to their table" (page 10).
- Lesson 5: After reading information about the dairy system, students revise their dairy system model and explain the impacts of the dairy system on the environment. "Once they complete their models, students will reflect on the overall tasks the dairy system was designed for and the unintended consequences of the design. Allow students time to reflect on the tasks the dairy system accomplishes and its unintended consequences. Students will focus their reflection on how the system was created to optimize production and what impacts that optimization has on components outside of the system. In their reflection, students should describe why it would be important for us to consider the economic, social, environmental, and geopolitical costs and risks as well as benefits to the model and explain why we need to consider the boundaries of the dairy system. Prior to having students begin, engage in a short discussion about why it is important to identify these costs and benefits and the boundaries of the dairy system" (page 5).
- Lesson 6: Students re-evaluate claims from Lesson 1 and then write an argument based on their understandings from module 1. Students use a rubric that contains Look Fors that include an explanation of the costs and benefits of the dairy system overall, including economic, social, environmental, and/or geopolitical costs and benefits. However, an explicit connection is not made for modern civilization depending on the technological advances made in the dairy industry.

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

- *Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes*.
  - This is not a claimed focal element.
  - Lesson 10: Although photosynthesis and cellular respiration are a part of the carbon cycle, this lesson does not include these two aspects.
  - Lesson 11: Cellular respiration and photosynthesis are a part of the carbon cycle; however, these are not discussed in this lesson.

Crosscutting Concepts (CCCs) | **Rating: Adequate**

The reviewers found adequate evidence that students have the opportunity to use or develop the CCCs in this unit. There are eight CCC elements and five are focal. While there are multiple opportunities throughout the unit that students are supported to develop competence in the CCC elements, evidence of students using most or all of the claimed CCC elements in service of making sense of phenomena was not located.

Cause and Effect

- *Systems can be designed to have a desired effect.*
  - This is a claimed focal element.
  - Lesson 15: After observing the investigative phenomenon videos students are asked, "ask students to share why they think the design of the system was done in this way and if the design was intended to take into account the effect on nearby plants and animals. Build off student response to confirm that the construction of the dairy system was intended to support the production of dairy products and not to take into account nearby plants and animals. After agreeing on these observations, introduce the Module Question: 'What impact does the dairy production system have on biodiversity?'" (page 4). Although students are asked to think about the purpose of the design, this lesson is more aligned with the **Systems and System Models** element, *Systems can be designed to do specific tasks*.
  - Lesson 17: Students read informational text to answer the questions: what else is changing in biodiversity and why does it matter to humans. Then students are asked to, "reflect on the purpose of the design of the dairy system and determine what it was intended to do. Ask students to write ideas about the unintended effects the design of the system has on plants, animals, humans, and communities. As students develop their ideas, have them clarify any potential cause and effect relationships they find" (page 5).
  - Lesson 18: Students revise their initial models from Lesson 15. They use the information gained from the module to illustrate how the design of the dairy system has adverse impacts on biodiversity, which is not the desired effect. Therefore, students are not developing this element.
  - Lesson 19: Students use a computational model from Lesson 16 to calculate biodiversity for three different sample sites, comparing the biodiversity of the grazed location to that of the monoculture crop field and the undisturbed field. This lesson is more aligned with the **Systems and System Models** element, *Systems can be designed to do specific tasks.*
  - Lesson 20: Students construct a written argument using the information gathered from modules 1–3. While students are encouraged to include "How new systems of cattle grazing can reduce some of the impacts of the system on biodiversity" (page 6), it is not an explicit connection to how these systems were designed to produce a desired effect.

Energy and Matter: Flows, Cycles and Conservation

- *Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.*
  - This is a claimed focal element.
  - Lesson 7: Students create an initial model of the investigative phenomenon. "As students start to work on their models, hold a class discussion to determine how students will define the system, the components of the system, and the boundaries of the system they are considering for this model. Share that just like in their models of the dairy system from module one, students can define the system and system boundaries here. Build on student responses to confirm that the components of the system can include the Earth, dairy cows, and transportation trucks. Ask students what other components outside the system they should represent when considering climate change and Earth's temperature. Confirm that students should also represent the Sun and the light and heat that comes from the Sun that influences Earth's temperature. Finally, share with students that they should distinguish between the matter (methane, CO_2) and energy (radiation from the Sun in their models and that the class can use common conventions, such as differently colored arrows, to show this difference" (page 5). However, in this activity, students are only indicating the components of the system. Therefore, this is more aligned with the Grade 6–8 **System and System Models** element*, Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.*
  - Lesson 9: Students revise their initial models. "Build on student responses to agree that, to show a comparison of their effects, we can include a second source of greenhouse gasses: carbon dioxide from factories and transit in the dairy system. Based on this reasoning, students will add to their existing model or include a second model panel to compare emissions from cow burps and emissions from transit for comparison. Students will revise their initial model that shows how they would now answer the Module Question: 'How could cow burps be influencing climate change?' As students work on their Lesson 9 Part 2: Revisiting Initial Models, circulate the room to formatively assess their models and provide feedback by asking questions about their models" (page 3). In this activity, students are only indicating the components of the system. Therefore, this is more aligned with the Grade 6–8 **System and System Models** element, *Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.*
  - Lesson 10: Students use models to investigate the movement of methane and carbon dioxide. "Building off what students found in the reading, share that we will now look closer at how carbon molecules move from one pool to another to determine why methane and carbon dioxide stay in the atmosphere for different amounts of time. Share with students that we will use a hands-on 'science theater' model called the Carbon Travel Game to act out the processes by which carbon fluxes move carbon molecules from one pool to another" (page 4). Then, "As students finish the game, they will return to the class model. Using a different color marker than the one they used for the first half of the game, students will

show their new journey again using arrows from one carbon pool to another. This should be done on the same drawing from the first half of the activity for comparison" (page 6).

- Lesson 11: Students revise their models to "represent the movement of matter between the different carbon pools of the Earth system and the movement of energy from the Sun to the Earth system, from the Earth and getting trapped in the system by greenhouse gases, and from the Earth out of the system into space" (page 3). This activity could also be aligned with the **Systems and System Models** element, *Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions — including energy, matter, and information flows — within and between systems at different scales.*

Systems and System Models

- *Systems can be designed to do specific tasks.*
  - This is a claimed focal element.
  - Lesson 1: After watching a video and reading claims the media has made about the impact the dairy industry has on the environment, students write an initial argument about the effect they think the dairy industry has had on the environment. At this point in the unit students are not provided with enough evidence to make the connection to this CCC element.
  - Lesson 3: Students use dairy system cards to learn more information about the dairy system components. "Each card gives information about the inputs, outputs, and functions of the different components of the dairy system. Each card has content and links to more information or videos about the dairy system component" (page 4). Then students analyze their component and write a summary reflecting on why thinking about the boundaries of the component helped them understand what we are focusing on and not focusing on in this analysis of the system. Use a Think-Pair-Share routine for students to share their responses.
  - Lesson 4: Students create a class consensus model that shows how dairy products get to consumers. Students discuss inputs, outputs, and boundaries of the system.
  - Lesson 5: Students revise their dairy system models. Then, "Once they complete their models, students will reflect on the overall tasks the dairy system was designed for and the unintended consequences of the design. Allow students time to reflect on the tasks the dairy system accomplishes and its unintended consequences. Students will focus their reflection on how the system was created to optimize production and what impacts that optimization has on components outside of the system" (page 5).
  - Lesson 6: Students re-evaluate claims from Lesson 1 then discuss in their groups. The students are asked the questions, "What do you now know about the tasks the dairy system is designed to accomplish? What do you know about its unintended effects?" (page 4).
  - Lesson 14: Students again re-evaluate claims from Lesson 1 and then discuss their answers in groups. The teacher asks students the questions, "What do you now know about the tasks the dairy system is designed to accomplish? What do you know about its unintended effects?" (page 4).

- Lesson 19: Students use computational model data to compare the biodiversity in three different land areas. Then they discuss their observations. This CCC element is only mentioned in the CCC support on page 6, "Students see that the design of the dairy system can be changed to achieve new effects and accomplish new tasks. By switching to a grazing system, the land where the grass the cattle graze on becomes more biodiverse than the land when it was a monoculture crop." Students are not explicitly engaged with this element.
- Lesson 20: Students again re-evaluate claims from Lesson 1 and then discuss their answers in groups. The teacher asks students the questions, "What do you now know about the tasks the dairy system is designed to accomplish? What do you know about its unintended effects?" (page 4).
- Lesson 22: Students define the criteria and constraints for their engineering design process. Students are not explicitly told they are designing a dairy system that would carry out a new task; therefore, they do not engage with this CCC element.
- Lesson 23: Evidence of this element was not located in this lesson.
- Lesson 24: Students develop a solution to a given problem in the dairy system. The solution will reflect the system's ability to complete the specific task (dairy production) while meeting identified criteria.

- *When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models (SYS-H2).*
  - This is a claimed focal element.
  - Lesson 2: Students create two initial models showcasing how dairy products were made differently in the past compared to today. Then they create a class consensus model where they decide on the different components that should be included on their model. On page 9 the CCC support states, "At this point of the progression of the CCC in this lesson, we are reviewing the terms inputs and outputs from the 6-8 grade band and introducing the term boundaries. As we progress through this module, students will progress towards a more sophisticated understanding of how system boundaries can help in describing the function of a system and its internalized and externalized impacts on the environment."
  - Lesson 3: Students receive Dairy System Component cards and complete a graphic organizer that explains the inputs, outputs, and boundaries of the different components of the dairy system.
  - Lesson 5: Students revise their dairy system models using a graphic organizer and then, "reflect on the overall tasks the dairy system was designed for and the unintended consequences of the design. Allow students time to reflect on the tasks the dairy system accomplishes and its unintended consequences. Students will focus their reflection on how the system was created to optimize production and what impacts that optimization has on components outside of the system. In their reflection, students should describe why it would be important for us to consider the economic, social, environmental, and geopolitical costs and risks as well as benefits to the model and explain why we need to consider the boundaries of the dairy system. Prior to having students begin, engage in a short discussion

about why it is important to identify these costs and benefits and the boundaries of the dairy system" (page 5).
    - Lesson 6: Students re-evaluate claims from Lesson 1 then discuss in their groups. The students are asked the questions, "What do you now know about the tasks the dairy system is designed to accomplish? What do you know about its unintended effects?" (page 4).
- *Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions — including energy, matter, and information flows — within and between systems at different scales.*
    - This is not a claimed focal element.
    - Lesson 8: "Students will use three computer models to investigate the mechanism of how greenhouse gas emissions may lead to rising global temperatures. Explain to students that, in science, we often use multiple models to represent the same process or system. Each model can tell us something unique based on what it emphasizes. No single model is an exact representation of the real world. All models have strengths that clarify specific parts of how a phenomenon works, and all have limitations that obscure other parts of how a phenomenon works. Our task in this activity is to identify the strengths and limitations of models that show the same process and use what we can find from the models to explain how greenhouse gas emissions may be related to changing global average temperatures. As students begin to explore each of the models, use a Think-Pair-Share to ask them how the model represents the system that was defined in the previous lesson (Earth, atmosphere, and human activity) and how the boundaries they used in their model compare to those presented in these simulations" (page 6).
    - Lesson 11: "Students will represent the movement of matter between the different carbon pools of the Earth system and the movement of energy from the Sun to the Earth system, from the Earth and getting trapped in the system by greenhouse gases, and from the Earth out of the system into space" (page 3).

Scale, Proportion and Quantity

- *The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.*
    - This is a claimed focal element.
    - Lesson 10: Students analyze greenhouse gas residence time data to understand the amount of time methane and carbon dioxide stay in the atmosphere. Then, they create a hands-on model to show the movement of methane and carbon dioxide as they move into the atmosphere. Scale and proportion are not emphasized in this lesson; however, students do analyze the quantities of carbon dioxide and methane that build up in the atmosphere.
    - Lesson 12: "Share with students that, to make progress on figuring out how emissions from the dairy industry compare to those of other industries, students will analyze data on greenhouse gas emissions by sector. Ask students how they can use the lens of scale, proportion, and quantity to investigate this question. Listen for student responses that indicate that students can compare the quantities of emissions from industries to see which

industry contributes the most greenhouse gasses to the atmosphere. Share the Lesson 12 Student Handout Greenhouse Gas Emissions by Sector. Instruct students to record the analysis of the current trends of greenhouse gas emissions from each industry on their Lesson 12 Student Guide Part 3: Analyzing Data on the Greenhouse Emissions by Industrial Sector. Students should also include their initial thoughts about human impact and greenhouse gases to consider if human activity changes in the various industries discussed" (page 4). Then students are asked, "how they can continue to use the lens of scale, proportion, and quantity to now evaluate the initial claims they made in this lesson. Listen for student responses to indicate that they can use the emissions data they gathered to compare the quantity of emissions of dairy and agriculture with other industries to see if their initial claims were valid or not. Build off student responses to share with students that they will now return to the initial claims they made, update them, and use the evidence they have gathered to support their new claims" (page 5).

- Lesson 13: Students use a computational model to make predictions about how human activity can impact temperature change. "Students can manipulate variables in the 'Transport' category and the 'Methane and Other Gases' category, among others" (page 4). Then students work with partners to, "use their directions to engage with the En-ROADS computer model to develop a scenario to decrease global average temperatures to under 2°C" (page 5). This allows students to change proportion of human activities on different energy supplies.
- Lesson 14: Evidence of this element was not located.

Patterns

- *Mathematical representations are needed to identify some patterns.*
  - This is not a claimed focal element.
  - Lesson 16: "Students will now create a computational model using the Lesson 16 Plant and Animal Counts in Different Fields spreadsheet to determine the differences in biodiversity as measured by Simpson's Index at each of the six samples of land at the two different locations. This will help them figure out how the biodiversity of the land changed when it was converted from undisturbed land to monoculture fields" (page 4). Then students are asked to find the averages of the two sites and answer the following questions: What patterns in biodiversity exist between the two locations? How did creating the spreadsheet model help you reveal patterns in biodiversity? CCC support is located in this lesson on page 6, it states, "Students are using the results of the mathematical model to find patterns that they might not have been able to find previously without using the mathematical computation. Students see a consistent pattern of results across sample sites: that the undisturbed land had greater biodiversity than that of the monoculture crop field" (page 6).
- *Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system.*
  - This is not a claimed focal element.

- Lesson 21: Students define the problem by analyzing costs and benefits of the diary system. The CCC support on page 5 states, "Here, students are engaging in this element by analyzing the costs and benefits of the dairy system as patterns of performance to help them define a problem to reengineer and improve the system." However, the connections between the analysis and the patterns students should notice is not made clear in the activity.

Suggestions for Improvement

Science and Engineering Practices

- Consider including a note on each lesson plan to explain the bolding of certain words for each element.
- Consider reducing the number of SEPs to increase student opportunities to develop and use the focal SEP elements.
- Consider providing more opportunities for students to engage in critiquing scientific arguments if this is to be a focal element of this unit.
- In Lesson 21, a list is intended to be generated from students. However, the teacher support states that if the list does not include the "problem," the teacher will need to do additional research to provide students with the materials needed to complete an activity in a later lesson. Consider including websites that the teacher could refer to for support if needed.

Disciplinary Core Ideas

- Consider reducing the number of DCIs to increase student opportunities to develop and use the focal DCI elements.
- Consider including a note on each lesson plan to explain the bolding of certain words for each element.

Crosscutting Concepts

- Consider including a note on each lesson plan to explain the bolding of certain words for each element.

Media Mayhem

EQuIP RUBRIC FOR SCIENCE EVALUATION

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** *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that student performances integrate elements of the three dimensions in service of figuring out phenomena or designing solutions to problems. Students have several opportunities to use multiple dimensions together in service of sense-making.

The following are some instances students used elements of all three dimensions at a grade-appropriate level to make sense of phenomenon:

- Lesson 5: After students summarize previous knowledge about the parts of the dairy system, they read scientific text describing the economic, social, environmental, and geopolitical impacts of the dairy system, as well as their costs, risks, and benefits. After discussing the articles, they revise their models. Students integrate the following elements of the three dimensions in this activity:
  - SEP: *Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.*
  - CCC: *When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.*
  - DCI: **ESS3.A***: All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits.* ~~*New technologies and social regulations can change the balance of these factors.*~~
- Lesson 7: Students observe a new lesson-level phenomenon about how cow burps may be related to climate change. Then they create an initial model and discuss how methane emissions enter the atmosphere before generating additional questions that will support them in investigating this phenomenon further. Students integrate the following elements of the three dimensions in this activity:
  - SEP: *Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.*
  - CCC: *Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.*
  - DCI: *Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.*

- Lesson 9: Students revise their greenhouse effect models to illustrate how energy flows into and within an Earth system depending on atmospheric greenhouse gas concentrations. Then, they create a class consensus model before developing new questions for the DQB. Students integrate the following elements of the three dimensions in this activity:
  - SEP: *Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.*
  - CCC: *Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.*
  - DCI: *Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.*
- Lesson 10: Students engage in a simulation to discover how the flow of matter (carbon molecules) flow through Earth systems. The data is used to develop a class model demonstrating this flow of matter. Students integrate the following elements of the three dimensions in this activity:
  - SEP: *Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.*
  - CCC: *Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.*
  - DCI: *Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological and biological processes.*
- Lesson 13: Students use a computational model to predict how changes to the quantity of greenhouse gas emissions in the future will influence future changes in average global temperatures. Students integrate the following elements of the three dimensions in this activity:
  - SEP: *Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.*
  - CCC: *The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.*
  - DCI: *Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere.*

Suggestions for Improvement

N/A

Media Mayhem

EQuIP RUBRIC FOR SCIENCE EVALUATION

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** *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that lessons fit together coherently to target a set of Performance Expectations (PEs). There are content linkages across the unit that are explicit from the students' perspective. Most of the lessons build directly on prior lessons and students have regular opportunities to engage in asking questions and revisiting their questions in subsequent lessons. However, as students move through the unit part of what they figure out is not used as the next question to pursue. Additionally, students build proficiency in most, but not all, targeted PEs.

Key content linkages connect the lessons in the unit. However, students are not always supported to see how each module builds on previous modules. In addition, there are frequent reminders to students to explicitly link current lessons to prior lessons in the current module. For example:

- Each lesson begins with an Our Motivation section in which the teacher connects the previous lesson to the DQB in order to set the stage for the upcoming lesson (e.g., "Students can record these questions in Lesson 8 Student Guide Part 1: Our Motivation. This will help students understand how this lesson connects to what they are trying to figure out about the Anchor and Module Phenomena") (page 3).
- Lesson 3: Students reflect on a few of the models developed in Lesson 2 to determine differences in the models. These differences will be explored as students "gather evidence from a series of media to help…figure out what the parts of the dairy system are and what they do" (page 2).
- Lesson 5: At the end of the lesson, students are asked to "recall the media claims about the environmental impacts of the dairy industry that they started evaluating at the beginning of the unit. Ask students if they think they have gathered enough new information to evaluate these media claims in a new way" (page 8).
- Lesson 6: Students use their knowledge gained from Lessons 2–5 about the process of dairy production to support them in re-evaluating their claims from Lesson 1. Then they construct a

written argument to determine if the dairy system has a positive or negative impact on the environment. The conclusion of the lesson has the students returning back to the DQB. "Return to the class list of media claims from Lesson 1 and point out that we still placed several remaining claims in the unsure category, including those related to how the dairy system impacts climate. Then, direct the class back to the Driving Question Board and point out the Greenhouse Gas and Climate category of questions" (page 8). However, because the students have been discussing the order of dairy production and its effects, it is unlikely that they will suggest greenhouse gas and climate.

- Lesson 7: Returning to the media claims from Lesson 1, students are asked what to investigate next. "Build off student responses to point out the claims related to climate and greenhouse gases. Then, return to the Driving Question Board and revisit the questions in the Greenhouse Gas and Climate category" (page 2).
- Lesson 11: As a final step in this lesson, students will create a new list of questions that can help them determine additional information they need to know to help them figure out how cow burps are influencing climate change. After students have developed new questions, the teacher will "highlight student questions that they will next investigate related to comparing the amounts of greenhouse gases that come from different industries to see if cow burps from diary production and other aspects of the dairy system are contributing more greenhouse gases than other industries" (page 9).
- Lesson 14: "After students have shared, provided feedback, and noted areas of agreement and disagreement in their arguments, summarize the areas of disagreement to help students see that there is still more they need to figure out about how dairy impacts the environment. Return to the class list of media claims from Lesson 1 and point out that we still placed several remaining claims in the unsure category, including those related to how the dairy system impacts biodiversity. Then, direct the class back to the Driving Question Board and point out the Biodiversity and Environment category of questions" (page 8). Students are not likely to make this connection because they have spent the previous five lessons on climate and greenhouse gases. The connection between biodiversity and greenhouse gases is not explicit enough for students to make that connection at this time.
- Lesson 20: "Point out to students that in the previous lesson they investigated how grazing could reduce the impact of the dairy industry on biodiversity. Ask students if they think that there could be any other solutions to the costs and risks of the dairy system. Return to the Driving Question Board and point out any questions that students asked previously about the solutions the dairy system is pursuing to improve on the different environmental impacts students have identified throughout the unit. Share that students will next investigate how the dairy system is coming up with solutions to improve on its environmental impacts" (page 9).

The unit materials state, "We formed a conceptual bundle of the NGSS PEs to help guide our initial unit planning. We used the DCIs in this PE bundle as the focal DCIs in our unit. The SEPs and CCCs from these PEs are not necessarily those chosen as focal SEPs and CCCs for the unit" (Media Mayhem Unit Guide,

page 16). The following PEs are claimed, and most, but not all, of the elements required are used or developed in the learning sequence.

- **HS-ESS2-6**. *Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.*
- **HS-ESS3-2**. *Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*
- **HS-ESS3-4**. *Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*
- **HS-LS2-5**. *Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.* Evidence of students building proficiency in most of the DCI from this PE was not located.
- **HS-LS4-6**. *Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*
- **HS-ETS1-1**. *Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.*
- **HS-ETS1-3**. *Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability and aesthetics as well as possible social, cultural and environmental impacts.*

Suggestions for Improvement

Consider including opportunities for students to use their sense-making as a guide when choosing the next question to pursue.

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	**Adequate** *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that links are made across the science domains when appropriate because the unit focuses on Earth and life science domains and some connections are

established between these domains, but it isn't always clear to students how ideas from the different domains work together to explain phenomena. Also, students are not supported to understand how the targeted CCCs could be used for sense-making across the science domains.

All lesson-level phenomena can be explained using the Earth and Life science domains. For example:

- The lesson-level phenomena of dairy food systems is explained using the DCI **ESS3.A-H2: Natural Resources**. In Lesson 5, students summarize previous knowledge about the parts of the dairy system, they read scientific text describing the economic, social, environmental, and geopolitical impacts of the dairy system, as well as their costs, risks, and benefits. After discussing the articles, they revise their models. "Once they complete their models, students will reflect on the overall tasks the dairy system was designed for and the unintended consequences of the design. Allow students time to reflect on the tasks the dairy system accomplishes and its unintended consequences. Students will focus their reflection on how the system was created to optimize production and what impacts that optimization has on components outside of the system. In their reflection, students should describe why it would be important for us to consider the economic, social, environmental, and geopolitical costs and risks as well as benefits to the model and explain why we need to consider the boundaries of the dairy system. Prior to having students begin, engage in a short discussion about why it is important to identify these costs and benefits and the boundaries of the dairy system" (page 5).
- The lesson-level phenomena of cows burping contributing to climate change is explained using DCI **ESS2.D-H3: Weather and Climate** in Lesson 7. "Introduce the Cow Burps Video by telling students, "We noticed a lot of confusing claims about the dairy industry's impact on climate from Lesson 1. We had a lot of questions on our Driving Question Board about how climate change was related to the dairy industry. Let's look at this connection in a short video and see what we observe. After this conversation, introduce the term greenhouse gases to refer to gases in the atmosphere, such as methane, linked to climate change. Share with students that methane is a gas molecule that has the chemical formula CH_4, which we will sometimes use as a shorthand to refer to it" (pages 3–4).
- The lesson-level phenomena of the construction of dairy buildings affecting local wildlife is explained using DCI **LS4.D: Biodiversity and Humans** in Lesson 15**.** Students observe two videos to introduce the lesson-level phenomena and engage in a discussion on how they think the dairy production system impacts biodiversity. Then, students create initial models using the information gained from the videos about the effects of the dairy system on biodiversity.

In the following examples, students have discussions to make connections between the Earth sciences systems and the systems in life science. However, they are not supported to understand how the related CCC could be used for sense-making across the science domains. For example:

- Lesson 19: Students use computational model data to compare the biodiversity in three different land areas. Then they discuss their observations. "Students see that the design of the dairy system can be changed to achieve new effects and accomplish new tasks. By switching to a grazing system, the land where the grass the cattle graze on becomes more biodiverse than the

land when it was a monoculture crop" (page 6). This is a missed opportunity for students to see the connection between systems in these two different grazing systems (**LS4.D-H2**) and the dairy systems risks and benefits (**ESS3.A-H2**).

- Lesson 12: "Share with students that, to make progress on figuring out how emissions from the dairy industry compare to those of other industries, students will analyze data on greenhouse gas emissions by sector. Ask students how they can use the lens of scale, proportion, and quantity to investigate this question. Listen for student responses that indicate that students can compare the quantities of emissions from industries to see which industry contributes the most greenhouse gasses to the atmosphere. Students should also include their initial thoughts about human impact and greenhouse gases to consider if human activity changes in the various industries discussed" (page 4). The opportunity for students to connect how the quantities of emissions of greenhouse gases from dairy systems impact climate change is not provided. This is a missed opportunity to highlight how increased quantities of carbon dioxide in the atmosphere is polluting the environment which affects the biodiversity in an area.

Suggestions for Improvement

Consider making an explicit connection to possible uses of the targeted **Systems and System Models** CCC elements when the connections are made between Earth and life sciences.

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** *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials provide grade-appropriate connections to the Common Core State Standards (CCSS) in mathematics and English language arts (ELA). The CCSS are identified for some lessons and there is evidence that support is provided for teachers to make connections between the activity and the CCSS standards.

Students have opportunities to use writing, speaking, and listening skills in the unit. For example:

- Lesson 4: "Ask students to select one dairy product they want to focus on. Share with students that they will construct a detailed explanation of how this product gets to their table. Student explanations can be written in the Lesson 4 Student Guide Part 5: Construct an Explanation" (page 11).

- Lesson 6: "Provide students with the Lesson 6 Written Argument Rubric: Part 3 Task Look Fors, read them together, and again allow them to use the Look Fors to guide their responses. Allow students time to individually construct a new argument based on their new understandings from this module. Students can record their new argument in Lesson 6 Student Guide Part 3: Construct a Written Argument" (page 5).
- Lesson 8: "To complete this lesson, students should be given time to revise the class working explanation based on their new understanding of the mechanism of the greenhouse effect. They can record this explanation on their Lesson 8 Student Guide Part 5: Revise the Class Working Explanation. Show students their current working explanation from Part 2. Ask students how they would use the evidence they gathered from the simulations to revise the class working explanation of how cow burps cause climate change" (page 11).
- Lesson 15: "After the Stay and Stray Strategy, hold a whole-class share-out of the revised models. After one student from a group shares their group's model, allow students from other groups to ask probing questions. These questions should be focused on gathering more information from the student who helped create the model" (page 7).
- Lesson 24: "Tell students that they will develop this presentation to share with their peers, receive feedback from their peers, revise it, and then share it with an audience from their school or community" (page 3).

Some ELA CCSS are listed in individual lessons. Some examples include:

- **CCSS.ELA-SL 9-10.1***: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.*
  - Lesson 1: "Students will have different opinions as to how to sort these claims. Giving students time to engage in a small group and then in a larger group to contribute to whole class discussion is a way to build confidence with their own ideas and develop their thoughts clearly before sharing with diverse partners" (page 8).
- **CCSS.ELA-SL 9-10.1(c)***: Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.*
  - Lesson 1: Students share questions for the DQB and the materials state, "As students share their questions, ask them to create categories to group similar questions. As these question groups start to form, give the categories a name. The goal is that the emerging categories correspond to the upcoming unit modules so students can see that those questions motivate and drive the instruction of the following lessons" (page 11). While students are sharing the questions they created, they are not propelling the conversation by posing and responding to questions related to the larger topic. Students are simply sharing the questions they've created for the DQB and then the teacher is asking the students what they notice and wonder about the questions so they can be put into categories.

- **CCSS.ELA-SL 9-10.1(d)***: Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.*
  - Lesson 1: "The goal of this standard is to challenge students to respond to diverse perspectives. At this point in the unit, students will not have gathered evidence to support their claims and argue against the claims of their peers. Students will later do so again at the end of each module after they have gathered evidence in each module" (page 8). Students are not summarizing points of agreement and disagreement or making new connections in light of information being presented in this lesson.
  - Lesson 2: "The goal of this standard is to challenge students to respond to diverse perspectives. At this point in the unit, students may still disagree about the components of the model and recognize that there may be gaps in the model developed by the class. This model will continue to be added to throughout the module and is just a starting point. Students who disagree or have another perspective will have additional opportunities to share with their classmates throughout the module" (page 11).
  - Lesson 7: "The goal of this standard is to challenge students to respond to diverse perspectives. At this point in the lesson, students may have different reactions to the video. Remind students to share their perspective respectfully and connect their opinion to any evidence that can be gathered from the video and class discussion" (page 4).
  - Lesson 9: "Because student models may differ, it is important to emphasize this standard to help students focus on evidence vs. opinion when discussing what components to include in a Class Consensus Model. By centering the conversation around the evidence presented and the elements of a strong model with clear inputs and boundaries aligning with the content presented in the module, there is guidance on how to justify understanding among peers" (page 4).
  - Lesson 11: "The goal of this standard is to challenge students to respond to diverse perspectives. At this point in the lesson, students may disagree on what elements should be presented on the model. Remind students to use evidence from their previous learning to support their perspective when necessary" (page 5).
  - Lesson 14: "Students engage in this standard when they provide a respectful critique of their peers' ideas. Their assessment of these ideas should be based on evidence and reasoning as opposed to opinion" (page 8).
  - Lesson 22: "At this point in the lesson, students may disagree with their peers in their problem groups. Encourage them to rely on evidence they collected in the reading from the previous lesson to demonstrate their understanding and share their thoughts respectfully with their group" (page 6).
- **CCSS.ELA-SL 9-10.3***: Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.*
  - Lesson 15: "This standard is met as students listen to their peers. They should be listening to understand their perspective before moving into the Class Consensus Model" (page 7).

Students are not engaging in the full standard as they are not evaluating the speaker's point of view, reasoning, and using evidence and rhetoric; they are simply listening to their peers explain their perspective.

- **CCSS.ELA-SL 11-12.1(d)***: Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.*
  - Lesson 20: "Students engage in this standard when they provide a respectful critique of their peers' ideas. Their assessment of these ideas should be based on evidence and reasoning as opposed to opinion" (page 8). Students are not engaging in the full standard. They are not responding to diverse perspectives and summarizing points of agreement and disagreement.
- **CCSS.ELA-SL 9-10.4***: Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.*
  - Lesson 25: "Through their work on their Solutions Presentations, students are working to improve their work. Students should consider organization, audience, and the requirements of the task when developing their presentations" (page 5).
- **CCSS.ELA-WHST 9-10.1***: Write arguments focused on discipline-specific content. Students will engage in these standards as they use evidence from the module to create an argument regarding the overall environmental impact of the dairy system.*
  - Lesson 6: "To write a comprehensive argument, students will need to rely on scientific evidence they have explored throughout the module. Students will also provide their peers with a respectful critique of their claims" (page 6).
  - Lesson 21: "At this point in the lesson, students should have an understanding of the various problems associated with the dairy system but likely do not have enough evidence of solutions to potentially solve those problems. They will explore these solutions to fully develop their perspective throughout the module" (page 4).
- **CCSS.ELA-WHST 9-10.2(b)***: Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.*
  - Lesson 18: "As students develop their explanation to address the DCI, 'Human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, and pollution,' they should focus on concrete evidence and facts related to the topic. Doing so helps students demonstrate their sensemaking around the impact of the dairy industry on biodiversity" (page 4).
- **CCSS.ELA-WHST 9-10.9***: Draw evidence from informational texts to support analysis, reflection, and research.*
  - Lesson 3: "As students engage with the component cards, they should gather evidence to demonstrate their understanding of the dairy system inputs, outputs, and boundaries. Using the information presented in the text, students can develop an understanding of the system as a whole vs. individual aspects of the system. Engaging in this standard will support

students in making sense of the Module Question: 'How does the dairy system produce dairy products and get them to our table?'" (page 6).

- **CCSS.ELA-WHST 9-10.2:** *Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.*
  - Lesson 4: "Students engage with this standard when they develop their written explanation of a dairy product's journey through production. To fully construct their explanation, students use their knowledge of the technical processes associated with the dairy production" (page 11).
- **CCSS.ELA-WHST 9-10.5***: Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience*.
  - Lesson 8: "Students engage with this standard as they revise the existing class explanation about how cow burps cause climate change. Students use the evidence they gathered via the computer models to present the information in a way that allows the class audience to understand the revised explanation" (page 11).
  - Lesson 20: "Students engage with this standard as they revise their existing explanation about the impact of the dairy system on biodiversity and the environment related to the new scientific evidence, they gathered about Simpson's Biodiversity Index. Using their new understanding, they need to present the information obtained from their calculations and models about biodiversity in a way that allows the audience to make sense of their revised explanation" (page 6).
- **CCSS.ELA-RST 9-10.2***: Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.*
  - Lesson 17: "Students will engage in this standard by identifying the central ideas of each text and using the information that they find to answer the Lesson Question" (page 3). Students are not engaging in the full standard here. They are not tracing the text's explanation of the complex process.
  - Lesson 23: "Students will engage in this standard by identifying the central ideas of each text and using the information that they find to answer the Module Question" (page 4). Students are not engaging in the full standard here. They are not tracing the text's explanation of the complex process.
- **CCSS.ELA-RST 9-10.4***: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics*.
  - Lesson 10: "When drawing out the representative journeys of carbon dioxide and methane, students will draw the various carbon pools and use arrows to show the pathways taken by each of the compounds. This requires an understanding that the pools should be in boxes and what key terms are needed for each pool relative to those in the Carbon Travel Game. Additionally, students see that arrows indicate the directionality of movement of carbon in the model" (page 7).

- Lesson 24: "Through their work on their Solutions Presentations, students are working to improve their work. Students should consider organization, audience, and the requirements of the task when developing their presentations" (page 5).

Some mathematics CCSS are listed in individual lessons. Some examples include:

- **CCSS.MATHCONENT-HSN.Q.A.1***: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*
  - Lesson 12: "Students engage in this standard as they analyze Greenhouse Gas Emission by Industrial Sector data. Students interpret the various axes and axes scales used in the different graphs to extract trends from the data sets. This is important because the units used for each data set are unique and must be understood independently before they can be compared" (page 4).
  - Lesson 13: "Students engage in this standard as they analyze the En-Roads Data. Students interpret the various axes and axes scales used in the different graphs to extract trends from the data sets. This is important because the units used for each data set are unique and must be understood independently before they can be compared" (page 5).
- **CCSS.MATHCONENT-MP.4***: Model with mathematics.*
  - Lesson 16: "Students are engaging in these standards as they work to develop their biodiversity computational model using appropriate spreadsheet functions. Knowledge of the mathematical formula they are trying to build into the computational model will help students choose which formulas to use to accomplish the goal of the task" (page 5).
  - Lesson 19: "Students are engaging in these standards as they work to develop their biodiversity computational model using appropriate spreadsheet functions Knowledge of the mathematical formula, they are trying to build into the computational model will help students choose which formulas to use to accomplish the goal of the task" (page 5).
- **CCSS.MATHCONENT-MP.5***: Use appropriate tools strategically.*
  - Lesson 16: "Students are engaging in these standards as they work to develop their biodiversity computational model using appropriate spreadsheet functions. Knowledge of the mathematical formula they are trying to build into the computational model will help students choose which formulas to use to accomplish the goal of the task" (page 5).
  - Lesson 19: "Students are engaging in these standards as they work to develop their biodiversity computational model using appropriate spreadsheet functions Knowledge of the mathematical formula, they are trying to build into the computational model will help students choose which formulas to use to accomplish the goal of the task" (page 5).

Suggestions for Improvement

- Consider compiling a list of all the CCSS mathematics and ELA standards used in the unit. Teachers could use this as a reference, and it could be included in the Unit Guide.
- Consider making explicit to students how useful mathematics and ELA/literacy can be to their science sense-making.

Media Mayhem

EQuIP RUBRIC FOR SCIENCE EVALUATION

OVERALL CATEGORY I SCORE: **2** (0, 1, 2, 3)	
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

II.A. RELEVANCE AND AUTHENTICITY

II.B. STUDENT IDEAS

II.C. BUILDING PROGRESSIONS

II.D. SCIENTIFIC ACCURACY

II.E. DIFFERENTIATED INSTRUCTION

II.F. TEACHER SUPPORT FOR UNIT COHERENCE

II.G. SCAFFOLDED DIFFERENTIATION OVER TIME

Media Mayhem

EQuIP RUBRIC FOR SCIENCE EVALUATION

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	**Adequate** *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials engage students in authentic and meaningful scenarios that reflect the real world. Although the phenomena and classroom activities used are somewhat engaging to students, the materials provide limited support for connecting instruction to all students' homes, neighborhoods, communities, or cultures.

Students experience the unit general topic and lesson-level phenomena as directly as possible. For example:

- Lesson 1: Students watch a video to observe students protesting the dairy industry before analyzing various media claims made about the dairy industry.
- Lesson 2: Students observe a video that explains how dairy is produced before drawing a model of how they think dairy gets from the farm to their table.
- Lesson 3: Students use dairy system component cards to better understand the inputs and outputs of the dairy system.
- Lesson 7: Students watch a cow burp video to gain information about cows and their impact on the environment.
- Lesson 15: Students watch two videos to see how dairy systems can be built and how these newly introduced systems can affect the environment in that area.

Students have some opportunities to make personal connections to the instruction. However, a few of these opportunities do not provide support for teachers to help students make those connections. Related evidence includes:

- Lesson 2: "Students are presented with five dairy products in their Lesson 2 Student Guide Part 2: Sharing Our Life Experiences. Students can answer the questions that resonate the most with

them. All students will have differing life experiences when it comes to dairy products. Be sure to allow students to share if they feel comfortable doing so. This is an opportunity to continue to build on the norm for this unit that we will value the different experiences and opinions that students bring to the classroom. Emphasize that students will grow their thinking by being exposed to the ideas and experiences of their peers" (page 3).

- Lesson 7: "To help connect the Module Phenomenon to students, you may facilitate a conversation to connect the topic of greenhouse gases and climate to students. Use this opportunity to connect this topic to students' homes, neighborhoods, communities, and cultures as appropriate. Seek out and use students' current funds of knowledge from their own experiences" (page 4). Supports are not provided for teachers if students cannot think of ways that greenhouse gases and climate affect their lives. Also, while a sample list of questions is provided, they are general in nature, and none are explicit to students' homes, neighborhoods, communities, or cultures.
- Lesson 12: "Ask students if they think cow burps and transit from the dairy industry are the only factors contributing to greenhouse gases in the atmosphere. Allow students to share any additional ideas from their background experience. Listen for students to share any ideas related to emissions from other industries, such as manufacturing, transit, or other agricultural sectors" (page 3). Some students may need additional support in making these connections if they do not live close to an agricultural area or other industries that emit greenhouse gases.
- Lesson 17: "Some students may benefit from additional exploration of the topic. Encourage students to look for evidence of biodiversity loss in their homes or communities and reflect on the impact that might have on natural resources or interests" (page 4).
- Lesson 19: "To support students in making connections to their local community or personal experiences, ask students to think about the positive impacts of biodiversity. Ask students how they, their family, or their community benefit from increased biodiversity in your community, state, or world" (page 10).
- Lesson 25: Students present proposed solutions to address dairy system impacts on the environment to teacher-identified local stakeholders. Students then "share their presentations with their family or additional stakeholders/groups in the community who might find this information relevant" (page 4). This suggestion is more specific as an extension to the learning but does try to connect to students' communities.

Suggestions for Improvement

- Consider providing opportunities for students to ask questions that are explicitly connected to student experiences, communities, or cultures. Additionally, consider providing teacher support for how to cultivate these questions.
- Consider supporting teachers to use alternate phenomena or examples for students who have fewer personal connections to agriculture.
- Consider using the media claims as a way to make deeper connections to students' lives. This could help with the engagement between students and the classroom activities and/or inspire curiosity from students.

- Consider incorporating local claims that can support the various lesson-level phenomena used.

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	**Extensive** *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials provide students with opportunities to both share their ideas and thinking and respond to feedback on their ideas. While the unit includes lessons where students receive feedback to revise their thinking accordingly, there are missed opportunities for feedback earlier in the unit.

Students are supported to express and justify their ideas during the unit. Supports are provided for the teacher to facilitate these discussions. Related evidence includes:

- Lesson 1: After students watch the video of the students protesting the dairy industry, they think-pair-share with a partner to identify what they think the main argument in the video was. Then, "… ask students to record on their Lesson 1 Student Guide Part 1: Observing the Anchor Phenomenon if they agree or disagree with what the people in the video are saying. Allow a handful of students to share their ideas. Students will share a variety of opinions and have strong beliefs, and that is okay. You want to hear both sides and do not need a uniform class opinion" (page 4).
- Lesson 2: Students have multiple opportunities to use a Think-Pair-Share routine about their personal experiences with dairy products and analyzing dairy systems from two historic times. The Think-Pair-Share routine is described as, "To discuss the responses as a class, use the Think-Pair-Share Routine: Have students share their responses with a shoulder partner. Ask pairs to share with the whole class one life experience they had in common and one that was different. Student responses will vary in this activity, and that is okay. The purpose of this discussion is to share our background experiences with different dairy products. If responses are beyond the scope of this discussion (personal experience with dairy), lead students back to the questions in the Lesson 2 Student Guide Part 2: Sharing Our Life Experiences" (page 4).
- Lesson 3: Students use the Domino Share routine to build off other students' opinions about what is needed in the dairy industry to protect the environment. Then, students work with a partner to complete a graphic organizer to summarize information about the parts of the dairy system. The Domino shared routine is described, "As students share, use a Domino Share Routine to have them build off each other's contributions. Each group nominates a spokesperson. As a student from group 1 shares, all other students serve in a 'listener' role,

noting patterns or ideas that emerge as the group continues to share. Spokespersons from each group continue to share ideas until all groups have shared. The facilitator holds a whole class discussion and invites the remaining students to share what they heard that was similar across all the responses or a unique response they want to elevate" (page 4).

- Lesson 5: "Students will next engage in a Jigsaw routine to read one of the six sections of the text and share their findings with their peers. First, have students choose one section to read and annotate the text to determine the costs, risks, and benefits they find. Students will do so in a group that has chosen the same part of the text" (page 4).
- Lesson 6: Students "share their written arguments in pairs and provide a respectful critique of the ideas of their peers" (page 6). The students can use the Peer Feedback Protocol that is included on their task rubric. It states, "To Support Students in Revising Their Tasks Based on Peer or Teacher Feedback, 'Prior to submitting their work, hold a peer-feedback session using a protocol such as Tell-Ask-Give or with norms such as SPARK. Then have students revise their work based on the peer feedback. After submitting their work and receiving feedback and a grade, hold a session for students to norm on the features of high-quality work. Choose three samples of student work (one Emerging, one Developing, and one Proficient), anonymize them, and distribute them to students. Ask students to analyze the three samples of work and annotate what features of the work are high-quality examples of the Look Fors and what features are not. Share out the features of high-quality work that students identified and ask them to point to specific examples in the work samples. Build a class list of features of high-quality work. Then, allow students time to revise their work based on the list they generated and resubmit it for a revised grade'" (page 3).
- Lesson 12: Students write an initial claim comparing a different industry's emissions to dairy industry emissions before participating in a four corners routine to justify and explain their thinking.
- Lesson 17: Students read articles to gather information about what in biodiversity is changing and why it should matter to humans before working with partners to think-pair-share and come to consensus on which factors are main contributors to biodiversity loss.

Throughout the unit, artifacts show students reasoning and thinking changing over time.
In each module, the students have the opportunity to create and revise models for the lesson-level phenomena. For example:

- Lesson 2: In groups, students will create an initial model that answers the Module Question: "'How does the dairy system produce dairy products and get them to our table?' They will create two models: One representing how dairy products were made in the past and one for how dairy products are made today" (page 4).
- Lesson 4: Students revisit their models from Lesson 2 and revise them based on new knowledge. "With their Class Consensus Model from Lesson 2: Student Guide Part 4: Creating and Sharing Initial Models, students will identify specific components in their model that they think are supported by the evidence they have gathered or that they think they should revise. They will

put these thoughts on the graphic organizer in the Lesson 4 Student Guide Part 2: Review Initial Dairy System Model" (page 3).

- Lesson 5: Students return to the model again to make additions and revisions. "Students will now use the evidence gathered throughout this lesson to revise the Class Consensus Model from Lesson 4 Part 4: Create a Class Consensus Model to help us better understand our Driving Question: 'What is the impact of the dairy system on the environment?' Prompt students to use their graphic organizer from Lesson 5 Part 3: Obtaining Information from Texts to edit their model. The model must include all of the identified social, economic, environmental, and geopolitical costs and benefits of the system. Costs and risks should be written in red and benefits in green. Groups can add to their existing models from Lesson 4 or draw a new dairy system model in the Lesson 5 Student Guide Part 4: Revise Your Dairy System Model" (page 5).
- Lesson 7: "Students will create an initial model that shows how they would currently answer the Module Question on their Lesson 7 Student Guide Part 3: Creating an Initial Model. Allow students time to create a model to show how they think cow burps influence the climate" (page 4).
- Lesson 9: Students return to the models from Lesson 7 to revise. "Students will revise their initial model that shows how they would now answer the Module Question: 'How could cow burps be influencing climate change?' As students work on their Lesson 9 Part 2: Revisiting Initial Models, circulate the room to formatively assess their models and provide feedback by asking questions about their models" (page 3).
- Lesson 18: "Ask students to return to the model they created in Lesson 15, which shows how they think the construction of the dairy system impacts biodiversity and why it matters. Share that students will now revise these models, using the space provided in Part 2 of their Lesson 18 Student Guide, to show the impacts of the dairy system's construction on biodiversity and how this change in biodiversity affects humans. Students should also record an explanation of their models in words in the space provided" (page 3).

Feedback is provided to students; however, it occurs later in the unit. There are also some opportunities for students to receive and respond to peer feedback, but these are not explicitly called out in the unit and guidance for how students should respond to the feedback students receive from peers is often not present. Teachers are given some prompts to provide feedback to students, but guidance is not provided about the type of feedback to provide in relation to student thinking. Related evidence includes:

- Lesson 6: Students share their written work with a peer for critique. "Prior to submitting their work, hold a peer-feedback session using a protocol such as Tell-Ask-Give or with norms such as SPARK. Then have students revise their work based on the peer feedback" (Written Argument Rubric). There is no explicit guidance in how students should use the feedback to improve on their argument.
- Lesson 9: "Students will revise their initial model that shows how they would now answer the Module Question: 'How could cow burps be influencing climate change?' As students work on their Lesson 9 Part 2: Revisiting Initial Models, circulate the room to formatively assess their

models and provide feedback by asking questions about their models" (page 3). However, explicit support is not provided for the teacher to provide feedback or ask questions to support student thinking.

- Lesson 12: "Allow students time to revise their initial claims…. As students work, circulate the room to ask pressing questions: I see you wrote___. What new evidence do you have to support your position?" (page 5).
- Lesson 14: "After students have completed the task, you can use the Lesson 14 Written Argument Rubric: Part 2 Task Rubric to assess students' performance on this task. At the bottom, this rubric also contains guidance for how to support students in using a peer feedback protocol and an activity to discuss and norm on what features of high-quality student responses look like. Use either or both of these to have students reflect on and improve their work should you decide that additional steps are needed for your class to achieve proficiency" (page 5). Although teachers and students are provided additional support for feedback in the rubric, it guides them to two additional websites that explain general feedback protocols rather than specific examples of feedback in this context to support science thinking.
- Lesson 15: "As students work on their models, approach each group, and observe student work. Prompt students with questions such as: How did you come to that decision? What are you trying to show in your model?" (page 5)
- Lesson 20: After students have completed the task, you can use the Lesson 20 Task Rubric Part 3 to assess students' performances on this task. At the bottom, this rubric also contains guidance for how to support students in using a peer feedback protocol and an activity to discuss and norm on what features of high-quality student responses look like. Use either or both to have students reflect on and improve their work should you decide that additional steps are needed for your class to achieve proficiency. Similar to Lesson 14, the teachers and students are given additional support for feedback in the rubric and are guided to two additional websites that explain feedback protocols rather than examples of context-specific feedback to support science thinking.
- Lesson 24: Students participate in a gallery walk and then provide feedback to their peers about their proposed solution. Although presentation Look Fors are included in the lesson materials, the student recording sheet for feedback doesn't contain any additional information to assist students in giving their peers content-based feedback. In addition, support for teacher feedback was not located.
- Lesson 25: Students are "encouraged to reflect on the feedback received and the revisions they can make to their proposed solutions" received in Lesson 24. However, there is no evidence that students are required to, or know how to, use the feedback to make revisions.

Suggestions for Improvement

- Consider supporting teachers to provide feedback for individual student work that will guide students in changing their thinking at different times during the sequence of each lesson. For example, consider adding prompts for the teacher to provide students with feedback on their ideas at intervals other than the end of the unit.

- Consider providing teachers with examples of the types of feedback that might be helpful to individual students at various points in the unit in relation to their thinking and sense-making.

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** *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials identify and build on students' prior learning in all three dimensions. The materials reference prior proficiency students should have in the unit. In addition, the materials identify the expected level of proficiency students should have for each element of the three dimensions by the end of instruction, and often within each unit. However, guidance is not explicitly provided about how students will build upon their prior learning while building toward each of the targeted learning goals in the unit.

The materials point out how each lesson fits with the one that immediately preceded it and the one that follows, and guidance is provided for teachers regarding how all targeted elements of each dimension are explicitly built upon from one lesson to the next. Related evidence includes:

- In the Unit Guide, a "Focal Element Progression and Use Map" is provided (e.g., page 18). This section lists middle school elements of each dimension and states, "This unit builds on students' middle school-level knowledge of Developing and Using Models, Engaging in Argumentation, and Obtaining, Evaluating and Communicating Information" (page 19). This section lists where in the unit students use the new high school-level elements for all three dimensions, but only describes development for DCIs and some CCCs — not SEPs. For example:
  - [SEP] "in Module 1, students' models show that the dairy system interacts with other outside systems and the components of the dairy system interact with each other and with outside systems" (page 19). Only use of the SEP is described rather than development.
  - [SEP] "In the final lesson of Module 3, students construct arguments that state if they think the dairy system is beneficial or harmful for the environment. Students share their arguments with peers and respectfully press their peers' reasoning and evidence used in their arguments" (page 19). Only use of the SEP is described rather than development.

- [DCI] "This unit builds on this middle school knowledge by expanding students' understanding of the economic, social, and environmental consequences of resource extraction. For example, in Module 1, students figure out that the production of dairy products is a form of resource extraction and that it has associated economic, social, and environmental consequences" (page 21). Development of the DCI is described.
- [DCI] "This unit builds on this knowledge in that students figure out that human activity has adverse consequences on biodiversity and that sustaining biodiversity requires responsible management of natural resources. For example, students learn in Module 3 that the conversion of land to monoculture crops for cattle feed can have an adverse impact on biodiversity and that these changes can negatively impact humans through loss of pollinators, soil fertility, and ecosystem services" (page 21). Development of the DCI is described.
- [CCC] "In Module 1, students identify how even though the dairy production system is designed to produce dairy products, its design has unintended consequences on the environment. Students also build on this middle school knowledge by now not only defining a system and its interactions, but also by determining a system's boundaries and recognizing that a system's boundaries can be set as needed based on the problem being analyzed. For example, in Module 1, students recognize that the dairy system can be defined as the system that brings dairy products to consumers. This system definition helps analyze the function of the system, but it also reveals what impacts of the system are not considered a part of it and are instead externalized consequences on the environment outside of the system" (page 22). Only use of the CCC is described rather than development.
- [CCC] "This unit builds on this understanding by describing how phenomena may be significant or insignificant depending on the scale, proportion, and quantity by which they occur" (page 22). Development of the DCI is inferred.
- The Focal Element Use Map section of this table shows in which lessons the focal SEP elements are meant to be developed. This information is not provided for DCIs and CCCs.

- Lesson 2: The CCC Support callout box states, "In this module, students build on this idea by using their knowledge of a system's interactions to identify the function of the system, including the relationship between its design and the intended and unintended effects the system design has on the environment. In this lesson and the remainder of Module 1, students progress towards the high school grade band of this CCC by now not only defining a system and its interactions, but also by determining a system's boundaries and recognizing that a system's boundaries can be set as needed based on the problem being analyzed" (page 9). Only use of the CCC is described rather than development.
- Lesson 3: The CCC Support callout box states, "One of the CCC focuses of this unit is for students to understand how the design of a system can produce intended consequences (e.g., producing dairy products at low cost). Students will establish this intended design in these models. Later in the unit, in the remainder of this module and again in modules 2-3, students will figure out some of the unintended consequences of the design of the dairy system that extend outside of the system itself. If students need additional support working with these CCCs, consider: SYS-H1:

Ask students to step back and view the model as a whole. What seems to be the purpose of the dairy system and the way it was designed? SYS-H2: Use an analogy as noted in Lesson 3. For example, a garden needs inputs like soil, seeds, fertilizer, sunlight, and water to produce outputs of fruits/vegetables/flowers at the end of the season. At the same time, if the system boundaries include only the garden, then things beyond its boundaries that the garden interacts with include human labor, how the garden affects local wildlife, and how local weather influences the garden" (page 10). This description shows where ("In these models") students will learn one of the focal CCC elements.

- Lesson 4: The CCC Support callout box states, "In this module, students build on this idea by using their knowledge of a system's interactions to identify the function of the system" (page 10). This description states how students will learn one of the focal CCC elements.
- Lesson 6: The SEP Support callout box states, "In middle school, students constructed scientific arguments to support or refute an explanation of a phenomenon. In this unit, students build on their middle school experience to also construct counterarguments based on evidence. In this task, students will only be assessed on their written arguments" (page 6). Only use of the SEP element is described, rather than development.
- Lesson 7: The DCI Support callout box states, "In this unit, students build on this middle school understanding by establishing the mechanism by which excess production of greenhouse gases by the agricultural and other industries can contribute to changes in changes in average atmospheric temperature" (page 7). This description shows generally how students will build this DCI understanding.
- Lesson 8: The CCC Support callout box states, "Students should have experience distinguishing between cause and effect and correlation from middle school. If your students are struggling with these questions, briefly introduce the two concepts. You can use a more familiar example, such as the correlation between ice cream sales and shark attacks during summer months and how that relationship does not necessarily indicate a causal relationship. Then, ask students if the data they interpreted shows a correlational or cause-and-effect relationship" (page 6).
- Lesson 21: The DCI Support callout box states, "This unit builds on this knowledge in that students figure out that human activity has adverse consequences on biodiversity and that sustaining biodiversity requires responsible management of natural resources. Students figured out the impacts of human activity on biodiversity in Module 3, and in this module, students will figure out strategies by which the dairy system is undertaking to more responsibly manage natural resources, including climate and biodiversity" (page 6).

Suggestions for Improvement

Consider explicitly stating how students will build on their prior understandings throughout the unit in all three dimensions, in addition to how students will apply the focal elements of the three dimensions.

Media Mayhem

EQuIP RUBRIC FOR SCIENCE EVALUATION

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** *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials use scientifically accurate and grade-appropriate scientific information because all science ideas and representations in the materials are accurate. Teacher guidance is provided to help ensure accurate representations and discussions for students.

Related evidence includes:

- Lesson 3: Students utilize Dairy System Component Cards, which include relevant readings and links to further readings and videos.
- Lesson 6: Students read an adapted text from the journal *Geohealth*.
- Lesson 8: Students utilize various scientifically accurate simulations to explore climate change.
- Lesson 5: "Use a relatable analogy if students need support with understanding cost, risks, and benefits, for example, buying a new video game. When you purchase a video game, there is a cost that you pay for the game, and there is the benefit of having a game to play and share with friends. However, there's also the risk that you spend so much time on the game you forget to do chores or homework, which impacts other areas of your life" (page 4).
- Lesson 10: "Though greenhouse warming potential is another factor by which carbon dioxide and methane impact the greenhouse effect differently, it is not one we will focus on in this lesson. This is because the mechanism explaining why they have different global warming potentials includes scientific ideas beyond this unit's scope, such as how these molecules interact with electromagnetic radiation" (page 3).
- Lesson 12: After students have constructed an argument comparing greenhouse gas emissions from dairy to other industries, students move to a corner of the room that best represents their position. In a whole-class discussion, "students argue until a consensus is reached that the dairy industry emits much less greenhouse gases than other technological industries." This process describes a misconception of the intent of a scientific argument and the process of science as the implication is that all students should come to the same conclusion.
- Lesson 17: Students read scientifically accurate articles to identify evidence to answer the lesson investigative question.
- Lesson 18: "As students develop their explanation to address the DCI, 'Human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat

destruction, and pollution,' they should focus on concrete evidence and facts related to the topic. Doing so helps students demonstrate their sensemaking around the impact of the dairy industry on biodiversity" (page 5).

Suggestions for Improvement

N/A

II.E. DIFFERENTIATED INSTRUCTION

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.

Rating for Criterion II.E. Differentiated Instruction	**Adequate** *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials provide guidance for teachers to support differentiated instruction. There are limited supports provided to support multilingual learners or learners with disabilities. In addition, there is no guidance provided for adaptations should a student enter the lesson with prior learning proficiency levels significantly above or below those expected for the unit.

Materials provide support for students who struggle to meet learning goals. However, most of these suggestions simply provide more questions for teachers to ask the students and some of the differentiation strategies do not specify the student groups they are targeted for. For example:

- Lesson 2: "If students need additional support in finding gaps in the models, consider: Have students verbally describe the system and, as they do so, consider if any steps might logically be missing. Tell them, 'Talk me through how milk gets to your table without looking at the model.' This allows them to visualize the system and see if there are gaps present. Remind them that we are in the beginning stages of the module, and they will learn more and have time to edit their model later in the module" (page 10).

- Lesson 3: "Students will read the literature, view the additional resources by going to websites or watching videos linked on their cards. If students need additional support in reading/watching the card content: Allow them to work together in their groups by asking questions like, 'What do you think this means?' or 'Tell me more about what you saw in the video?' If students need more teacher-led support, use pressing questions to elicit student observations like, 'Why do you think that?', 'Why is this step important?', or 'What can you infer from this reading/video?' Students will individually write a 2-3 sentence summary that paraphrases the inputs/outputs and function" (page 4). The teacher is only supporting students by asking additional questions.
- Lesson 4: "As students work in groups, approach each group to look at their models. If students are struggling to identify how to connect their components and determine the system boundaries, ask questions such as: What components are important to include to explain how dairy products are made? Pick two components that you think interact with each other. What are some ways you use pictures or words to show this interaction? Based on your model, what seems to be the overall task that the dairy system accomplishes? Use systems language with questions such as, 'What inputs and outputs are important for this component?', 'What things are a part of this system and what things are outside of this system?', or 'What impacts does this component have that affect things outside of the system?' Focus students' attention on a certain part of the model they may be missing" (page 8). The teacher is only supporting students by asking additional questions.
- Lesson 5: "To Provide Additional Support for Students: If students are struggling with adding the inputs, outputs, or boundaries, consider providing the following prompts: Remind them to refer to the last lesson's model conventions chart to ensure all areas are completed. Have students start with the first components, ask students to talk through the process, and have the partner take notes. This will get the ideas out of their head and onto paper. Remind the students that this is a process, and they will continue to refine it as we learn. What new ideas have you learned in this lesson on how the dairy process impacts people? How do the different parts of your model impact people? Why is it important for people to understand the costs, risks, and benefits of a designed system? How is your model communicating the costs, risks, and benefits of this designed system?" (page 6). The teacher is only supporting students by asking additional questions.
- Lesson 7: "If students need additional support in finding gaps in the models, consider: Having students verbally describe the system and, as they do so, consider if any component might logically be missing. Say, 'Talk me through how cow burps end up in the atmosphere without looking at the model.' This allows them to visualize the system and see if there are gaps present. Reminding them that we are in the beginning stages of the module, and they will learn more and have time to edit their model later in the module" (page 9).
- Lesson 12: "If students need additional support interpreting the data sets, consider: Providing students with an annotation strategy, such as showing arrows on different segments of the graph to indicate increases or decreases. Focusing students on specific parts of the graphs that

they may be overlooking. Establishing what the graph is showing by asking students to describe what each graph axis is measuring" (page 4).

- Lesson 15: "As students work, if students are struggling to identify the strengths and limitations of each other's models, consider providing the following prompts to facilitate additional questions: What does this type of model show that others do not? What does it not show? Does this type of model clearly show how the construction of the dairy system impacts biodiversity? We have figured out a lot about different systems affected by the dairy food system. What new systems were introduced in the videos we watched? What new questions do we have about these systems?" (page 6). The teacher is only supporting students by asking additional questions.
- Lesson 20: "To differentiate this practice, the Lesson 20 Student Handout Feedback Sheet includes a blank space for students to provide evidence and reasoning for their feedback – this is for higher-level differentiation. Additional prompts such as, 'Did they use the right evidence?', 'What is your reasoning?', etc., are provided on another version of the feedback sheet for lower-level differentiation" (page 8). These additional prompts are not supporting students to make connections to the SEP.

Guidance is provided throughout the unit for students who might benefit from English language support. For example:

- Lesson 1: "Additionally, to support multilingual learners or other learners, here and throughout the unit, allow students to express their ideas in a written, verbal, or drawn format as needed. This can support students who may struggle with one form of expression and still take part in the classroom community" (page 7).
- Lesson 3: "For multilingual students or students who are internal processors, it's helpful to allow time or opportunity for students to process information individually or by using non-linguistic processing modes before group share-outs" (page 3).
- Lesson 7: "To increase access for all learners, especially multilingual students, utilize the closed captioning feature while playing the video" (page 3).

Support is provided throughout the unit for students who read below grade level. For example:

- Lesson 10: "For students who need additional support, consider reading the passage out loud. Stop at every paragraph break and allow students to highlight or underline unknown words. They can also discuss with a partner to reflect on what they think those words mean using context clues from the story" (page 4).
- Lesson 17: "To support students in doing a close reading of the article, you may wish to use a reading strategy such as a Partner Read-Aloud in which one student reads a short passage aloud, and the other student listens and shares questions, reflections, and main ideas that they thought of during the reading" (page 3).
- Lesson 23: "If students need additional support in reading the text, consider asking students to use a collaborative reading strategy such as a Read-Aloud-Think-Aloud" (page 3). While this

strategy could be effective, students are not likely to use it because they have not seen it modeled or used it in class.

Some extensions are provided in the unit. However, most of these materials are simply additional activities or focused on asking additional questions for students to complete, rather than deepening student proficiencies. Examples include:

- Lesson 8: "Due to the social relevance of this topic, some students might demonstrate an increased interest in these discussions and benefit from additional engagement with the concepts. Consider providing students the option to research the causes of climate change (e.g., deep history data on Earth's average atmospheric temperature, ice core sample analysis, solar and astronomic influences on climate, or paleoclimatology) further on their own time and share their findings with the class at a later lesson to honor their engagement" (page 9). This is an additional activity for students to complete rather than an extension of the activity they are already completing.
- Lesson 8: "For students who demonstrate high interest or increased knowledge of these social, economic, and energy topics, you may want to ask them to research each topic in more depth. Ask students to use the internet to investigate questions such as, 'How was this data collected?', 'What are limitations on what the data are showing?', 'What are limitations on the conclusions we can draw from this data?', or 'What do these data indicate about how our society uses energy?'" (page 5). This is an additional activity for students to complete rather than an extension of the activity they are already completing.
- Lesson 10: "Create a learning extension opportunity by encouraging students to research the residence times or greenhouse warming potential of other greenhouse gases on their own time and share their findings with the teacher or class during a later lesson" (page 3). This is an additional activity for students to complete rather than an extension of the activity they are already completing.
- Lesson 11: "For students who show interest in the topic, you may want to ask them to research other greenhouse gases, such as Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulfur hexafluoride (SF_6), or Nitrogen trifluoride (NF_3). Ask students to figure out what industrial processes these greenhouse gases are produced by and what happens to them when they enter the atmosphere" (page 8). This is an additional activity for students to complete rather than an extension of the activity they are already completing.
- Lesson 12: "If there are students demonstrating high engagement with these data, encourage them to explore some of these data sets further on their own time. Provide prompts such as, 'What else in these data sets are you curious about?', 'Why might that industry contribute so much (or so little) to greenhouse gas emissions?', or 'What do you think that industry has done to increase or decrease their emissions over the years?' Additionally, you could prompt students to make a list of the human activities that are discussed in the data sets. This list can include how temperature might change if this activity were decreased/increased" (page 5). This is an additional activity for students to complete rather than an extension of the activity they are already completing.

- Lesson 25: Some students might find this topic very relevant or interesting. Encourage them to continue their learning and growth in this area by sharing their presentations with their family or additional stakeholders/groups in the community who might find this information relevant. You can also ask students to research this topic in more depth and ask local stakeholders what solutions they are trying out and if the student can volunteer to be a part of the work the stakeholder is doing" (page 4). This is an additional activity for students to complete rather than an extension of the activity they are already completing.

Suggestions for Improvement

- Consider providing explicit differentiated strategies teachers can use to support all students in their development of the three dimensions, particularly students who may be struggling to meet the learning goal or students who have already developed proficiency in the learning objective. Consider providing support for teachers to assist students who are struggling with meeting the learning goals using individualized learning strategies. Consider explicitly identifying which student groups differentiation strategies are targeted for.
- Consider customizing the differentiation strategies such that they support student learning and engagement in all 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 sense-making and/or problem-solving is linked to learning in all three dimensions.

Rating for Criterion II.F. Teacher Support for Unit Coherence	**Adequate** *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials support teachers in facilitating coherent student learning experiences over time. While support is provided in each lesson, it is not clear that students understand how their learning in all three dimensions is linked to their sense-making.

Frequent guidance is provided to teachers throughout the unit linking student engagement across lessons by providing explicit connections between lessons. Related evidence includes:

- In the Media Mayhem Unit Guide, the Module Pacing (pages 3–8) includes the module level phenomenon, what the students do and figure out as well as the navigation focus points between modules. This information is also located on the first page of each lesson for all modules.
- Each lesson contains an "Our Motivation" section at the beginning, as well as a "Use of Phenomena" callout box. These two boxes explain how the previous lesson is linked to the current lesson and provides support for the teacher to better understand how the module-level phenomenon is connected to the overall unit topic. In addition, each lesson concludes with a "Asking New Questions" section or "Navigate to the next lesson" section. These two sections either return to the DQB or have lesson specific questions to support students in connecting the current lesson to the upcoming lesson.
- Lesson 3: Use of Phenomena callout box states, "Between Lessons 8 and 13, students will focus on the Module Phenomenon. In Lesson 14, they will return to evaluating the media claims from the Anchor Phenomenon using the knowledge they gain from this module" (page 2). This information does not support teachers in understanding how the current lesson connects to the phenomena for the unit.
- Lesson 3: The Navigate to the Next Lesson section states, "Ask students what they think they can do next to help them progress in figuring out the Module Question: 'How does the dairy system produce dairy products and get them to our table?' Listen for student responses that indicate that students are interested in seeing how all the different parts of the dairy system work together to make dairy products and how the whole system impacts the environment. Build off student responses to confirm that students will next assemble a full model of the dairy food production system using the information they gathered in this lesson" (page 7).
- Lesson 4: The Our Motivation section states, "Finally, point to the Dairy Industry category of questions on the Driving Question Board. Share a few selected questions that align with what students will investigate in the upcoming lesson. Example student questions or ideas could include: We have made models of the dairy system, but what parts are we missing? I think we need to know more about the order of the steps in the dairy system. What steps are we missing? Students can record these questions in their Lesson 4 Student Guide Part 1: Our Motivation. This will help students understand how this lesson connects to what they were trying to figure out about the Module Phenomenon" (page 2).
- Lesson 4: The Asking New Questions section states, "As a final step in this lesson, students will create a new list of questions that can help them determine what additional information they need to know to help them figure out the steps of the dairy system. They can write these questions on their Lesson 4 Student Guide Part 6: Asking New Questions. Add these questions to the Dairy Industry category of the Driving Question Board so they can continue to be referenced in the coming lessons" (page 11).
- Lesson 6: The Use of Phenomena callout box states, "In this lesson, students will use what they have figured out about the Module Phenomenon, how dairy products get to our tables, to return to the Anchor Phenomenon and evaluate selected media claims once again" (page 2).

- Lesson 6: The Navigation to the Next Module section states, “After students have shared, provided feedback, and noted areas of agreement and disagreement in their arguments, summarize the areas of disagreement to help students see that there is still more they need to figure out about how the dairy industry impacts the environment. Return to the class list of media claims from Lesson 1 and point out that we still placed several remaining claims in the unsure category, including those related to how the dairy system impacts climate. Then, direct the class back to the Driving Question Board and point out the Greenhouse Gas and Climate category of questions. Lead a class discussion for students to share what from these categories needs further investigation to assess the remaining media claims and to resolve the contradictions in their arguments and determine the environmental impact of dairy production” (page 7).
- Lesson 7: The Use of Phenomena callout box states, “Students ended the previous lesson by asking what questions need further investigation to understand the Anchor Phenomenon and revisiting the Driving Question Board. The next set of media claims from the Anchor Phenomenon that students will investigate are Claims 2, 5, 6, 7, 9, and 10. These claims also correspond to the Greenhouse Gas and Climate category from the Driving Question Board. Therefore, in this module, students will start by observing a Module Phenomenon that asks students to figure out how cow burps could be influencing climate change. Figuring out this Module Phenomenon will help students progress on their questions about the overall Anchor Phenomenon for the unit: how the dairy system impacts the environment” (page 2).
- Lesson 7: The Asking New Questions section states, “As a final step in this lesson, students will create a new list of questions to help them determine what additional information they need to know to help them figure out how cow burps affect climate change. They can write these questions on their Lesson 7 Student Guide Part 5: Asking New Questions. Add these questions to the Greenhouse Gas and Climate category of the Driving Question Board so they can continue to be referenced in the coming lessons” (page 10).
- Lesson 14: Our Motivation states, “Build off student responses to share that what we have figured out about how the dairy system affects climate will help us reassess the media claims and determine how the dairy production system impacts the environment. You can also point to any student questions on the Driving Question Board about Media Claims 2, 5, 6, 7, 9, and 10. Direct students' attention to these media claims and share that students will now re-evaluate the validity of these claims based on the new evidence they have gathered in the module. They will then revise their arguments for what they think the overall impact of the dairy system is on the environment” (page 3).
- Lesson 14: Navigating to the Next Module states, “After students have shared, provided feedback, and noted areas of agreement and disagreement in their arguments, summarize the areas of disagreement to help students see that there is still more they need to figure out about how dairy impacts the environment. Return to the class list of media claims from Lesson 1 and point out that we still placed several remaining claims in the unsure category, including those related to how the dairy system impacts biodiversity. Then, direct the class back to the Driving Question Board and point out the Biodiversity and Environment category of questions. Lead a

class discussion for students to share what needs further investigation to truly assess environmental impact and address contradictions among their arguments" (page 8).

Throughout the unit support is provided in some lessons where the teacher is provided guidance to make connections that would allow students to somewhat recognize what they have learned in one of the three dimensions. However, these are inconsistently placed throughout the unit so these opportunities may be missed. For example:

- Lesson 4: "SYS-H2 focuses on defining the boundaries of the system. This element can help students analyze the impacts of a system, including externalized costs of a system that extend beyond its boundaries. Establishing the boundaries of the system here will help students understand throughout the unit how the dairy system's design was focused mostly on accomplishing a single task: producing dairy products efficiently for consumers. By establishing this, students engage in SYS-H1. One of the CCC focuses of this unit is for students to understand how the design of a system can produce intended consequences (e.g., producing dairy products at low cost). Students will establish this intended design in these models. Later in the unit, in the remainder of this module and again in modules 2-3, students will figure out some of the unintended consequences of the design of the dairy system that extend outside of the system itself. If students need additional support working with these CCCs, consider: SYS-H1: Ask students to step back and view the model as a whole. What seems to be the purpose of the dairy system and the way it was designed? SYS-H2: Use an analogy as noted in Lesson 3. For example, a garden needs inputs like soil, seeds, fertilizer, sunlight, and water to produce outputs of fruits/vegetables/flowers at the end of the season. At the same time, if the system boundaries include only the garden, then things beyond its boundaries that the garden interacts with include human labor, how the garden affects local wildlife, and how local weather influences the garden" (page 10).
- Lesson 5: CCC support is provided for the same CCC elements as Lesson 4. "Here, students engage in both of these CCC elements by considering the task the dairy system was designed for and then considering how a model of the dairy system can help reveal what impacts it is having on the external environment that were not considered in its intended design" (page 6). Although CCC support is provided for these two lessons, the support is not explicitly featured again until Lesson 19. Therefore, students may not make the connection in between Lessons 5 and 19. Also, this statement is telling teachers how the students engage with this CCC element in this activity rather than providing support for teachers to assist students in understanding how the phenomenon connects to their learning.
- Lesson 19: CCC support is resumed for **SYS-H1**. "Students see that the design of the dairy system can be changed to achieve new effects and accomplish new tasks. By switching to a grazing system, the land where the grass the cattle graze on becomes more biodiverse than the land when it was a monoculture crop" (page 6). Support for different CCC elements is given in Lessons 20 and 21; therefore, students may not be making the connection to what they have learned in **SYS-H1**. Also, this statement is telling teachers how the students engage with this CCC

element in this activity rather than providing support for teachers to assist students in understanding how the phenomenon connects to their learning.

- Lesson 22: CCC Support callout box for **SYS-H1** states, "Students engage in this element by reflecting on how a new design for the dairy system that meets the criteria they chose would accomplish new tasks" (page 6). This statement is telling teachers how the students engage with this CCC element in this activity rather than providing support for teachers to assist students in understanding how the phenomenon connects to their learning.

Suggestions for Improvement

- Consider providing teachers with information about how to assist students in tracking the development of **HS-LS2-5** throughout the unit. Students use all three dimensions frequently. However, there isn't a clear path for teachers to see how they can support their students in ensuring they have developed all three dimensions of this PE.
- Consider including explicit, consistent, teacher guidance and strategies for supporting students to see how their learning in all three dimensions connects to their sense-making and problem solving throughout the unit.

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** *(None, Inadequate, Adequate, Extensive)*

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. Scaffolding for the focal SEP elements is not reduced over time in a logical way that supports students in deepening their understanding or in using the elements more independently over the course of the unit.

The Media Mayhem Unit Guide states, "In each lesson teacher guide, we show the elements of the NGSS that are targeted in the lesson. We use bolding in these elements to demonstrate what parts of the elements students have and have not yet built proficiency within each lesson. As the unit progresses, students will become more proficient in the targeted elements and more of the element will gain bolded language. This allows the teacher to build student proficiency of an element across the unit instead of all in one lesson" (page 16). However, the bolding of terms is inconsistently used throughout the unit, which could cause confusion for teachers. For example:

- Two SEP elements from **Engaging in Arguments from Evidence** are claimed to be developed in the unit.
  - ***Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives****, and determining additional information required to resolve contradictions.*
    - According to the Media Mayhem Unit Guide, the students should have proficiency in the bolded portion of this element by the end of the unit.
    - Lesson 1: ***Respectfully provide and/or receive critiques on scientific arguments by*** *probing reasoning and evidence,* ***challenging ideas and conclusions, responding thoughtfully to diverse perspectives,*** *and determining additional information required to resolve contradictions.*
      - The bolded portion of the SEP element should be the focus of this lesson. In this lesson, students analyze various claims made by the media about the dairy industry and write whether they agree or disagree with the claims. Students then share their writings and discuss their similar and differing views on the claims. Students do not critique each other's arguments, but rather simply share their arguments and discuss their points of view.
    - Lesson 14: ***Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives,*** *and determining additional information required to resolve contradictions.*
      - The bolded portion of the SEP element should be the focus of this lesson. Students are given a rubric and feedback protocol to use during the critique portion of the lesson. However, this is the first time they have engaged in this protocol, and it is not introduced prior to this lesson. This element is not scaffolded. Also, students have not engaged with this element since Lesson 1; therefore, they are unlikely to complete the targeted portions of this element.
    - Lesson 20: ***Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions,*** *responding thoughtfully to diverse perspectives, and* ***determining additional information required to resolve contradictions.***
      - The bolded portion of the SEP element should be the focus of this lesson. Students complete the same feedback protocol that they completed in Lesson 14. Scaffolding for this element is not located in this lesson.
  - ***Construct, use, and/or present an oral and written argument or counterarguments based on data and evidence.***
    - According to the Media Mayhem Unit Guide, the students should have proficiency in the bolded portion of this element by the end of the unit.
    - Lesson 6: ***Construct,*** *use****, and/****or* ***present an oral and written argument*** *or counterarguments* ***based on data and evidence.***

- The bolded portion of the SEP element should be the focus of this lesson. In this lesson, students return to their initial argument written in Lesson 1 and revise it based on their new knowledge. They are given Look Fors to assist them in writing their responses and a rubric on how to engage with their peers for the peer feedback portion of the lesson. Modeling the use of this protocol is suggested for teachers. Therefore, teachers may not model this very important part of the lesson and students may not understand this process as this is the first time they are being introduced to it.

  - Lesson 12: ***Construct, use, and/or present an oral and written argument or counterarguments based on data and evidence.***
    - The bolded portion of the SEP element should be the focus of this lesson. In this lesson, students develop an initial argument about greenhouse gas emissions across sectors. Then, after analyzing data they revise their initial argument to include the new evidence they have gathered. To close the lesson, students share out their new argument. Students are not provided any information prior to this lesson about how to construct a counterargument, or what a counterargument is. Scaffolding is not included in this lesson for this element.
  - Lesson 14: ***Construct,*** *use****, and/****or* ***present an oral and written argument*** *or counterarguments* ***based on data and evidence.***
    - The bolded portion of the SEP element should be the focus of this lesson. In this lesson, "students return to their argument from Lesson 6 about what they thought the overall impact of dairy production is on the environment. Students will now revise their arguments to try to come up with a holistic view of the dairy system based on what they learned in both module one and module two of this unit" (page 6). Again, students are given Look Fors and a rubric to revise their Lesson 6 argument. Students are also provided guidance on how to conduct the peer feedback protocol which they can use when they engage in the critiquing part of the lesson.
  - Lesson 20: ***Construct,*** *use****, and/****or* ***present an oral and written argument*** *or counterarguments* ***based on data and evidence.***
    - The bolded portion of the SEP element should be the focus of this lesson. Students complete the same activity as Lesson 14. Scaffolding for this lesson was not located.

- One SEP element from **Obtaining, Evaluating and Communicating Information** is claimed to be developed in the unit.
  - ***Evaluate the validity and reliability of and/or synthesize multiple claims,*** *methods, and/or designs* ***that appear in*** *scientific and technical texts or* ***media reports, verifying the data when possible.***
    - According to the Media Mayhem Unit Guide, the students should have proficiency in the bolded portion of this element by the end of the unit.

- Lesson 1: ***Evaluate the validity and reliability of*** *and/or synthesize* ***multiple claims****, methods, and/or designs* ***that appear in*** *scientific and technical texts or media reports, verifying the data when possible.*
  - The bolded portion of the SEP element should be the focus of this lesson. In this lesson, this SEP element is labeled as a pre-assessment opportunity. Students analyze different claims made by the media about the dairy industry.
- Lesson 6: ***Evaluate the validity and reliability of and/or synthesize multiple claims****, methods, and/or designs* ***that appear in*** *scientific and technical texts or* ***media reports, verifying the data when possible.***
  - The bolded portion of the SEP element should be the focus of this lesson. Using a model created earlier in the unit, students re-evaluate their claims. They are given Look Fors to assist them in determining whether each claim is valid or reliable. Then they discuss their new findings.
- Lesson 14: ***Evaluate the validity and reliability of and/or synthesize multiple claims****, methods, and/or designs* ***that appear in*** *scientific and technical texts or* ***media reports, verifying the data when possible.***
  - The bolded portion of the SEP element should be the focus of this lesson. Students complete the same activity as Lesson 6 but using their new model in Lesson 14. Scaffolding for this element was not located.
- Lesson 20: ***Evaluate the validity and reliability of and/or synthesize multiple claims****, methods, and/or designs* ***that appear in*** *scientific and technical texts or* ***media reports, verifying the data when possible.***
  - The bolded portion of the SEP element should be the focus of this lesson. Students complete the same activity as Lessons 14 and 6, only they return to their original argument written in Lesson 1. Scaffolding for this element was not located.

- One SEP element from **Developing and Using Models** is claimed to be developed in the unit.
  - ***Develop, revise, and/or use a model based on evidence to illustrate*** *and/or predict* ***the relationships between systems or between components of a system.***
    - According to the Media Mayhem Unit Guide, the students should have proficiency in the bolded portion of this element by the end of the unit.
    - Lesson 2: ***Develop,*** *revise, and/or use* ***a model*** *based on evidence* ***to illustrate*** *and/or predict* ***the relationships between*** *systems or between* ***components of a system.***
      - The bolded portion of the SEP element should be the focus of this lesson. Also, this lesson is identified as a pre-assessment for this element. In this lesson, "students will create an initial model that answers the Module Question: 'How does the dairy system produce dairy products and get them to our table?' They will create two models: One representing how dairy products were made in the past and one for how dairy products are made today" (page 4). After creating both models students discuss similarities and differences before creating a class consensus model.
    - Lesson 4: ***Develop,*** *revise, and/or use* ***a model*** *based on evidence* ***to illustrate*** *and/or predict* ***the relationships between*** *systems or between* ***components of a system.***

- The bolded portion of the SEP element should be the focus of this lesson. In this lesson, students return to their class consensus model from Lesson 2 and identify specific portions of the model that need to be revised based on their new learning from Lesson 3. Then they use the dairy system component cards to create a two- and four-component system model that includes inputs and outputs for the system before creating a class consensus model. Students are given Look Fors to support them with conventions needed to properly complete the models for this lesson.

- Lesson 5: ***Develop,*** *revise, and/or use* ***a model*** *based on evidence* ***to illustrate*** *and/or predict* ***the relationships between*** *systems or between* ***components of a system.***
  - The bolded portion of the SEP element should be the focus of this lesson. Students read text to support them in revising their dairy system consensus model created in Lesson 4. Similar to Lesson 4, students are given something to help them better understand what elements need to be included on their model. Additional scaffolding was not located.
- Lesson 7: ***Develop,*** *revise, and/or use* ***a model*** *based on evidence* ***to illustrate and/or predict the relationships between systems or between components of a system.***
  - The bolded portion of the SEP element should be the focus of this lesson. This lesson is also categorized as a pre-assessment for this element. However, students have engaged with many other parts of this element prior to this lesson; therefore, it's unclear why it is identified as a pre-assessment. Students create an initial model of how they think cow burps affect the environment. After confirming the components needed to be included, students share their initial models with their peers before making a class consensus model.
- Lesson 9: ***Develop,*** *revise, and/or use* ***a model*** *based on evidence* ***to illustrate and/or predict the relationships between systems or between components of a system.***
  - The bolded portion of the SEP element should be the focus of this lesson. Students revise their models from Lesson 7 using knowledge gained from Lesson 8 before building a class consensus model. Additional scaffolding was not located. The "revise" portion of this element is not bolded even though students have continued to revise models throughout the unit thus far.
- Lesson 10: ***Develop,*** *revise, and/or use* ***a model*** *based on evidence* ***to illustrate and/or predict the relationships between systems or between components of a system.***
  - The bolded portion of the SEP element should be the focus of this lesson. Students play the carbon travel game before returning to the class consensus model, using what they have learned they add new components to the model before using the model to write an explanation about why methane has shorter residence time than carbon dioxide. Scaffolding was not located in this lesson.
- Lesson 11: ***Develop,*** *revise, and/or use* ***a model*** *based on evidence* ***to illustrate and/or predict the relationships between systems or between components of a system.***
  - The bolded portion of the SEP element should be the focus of this lesson. Students return to their models from Lesson 10 and use the information gained from the

previous lesson to revise it before creating a class consensus model. Scaffolding was not located in this lesson.

Suggestions for Improvement

- Consider reducing teacher scaffolds for all targeted SEP elements so that students are able to use the elements more independently or deeply by the end of the unit.
- Consider explicitly indicating where and when to add and remove supports to move students toward independence.

OVERALL CATEGORY II SCORE: 3 (0, 1, 2, 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

III.A. MONITORING 3D STUDENT PERFORMANCES

III.B. FORMATIVE

III.C. SCORING GUIDANCE

III.D. UNBIASED TASK/ITEMS

III.E. COHERENT ASSESSMENT SYSTEM

III.F. OPPORTUNITY TO LEARN

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** *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials elicit direct, observable evidence of students using practices with DCIs and CCCs to make sense of phenomena or design solutions. Students produce artifacts with grade-appropriate SEPS, DCIs and CCCs. However, the formal tasks are driven by general topics and students are not provided with the opportunity to apply their learning to a different scenario than the unit topic.

The materials provide frequent opportunities for students to produce direct, observable artifacts of three-dimensional learning. Examples of three-dimensional student artifacts produced include:

- Lesson 2: "Students develop a model to illustrate the relationships between the inputs, outputs, and boundaries of the dairy food system. What to look for: Models show components and interactions from the dairy production video. Models show components and interactions from the dairy production video. Models include inputs, outputs, and boundaries. Models show the relationship of how the dairy system supports the needs of modern civilization to bring food to consumers" (page 6). In this performance, students use the following claimed elements:
  - SEP: *Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.*
  - CCC: *When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.*
  - DCI: *Modern civilization depends on major technological systems, including those related to agriculture, health, water energy, transportation, manufacturing, construction, and communications.*
- Lesson 4: "Students revise their initial models to show how the dairy food system is a combination of major technological systems with various inputs and outputs, allowing it to perform its specific task of dairy food production. What To Look and Listen For: Models include inputs, outputs, and boundaries. Models show interactions of the dairy system with factors or systems outside of the dairy system. Models show the relationship of how the dairy system supports the needs of modern civilization to bring food to consumers" (page 8). In this performance, students use the following claimed elements:

- SEP: *Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.*
- CCC: *When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.*
- DCI: *Modern civilization depends on major technological systems, including those related to agriculture, health, water energy, transportation, manufacturing, construction, and communications.*

- Lesson 9: "Students revise their greenhouse effect models to illustrate how energy flows into and within the Earth system depending upon atmospheric greenhouse gas concentrations. What to Look and Listen For: Students revise their models based on the new information they have learned about carbon dioxide. Models include the relationships between systems or between components of a system. Models include how energy flows into and within the Earth system depending upon atmosphere greenhouse gas concentrations. Models include how human activity has increased carbon dioxide concentrations and thus affects climate" (page 3). In this performance, students use the following claimed elements:
  - SEP: *Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.*
  - CCC: *Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.*
  - DCI: *Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.*
- Lesson 13: "Students use a computational model to predict how changes to the quantity of greenhouse gas emissions by human activity in the future will influence future changes in average global temperatures. What To Look and Listen For: Students use the computational model to predict changes to the quantity of greenhouse gas emissions by human activity in the future. Students use the computational model to see how human activity in the future will affect average global temperatures. Students use the computational model to find solutions to reduce the quantity of greenhouse gas emissions by human activity in the future" (page 5). In this performance, students use the following claimed elements:
  - SEP: *Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.*
  - CCC: *The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.*
  - DCI: *Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere.*

- Lesson 17: "Students will evaluate scientific information from multiple sources to explain why preserving biodiversity is essential to supporting human life and how the design of the dairy food system is reducing biodiversity. What To Look and Listen For: Students will read multiple articles to determine the impact of agricultural systems on biodiversity. Students will evaluate the source by considering how well each source connects to the purpose of reading it. Students will find relevant evidence from the texts to determine if the design of agricultural systems were intended to affect biodiversity" (page 4). In this performance, students use the following claimed elements:
  - SEP: *Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible.*
  - CCC: *Systems can be designed to have a desired effect.*
  - DCI: *Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus, sustaining biodiversity so that ecosystem functioning, and productivity are maintained is essential to supporting and enhancing life on Earth. ~~Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.~~*

The Unit Guide states that there are three-dimensional learning objectives in each lesson and the targeted elements of each dimension are bolded. The document also states, "Each lesson also includes multiple informal formative assessment opportunities for students and the teacher to monitor and respond to student performance in three dimensions. Through discourse and writing, students are consistently able to share their thinking with peers and with the teacher and respond to the ideas of their peers. These provide opportunities for the teacher to assess and adjust their teaching approaches to better meet and respond to the current thinking of their students" (page 13). The last lesson of each module (Lessons 6, 14, 20, and 26) contain a performance assessment task.

The performance assessment tasks are not focused on engaging students in sense-making. Students are using the DCIs, CCCs, and SEPs, without applying them to a phenomena or problem. Often, these performance tasks simply ask students to complete the same activity with different elements and the phenomena remains the same. For example:

- Lesson 6: Students are told they will complete an assessment task both individually and as a group for this lesson. The first part of the assessment task instructs students to examine their claims from a previous lesson. Then students begin the independent portion of the task. "When groups have finished sorting the claims, students should work independently to assess the validity of a single media claim of their choice. Share the Lesson 6 Written Argument Rubric: Part 2 Task Look Fors with students and read them together. Share that students can use these Look Fors as a guide on how to achieve proficiency on the task. You can use the Lesson 6 Written Argument Rubric: Part 2 Task Rubric to assess students' performance on this task. At the

bottom, this rubric also contains guidance for how to support students in using a peer feedback protocol and an activity to discuss and norm on what features of high-quality student responses look like. Use either or both to have students reflect on and improve their work should you decide that additional steps are needed for your class to achieve proficiency" (page 4). Students use the following elements in the task:

- SEP: *Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible.*
- DCI: *All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors.*
- CCC: *When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.*

- Lesson 6*:* After completing parts 1 and 2 they begin part 3 where students are to construct a written argument. "Next, students will return to their argument from Lesson 1 Part 4: Writing an Initial Argument About Dairy's Impact on the Environment and revise their argument to indicate if they think the dairy system has an overall positive or negative impact on the environment. Students should use the evidence they gathered in this module to do so. Provide students with the Lesson 6 Written Argument Rubric: Part 3 Task Look Fors, read them together, and again allow them to use the Look Fors to guide their responses. Allow students time to individually construct a new argument based on their new understandings from this module. Students can record their new argument in Lesson 6 Student Guide Part 3: Construct a Written Argument" (page 5). Students are not applying learning to a new scenario or phenomena. Students use the following elements in the task:
  - SEP: *Construct, use, and/or present an oral and written argument or counter arguments based on data and evidence.*
  - DCI: *All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors.*
  - CCC: *Systems can be designed to do specific tasks.*
- Lesson 14: "After students have completed the task, you can use the Lesson 14 Written Argument Rubric: Part 2 Task Rubric to assess students' performance on this task. At the bottom, this rubric also contains guidance for how to support students in using a peer feedback protocol and an activity to discuss and norm on what features of high-quality student responses look like. Use either or both of these to have students reflect on and improve their work should you decide that additional steps are needed for your class to achieve proficiency. After returning their work to students, you can hold a reflective conversation about the veracity of the media claims. Be sure to highlight to students that it is true that dairy production contributes greenhouse gases to the atmosphere. However, many of these claims do not give context to share that greenhouse gas emissions from the agricultural industry are much less than that of

other industries. Acknowledge that the emissions can still be improved upon, but we are seeing how media claims are sometimes only partially accurate" (page 5). Students use the following elements in the task:

- SEP: **INFO-H4***: Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible.*
- DCI: **ESS2.D-H3***: Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.*
- CCC: **SPQ-H1***: The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.*

- Lesson 14: "Next, students will return to their argument from Lesson 14 Part 3: Construct a Written Argument and revise their argument to indicate if they think the dairy system has an overall positive or negative impact on the environment. Students should use the evidence they gathered in both modules 1 and 2 to do so. Ask students to gather their resources from the module, including models, data sets, and texts from the unit so far. Next, ask students to return to their argument from Lesson 6 about what they thought the overall impact of dairy production is on the environment. Students will now revise their arguments to try to come up with a holistic view of the dairy system based on what they learned in both module one and module two of this unit. Provide students with the Part 3 Task Look Fors, read them together, and again allow them to use the Look Fors to guide their responses. Allow students time to individually revise their arguments based on their new understandings from this module. Students can record their new argument in Lesson 14 Student Guide Part 3: Constructing a Written Argument. After students have completed the task, you can use the Lesson 14 Written Argument Rubric: Part 3 Task Rubric to assess students' performance on this task. At the bottom, this rubric also contains guidance for how to support students in using a peer feedback protocol and an activity to discuss and norm on what features of high-quality student responses look like. Use either or both of these to have students reflect on and improve their work should you decide that additional steps are needed for your class to achieve proficiency" (page 6). Students are not applying learning to a new scenario or phenomena. Students use the following elements in the task:
  - SEP: **ARG-H4**: *Construct, use, and/or present an oral and written argument or counterarguments based on data and evidence.*
  - DCI: **ESS3.A-H2***: All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors.*
  - CCC: **SYS-H1***: Systems can be designed to do specific tasks.*

Suggestions for Improvement

- Consider increasing the amount of support for teachers to monitor student learning of the targeted focal elements of all three dimensions.
- Consider clearly labeling the summative assessment tasks in the unit.

- Consider revising the summative tasks for each module to a different scenario that includes a different phenomenon or problem with three-dimensional questions, so students are able to show mastery of the unit PEs in different ways.

III.B. FORMATIVE	
Embeds formative assessment processes throughout that evaluate student learning to inform instruction.	
Rating for Criterion III.B. Formative	**Adequate** *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials embed formative assessment processes throughout the unit that evaluate student learning and inform instruction. Throughout the unit, many formative assessment opportunities are called out for teachers, and some support is provided for informing instruction based on student responses. However, most of this support is focused on making instructional decisions for the majority of the students in the classroom and few supports are provided to attend to the needs of individual students.

The Media Mayhem Unit Guide document states, "This unit contains multiple opportunities for formative assessment, including artifacts of student three-dimensional performance in each lesson and embedded student discourse and writing. In each lesson, one or more Formative Assessment Opportunity boxes call out a moment in the lesson in which students produce an artifact that shows their performance of the targeted three-dimensional learning objective for that lesson. The teacher can use these artifacts to assess students' understanding of the lesson goal by providing formative feedback and/or a grade or by having students give each other feedback on their artifacts" (page 13).

Related evidence includes:

- Lesson 2: A Formative Assessment Opportunity is contained in a yellow callout box located inside of the lesson. It focuses on when students develop a model to illustrate the relationships between inputs and outputs of the dairy system. The teacher is told to look and listen for "models that show components, interactions and that include inputs, outputs and boundaries and modes that show the relationship of how the diary system supports civilization to bring food to consumers" (page 6). The specific elements are indicated by the Look and Listen For bullets.
- Lesson 4: A Formative Assessment Opportunity callout box is located on page 7. It says, "Students revise their initial models to show how the dairy food system is a combination of major technological systems with various inputs and outputs, allowing it to perform its specific task of dairy food production." The teacher is told to look and listen for "models that show components, interactions and that include inputs, outputs and boundaries and modes that show

the relationship of how the diary system supports civilization to bring food to consumers" (page 7).

- Lesson 7: The Formative Assessment Opportunity is called out on page 7. It states, "Students develop a model to illustrate the interactions between the Earth's system and greenhouse gas emissions released from the dairy food system, resulting in changes in the atmosphere." The teacher Look and Listen Fors include: "Models show matter and energy as they interact with components of the model. (MOD-H3) (EM-H2). Models include changes in the atmosphere due to the dairy food system. (MOD-H3) (ESS2.D-H3) (EM-H2)."
- Lesson 10: Page 6 contains the Formative Assessment Opportunity which features, "Students develop and use a model of how carbon flows between components of the Earth system, including among the biosphere, hydrosphere, oceans, and geosphere, through chemical, physical, geological, and biological processes." The teacher is told to look and listen for the following: "Class Consensus Model shows and defines each of the different Earth system. (MOD-H3) (EM-H2) (SPQ-H1) The model shows carbon exchanged among the biosphere, atmosphere, oceans, and geosphere. (MOD-H3) (LS2.B-H3) The movement of carbon is happening through chemical, physical, geological, and biological processes. (MOD-H3) (LS2.B-H3)" (page 6).
- Lesson 16: Page 5 contains the Formative Assessment Opportunity callout box which states, "Students create a computational model to examine patterns using mathematical representations that reveal how habitat destruction impacts biodiversity." The teacher is told to look and listen for the following: "Students use the computational model to compare how biodiversity changes as land use changes. (MATH-H2) (LS4.D-H2) (PAT-H4) Patterns in biodiversity, as revealed by the results of the computational model, show how the dairy system impacts biodiversity. (MATH-H2) (LS4.D-H2) (PAT-H4)" (page 5).
- Lesson 19: The Formative Assessment Opportunity states, "Students use a computational model to calculate how biodiversity can change when a grazing system is designed to accomplish a new task protecting biodiversity" (page 5). The teacher Look and Listen For states, "Students use the computational model to compare how biodiversity changes under a grazing management system. (MATH-H2) (LS4.D-H2) Students use the results of the computational model to provide evidence to describe how the grazing system is designed to accomplish a new task: protect biodiversity. (MATH-H2) (LS4.D-H2) (CE-H3) (SYS-H1)" (page 5).
- Lesson 22: The Formative Assessment Opportunity states, "Students define criteria and constraints to help redesign the dairy system to accomplish new tasks, taking into consideration risk management, cost, safety, reliability, and social, cultural, and environmental impacts" (page 5). The teacher Look and Listen Fors state, "Students classify their list of criteria and constraints into the corresponding categories: scientific, social, cultural, economic, and environmental needs. (AQDP-H8) (AQDP-H9) (ETS1.A-H1) Students should be able to justify their criteria/ constraint choices based on the new tasks they want the dairy system to accomplish (ETS1.A-H1) (SYS-H1)" (page 5).

In most of the Formative Assessment Opportunity sections, there are notes to the teacher about how to use the results of the formative assessment to modify instruction. However, some of the time the

suggestions do not attend to issues of equity, and the strategies suggested do not help teachers respond to student thinking in relation to the learning targets. For example:

- Lesson 2: "To Provide Additional Support for Students: As students work in groups, approach each group to look at their models. If students are struggling to identify what components and interactions to include, ask questions such as: What components are important to include to explain how dairy products are made? Pick two components that you think interact with each other. What are some ways your model uses pictures or words to show this interaction? How does your model show how the dairy system supports human needs? Use systems language with questions such as, 'What inputs and outputs exist for this component?' or 'What things are a part of this system, and what things are outside of this system?' Focus students' attention on a part of the model they may be missing" (page 6). However, the suggestions do not help teachers respond to student thinking in relation to the learning targets.
- Lesson 4: "To Provide Additional Support for Students: As students work in groups, approach each group to look at their models. If students are struggling to identify how to connect their components and determine the system boundaries, ask questions such as: What components are important to include to explain how dairy products are made? Pick two components that you think interact with each other. What are some ways you use pictures or words to show this Interaction? Based on your model, what seems to be the overall task that the dairy system accomplishes? Use systems language with questions such as, 'What inputs and outputs are important for this component?', 'What things are a part of this system and what things are outside of this system?', or 'What impacts does this component have that affect things outside of the system?' Focus students' attention on a certain part of the model they may be missing" (page 8). The teacher is not given any guidance as to how to change instruction based upon student responses to the support.
- Lesson 5: "To Provide Additional Support for Students: If students are struggling with adding the inputs, outputs, or boundaries, consider providing the following prompts: Remind them to refer to the last lesson's model conventions chart to ensure all areas are completed. Have students start with the first components, ask students to talk through the process, and have the partner take notes. This will get the ideas out of their head and onto paper. Remind the students that this is a process, and they will continue to refine it as we learn" (page 6).
- Lesson 8: "To Provide Additional Support for Students: As students work on interpreting the models and their explanations, approach each group to look at their work. If students are struggling, consider providing the following prompts: Focusing students' attention on specific features of the model that they may have missed. Sharing a more relatable example of how to identify strengths and limitations of models, such as two different kinds of weather maps. Asking students to view two models side-by-side and compare their features one at a time. Helping students define a system and the system boundaries as we think is best to communicate our ideas and set the focus for the analysis we are doing" (page 9).
- Lesson 9: "To Provide Additional Support for Students: As students work in groups, approach each group to look at their work. If students need additional support in developing their models, consider asking the following questions: What evidence from the previous lessons did you use to

find new components to add to your model? What new ideas did you add to your model? What are you trying to show? Are the boundaries of the system still the same, or do you think they should change? If they need to change, what needs to be shown as part of the system now? How do you think methane and carbon dioxide added to the atmosphere result in the greenhouse effect? Do you think they act the same or differently? What flows of energy within, into, and out of the system should we show in this model? How will that help us explain the greenhouse effect?" (page 3). This is the same support that is provided to students in Lesson 8. These suggestions do not help teachers respond to student thinking in relation to the learning targets.

- Lesson 11: "To Provide Additional Support for Students: As students work on their models, approach them to see their work. If students are struggling, consider providing the following prompts: Asking students to refer to their resources from the previous lessons and try to find new components and processes to add to their model. Focusing students' attention on areas of their models that may be missing something and asking them what might help explain the connection between carbon and the greenhouse effect. Providing students with a graphic organizer to help keep track of the flows of matter from cows or factories to the next components of the system, and to keep track of flows of energy from the Sun into the Earth system" (page 4).
- Lesson 13: "To Provide Additional Support for Students: As students are working, move around the room to see their progress. If students are struggling, consider providing the following prompts: Why are we using this computer model? What are the different things we can change in the computer simulation? How easy or difficult would it be to change these different things in society? According to this simulation, what would happen if we did nothing? What things in the simulation increase greenhouse gas emissions? How do you know? What things in the simulation decrease greenhouse gas emissions? What choices do you think we as a society could change to reduce greenhouse gas emissions? Why would some changes be harder than others to implement? What were the strengths of this model? What were its limitations?" (page 6). The teacher support doesn't assist students in making the connections needed to complete the formative assessment task.
- Lesson 15: "To Provide Additional Support for Students: As students work, if students are struggling to identify the strengths and limitations of each other's models, consider providing the following prompts to facilitate additional questions: What does this type of model show that others do not? What does it not show? Does this type of model clearly show how the construction of the dairy system impacts biodiversity? We have figured out a lot about different systems affected by the dairy food system. What new systems were introduced in the videos we watched? What new questions do we have about these systems?" (page 6). The teacher support doesn't assist students in making the connections needed to complete the formative assessment task.
- Lesson 18: Formative Assessment Opportunity. "Students develop and use a model to illustrate how the design of the dairy food system can have adverse impacts on biodiversity" (page 3). A

list of what to look and listen for is provided and connected to specific elements. Suggestions, in the form of questions, for additional support are also provided.

- Lesson 20: After writing an argument, students share with peers and provide respectful critiques of their peers' ideas using the provided protocol. It is stated, "This is now the third time in the unit that students have engaged in a respectful argumentation session. Accordingly, you can ask students to engage in argumentation without the support of a protocol to see how proficient they have become in respectful argumentation" (page 7).
- Lesson 23: Formative Assessment Opportunity. "Students gather and summarize central ideas from texts to evaluate competing design solutions that can redesign components of the dairy system to improve on the problems of the dairy system while considering a variety of criteria and constraints" (page 7). A list of what to look for and listen for is provided and connected to specific elements. Suggestions for additional support, in the form of questions to ask, for students are provided.

Suggestions for Improvement

- Consider aligning the focal elements of each dimension being assessed to the lesson objectives and the formative assessment opportunities.
- Consider including additional opportunities within formative assessments for students to demonstrate their thinking in whatever way is best for them in order to attend to students' individual levels and needs.

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	**Extensive** *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials include aligned rubrics and scoring guidelines that help the teacher interpret student performance for all three dimensions.

- Each lesson (except the four summative assessment lessons) has a three-dimensional learning objective and targeted elements that are identified on the first page. Each lesson also claims the lesson learning objective as an assessment target for at least one assessment opportunity and

names Look Fors related to all three dimensions along with an assessment rubric. Examples include:

- Lesson 2:
  - The Targeted elements for this lesson are:
    - SEP: **MOD-H3**: *Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.*
    - DCI: **ETS2.B-H1**: *Modern civilization depends on major technological systems, including those related to agriculture, health, water energy, transportation, manufacturing, construction, and communications.*
    - CCC: **SYS-H2**: *When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.*
  - The formative assessment target halfway through the lesson is indicated as being the same as the overall lesson learning goal: "Students develop a model to illustrate the relationships between the inputs, outputs, and boundaries of the dairy food system" (Teacher Guide, page 6).
  - Three student Look Fors are provided for the teacher, along with a rubric. These Look Fors and the rubric relate to all three dimensions.
- Lesson 5:
  - Both the lesson-level learning goal and the formative assessment target are: "Students use evidence from scientific literature to revise their dairy system model to include economic, social, environmental, and geopolitical costs, risks, and benefits that extend beyond the boundaries of the dairy system" (e.g., Teacher Guide, page 6).
  - Three student Look Fors are provided for the teacher, along with a rubric. These Look Fors and the rubric relate to all three dimensions (Teacher Guide, pages 6 and 7).
- Lesson 8:
  - Both the lesson-level learning goal and the formative assessment target are: "Students use multiple types of models, based on model merits and limitations, to simulate the greenhouse effect, including flows of energy and matter within the Earth system and how human activity has altered the greenhouse effect."
  - Four student Look Fors are provided for the teacher, along with a rubric that shows example student answers at each level of proficiency (Teacher Guide, pages 9 and 10).
- Lesson 12:
  - Both the lesson-level learning goal and the formative assessment target are: "Students construct, use, and present a written argument based on data and evidence to compare the quantity of carbon dioxide emissions from various human activities."
  - Three student Look Fors are provided for the teacher, along with a rubric that shows example student answers at each level of proficiency (Teacher Guide, page 6).

- Lesson 16:
  - Both the lesson-level learning goal and the formative assessment target are: "Students create a computational model to examine patterns using mathematical representations that reveal how habitat destruction impacts biodiversity."
  - Three student Look Fors are provided for the teacher, along with a scoring rubric. The proficient student response descriptor, but not the Look Fors, shows evidence of all three dimensions. The student Look Fors do not mention the targeted CCC element.
- Lesson 21:
  - Both the lesson-level learning goal and the formative assessment target are: "Students identify the benefits, costs, and risks of the dairy system, which they use to define a problem in the system that can be improved upon to manage natural resources more responsibly."
  - Three student Look Fors are provided for the teacher, along with a scoring rubric that shows sample student responses and each level of proficiency.

- Sample student answers are included in the summative assessment task rubrics (Lessons 6, 14, 20, and 26). However, these responses are not always tied to identified elements. For example:
  - Lesson 6: The targeted CCC element in the Part 2 Task Rubric (Rubric page 1) is: *When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models*. However, neither the Proficient-level student response nor the student Look Fors are related to this CCC element.
  - Lesson 20: The targeted SEP element in the Part 2 Task Rubric is: *Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible.* However, the Proficient-level student response and the student Look Fors only describe stating whether claims are accurate, inaccurate, or misleading. No mention is made of evaluating the sources of the claims.
- In the assessment tasks for Lessons 6, 14, 20, and 26, the student Look Fors are given to students, allowing them to self-assess.
- Each lesson gives teachers a completed student guide example page that contains example student responses for each part of the student guide.

Suggestions for Improvement

Consider ensuring that scoring guidance fully matches all elements of the three targeted dimensions.

Media Mayhem

EQuIP RUBRIC FOR SCIENCE EVALUATION

III.D. UNBIASED TASK/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** *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials assess student proficiency using accessible vocabulary, representations, and examples. Throughout the unit students are presented with text in assessments through an interactive and accessible manner, and vocabulary is grade appropriate. Students are provided with enough context to engage with assessments, and prompts are generally provided in at least two modalities (orally from the teacher and written in the Student Guide). However, there is little support for teacher awareness of the limitations of the scenarios presented for reaching all students and for providing students choices of responses across multiple modalities.

Related evidence includes:

- Throughout the unit, students are given a mix of text, visuals, and data tables to engage in formative assessment tasks.
- Throughout the unit, students are asked to respond in a variety of ways: talking about their learning with groups and the class, writing their answers, modeling ideas in a variety of forms, and engaging in gallery walks. Expected responses from students are included in the Look Fors callout boxes, but only a limited number of correct responses are included. This may bias the teacher for certain look for phrases and cause other forms of expression to be overlooked.
- Readings are provided that have been adapted from scientific texts to include grade-level appropriate texts in Lessons 3, 5, 17, 19, and 23.
- Lesson 4: In the Formative Assessment Opportunity, students are "revising their initial models to show how the dairy food system is a combination of major technological systems with various inputs and outputs, allowing it to perform its specific task of dairy food production" (page 7).
- Lesson 6: Students complete a summative task for the first module. While they have opportunities to work in a group to complete the first part of the task (re-sorting their claims), they complete parts 2 and 3 independently as they engage in writing tasks. Students only express their understanding through their written arguments.
- Lesson 9: In the Formative Assessment Opportunity, students are "revising their greenhouse effect models to illustrate how energy flows into and within the Earth system depending upon atmospheric greenhouse gas concentrations" (page 3).

- Lesson 12: Students participate in 4 Corners Routine to share with their peers their initial claim about how the dairy industry's emissions compare to other industries.
- Lesson 14: Students complete a summative task for module 2. They engage with the same activities as Lesson 6 including a group activity to sort claims, then two writings tasks. In the two writing tasks, students only express their understanding through their written arguments.
- In Lessons 20 and 26, students only express their understanding through their written arguments.
- Lesson 24: In the Formative Assessment Opportunity, students are "preparing a presentation to communicate how they are redesigning a part of the dairy system to help it improve upon its costs and risks" (page 4).

Students are supported in developing and understanding common language that is used in assessment tasks.

- Lesson 8: After students have developed an explanation of the mechanisms for how greenhouse gas emissions may lead to an increase in average temperatures, the teacher "can define the term greenhouse effect…. Students might be familiar with this term, so it is important to come to an agreement on what it means before moving on to the next lesson" (page 10).
- Lesson 9: "After the Class Consensus Model is built, you can help students unpack how they have used the term climate change throughout the module so far…. share with students that the long-term shifts in Earth's average temperature, in addition to other changes in long term climate patterns, are what we mean when we say climate change" (page 7).
- Lesson 16: "Some students might not be familiar with the term 'monoculture crop.' Assist students in understanding the term by asking if anyone knows what the root 'mono' means. Build on their understanding by asking students for examples of monoculture crops" (page 3).

Suggestions for Improvement

Consider including multiple modalities and student choice in summative assessment tasks

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** *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials include pre-, formative, summative, and self-assessment measures that assess three-dimensional learning. Although the teachers are provided with a purpose and rationale for how, when, and why student learning is measured across the materials, the rationale is not always clear on why elements are assessed in the order that they are actually assessed in the materials.

Assessment targets are identified for all summative assessments and align with the learning goals. The reviewers assumed that the formative assessment Look Fors were the assessment targets for the formative assessments throughout the modules. These Look Fors align with the learning goals.

Evidence of at least one example of each type is provided below:
Pre-Assessment:

- The Media Mayhem Unit Guide states, “In the Anchor Phenomenon lesson and in the Engage lessons in this unit, students create initial arguments or models of phenomena. In these lessons, students share the knowledge they have about the phenomenon from their own background experience. Accordingly, these are tagged as Pre-Assessment opportunities. The NGSS elements addressed in these lessons are tagged ‘Pre-Assessment’. These elements are not meant to be developed in the given lesson and instead are meant to be used by students for the first time such that the teacher can get a formative assessment on what prior knowledge students have of using these elements” (page 14).
- Lesson 2: All three dimensions are tagged as “pre-assessment” in this lesson. The Formative Assessment Opportunity states, “Students develop a model to illustrate the relationships between the inputs, outputs, and boundaries of the dairy food system” (page 6).
- Lesson 7: All three dimensions are tagged as “pre-assessment” in this lesson. The Formative Assessment Opportunity states, “Students develop a model to illustrate the interactions between the Earth’s system and greenhouse gas emissions released from the dairy food system, resulting in changes in the atmosphere” (page 5).
- Lesson 15: The DCI and CCC are tagged as “pre-assessment” in this lesson. The Formative Assessment Opportunity states, “Students develop initial models about the effects of the dairy

food system on biodiversity. Students evaluate the strengths and limitations of their peers' models" (page 6).

Formative Assessment:

- The Media Mayhem Unit Overview states, "This unit contains multiple opportunities for formative assessment, including artifacts of student three-dimensional performance in each lesson and embedded student discourse and writing. In each lesson, one or more Formative Assessment Opportunity boxes call out a moment in the lesson in which students produce an artifact that shows their performance of the targeted three-dimensional learning objective for that lesson. The teacher can use these artifacts to assess students' understanding of the lesson goal by providing formative feedback and/or a grade or by having students give each other feedback on their artifacts" (page 13).
- There are no Formative Assessment Opportunities in Lessons 6, 14, and 20 because these lessons contain the End of Module Task Assessments. However, this is a missed opportunity for formative assessments to occur before the writing task begins. All of these lessons feature the students completing two writing assignments. The first writing assignment does not always contain focal elements, but the second does, so the students are practicing writing their argument but with different elements the same day that they complete their summative writing.
- See additional evidence in Criterion III.B.

Summative Assessment:

- The Media Mayhem Unit Overview states, "Each module ends with a summative assessment opportunity in an Evaluate lesson. Students are evaluated on a three-dimensional combination of the unit focal elements in one or more tasks. The unit ends with a final performance task in which students demonstrate their proficiency of selected focal elements for the unit. Each summative assessment task comes with a rubric that can be used to assess students' progress towards proficiency in three dimensions and a set of Look Fors that students can use to guide their performance on the task" (page 13).
- Lessons 6, 14, 20, and 26 feature students completing the end of module writing task as the summative assessment. The activities for these lessons are the same, students are given time to re-sort their claims from Lesson 1 before they are given the rubric and Look Fors for the writing assessment.
    - Lesson 6: Students will reassess the claims made in Media Claims 1, 4, 8, and 13 from Lesson 1. Students use the information from their model and other evidence collected to re-sort the media claims, which may be completed in small groups. Independently, students assess the validity of a single media claim of their choice through a written argument.
    - Lesson 14: Students will reassess the claims made in Media Claims 2, 5, 6, 7, 9, and 10 from Lesson 1. Students use the information from their models, data sets and texts thus far gathered and used in this unit to revise their argument from Lesson 6.
    - Lesson 20: Students will reassess the claims made in Media Claims 11 and 12 from Lesson 1 to revise their argument from Lesson 14. "Share with students that this is the final time that

they will be updating this argument, so they will now be pulling together evidence from across the unit and using it to an overall understanding of the impacts of the diary system on the environment" (page 5).

- Lesson 26: Students are provided with two new media claims. After determining if the claims are valid, misleading, or invalid students "use evidence from the whole unit to verify or refute the information presented" in each claim (Student Guide, pages 1–2).

Self-Assessment:

- The Media Mayhem Overview states, "At the end of each Evaluate lesson in each module, students are provided with an opportunity to self-evaluate their progress in working with one or more of the focal SEP elements for the module. This gives students an opportunity to share how they think they are doing and how the classroom experience is going for them. This also provides the teacher an opportunity to check on how students are perceiving their classroom experience. Students are also provided with Look Fors on each Summative Assessment task that they can use to self-assess the artifact that they have produced on the assessment task" (page 13).
- Lesson 6: "After students have written their arguments, provide the Lesson 6 Student Handout Student Self-Assessment. Ask students to complete the Written Argument Self-Reflection checklist to give an opportunity for them to ensure they have met the requirements. If students don't have all the elements in the checklist, direct them back to their Class Consensus Model and suggest they look for additional evidence. Be sure to provide them with time to revise their written argument based on their self-reflection" (page 5).
- Lesson 14: "After students have written their arguments, provide the Lesson 14 Student Self-Assessment handout. Ask students to complete the Written Argument Self-Reflection checklist to ensure they have met the requirements. If students find they don't have all the elements in the checklist, suggest they look again at the arguments they have written. Give students time to revise their written argument based on their self-reflection" (page 7).
- Lesson 15: "Using the Stay and Stray Strategy allows students to compare and contrast their models with other students. This will help them observe the various ideas around the room to help open discussion on the topic and agree on and integrate new ideas. This allows them to self-evaluate the strengths and weaknesses of their model before implementing edits" (page 7).

Suggestions for Improvement

- Consider explicitly identifying how all assessments throughout the unit connect to multi-dimensional learning goals.
- Consider including summative tasks to measure students' learning of all focal elements.
- Consider adding an easily identifiable rationale for teachers to understand how, when, and why student learning is measured throughout the Teacher Guide lessons.
- Consider changing the formatting of the summative assessment tasks, presenting students with a scenario that would allow students to apply their new understanding of the phenomena.

Media Mayhem

EQuIP RUBRIC FOR SCIENCE EVALUATION

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	**Adequate** *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials provide iterative opportunities for students to demonstrate performance of practices connected with their understanding of DCIs and CCCs. For key claimed learning in the unit, there are at least two student performances that provide students with the opportunity to demonstrate their growth in proficiency over time. Additionally, while students have opportunities to use peer feedback to improve on their performance of tasks, there are no opportunities for them to use teacher feedback to improve on their performance.

Some opportunities are provided for student performance of **Developing and Using Models** in connection with the DCIs and CCCs. Related evidence includes:

- Lesson 4: "The class will now produce a new Class Consensus Model that shows how dairy foods get to consumers. Ask students to share their four-component models in order from the start to the end of the dairy production system" (page 8).
- Lesson 5: "Students will now use the evidence gathered throughout this lesson to revise the Class Consensus Model from Lesson 4 Part 4: Create a Class Consensus Model to help us better understand our Driving Question: "What is the impact of the dairy system on the environment?" Prompt students to use their graphic organizer from Lesson 5 Part 3: Obtaining Information from Texts to edit their model. The model must include all of the identified social, economic, environmental, and geopolitical costs and benefits of the system. Costs and risks should be written in red and benefits in green. Groups can add to their existing models from Lesson 4 or draw a new dairy system model in the Lesson 5 Student Guide Part 4: Revise Your Dairy System Model" (page 5).
- Lesson 7: "Students will create an initial model that shows how they would currently answer the Module Question on their Lesson 7 Student Guide Part 3: Creating an Initial Model. Allow students time to create a model to show how they think cow burps influence the climate. As students start to work on their models, hold a class discussion to determine how students will define the system, the components of the system, and the boundaries of the system they are considering for this model. Share that just like in their models of the dairy system from module one, students can define the system and system boundaries here. Build on student responses to confirm that the components of the system can include the Earth, dairy cows, and transportation trucks" (pages 4–5).

- Lesson 9: "Students will revise their initial model that shows how they would now answer the Module Question: 'How could cow burps be influencing climate change?' As students work on their Lesson 9 Part 2: Revisiting Initial Models, circulate the room to formatively assess their models and provide feedback by asking questions about their models" (page 3).

Students have opportunities to use some DCI elements several times iteratively during the unit. For example:

- Students have multiple opportunities to engage with the claimed **LS4.D** element, but it is not fully developed.
  - Lessons 15–20: Students focus on the effect of the diary system on the biodiversity of the environment. These effects focus on overexploitation and habitat destruction and do not explore the preservation of landscapes of recreational or inspirational values.
- Students have multiple opportunities to engage in the claimed **ESS2.D** element.
  - Lessons 7–14: Students focus on the role of the dairy system on methane and carbon dioxide concentrations. Students explore other sectors to compare their impact on global temperature changes with that of the overall agricultural system.

Students have multiple opportunities to use a CCC element from **Systems and System Models**.

- Lesson 5: Students develop a model of the dairy system, identifying various costs and benefits of the system. Students then reflect on the dairy system design and the unintended consequences of that design.
- Lesson 19: Students explore the effects of a rotational grazing system on the biodiversity of the farmland and how the system is designed to accomplish this feat.
- Module 4: Students design a solution to a problem associated with the dairy system industry. As they design their solution, they take into account the specific tasks required by the dairy system while meeting specific criteria to address the identified problem.

Feedback is provided to students. However, it only occurs when students are completing the summative assessment task. There are also some opportunities for students to receive and respond to peer feedback, but these are not explicitly called out in the unit. For example:

- Lesson 4: "The class will now produce a new Class Consensus Model that shows how dairy foods get to consumers. Ask students to share their four-component models in order from the start to the end of the dairy production system" (page 8). Feedback is not called out in this lesson; however, this would be a good place for students to engage with the peer feedback rubric prior to the Lesson 6 assessment task.
- Lesson 6: "After students have written their arguments, provide the Lesson 6 Student Handout Student Self-Assessment. Ask students to complete the Written Argument Self-Reflection checklist to give an opportunity for them to ensure they have met the requirements. If students don't have all the elements in the checklist, direct them back to their Class Consensus Model and suggest they look for additional evidence. Be sure to provide them with time to revise their written argument based on their self-reflection. Then, have students share their written

arguments in pairs and provide a respectful critique of the ideas of their peers. Use the protocol below to support students in providing a respectful critique of their peer's argument" (page 6).

- Lesson 14: "After students have written their arguments, instruct them to share their arguments with their peers and provide respectful critiques of their peers' ideas using the protocol below. Once again provide the Look Fors for students to review prior to beginning the task. Students can use these Look Fors to guide their responses. Students can capture their critiques that they will later share with their partner on their Lesson 14 Student Handout Critique Notes" (page 17).
- Lesson 20: "After students have written their arguments, provide the Lesson 20 Student Self-Assessment handout. Ask students to complete the Written Argument Self-Reflection checklist to give an opportunity for them to ensure they have met the requirements. If students don't have all the elements in the checklist, suggest they look again at the arguments they have written. Give students time to revise their written argument based on their self-reflection" (page 7).

Suggestions for Improvement

- Consider providing additional opportunities for students to receive written and oral feedback from their peers. In addition, supports for formal written feedback from the teacher and students using the feedback to revise their explanations and models before the summative writing tasks would be helpful.
- Consider prompting teachers to provide these kinds of iterative use-feedback-use cycles for all of the learning goals in all three dimensions.

OVERALL CATEGORY III SCORE: **3** (0, 1, 2, 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

SCORING GUIDES

SCORING GUIDES FOR EACH CATEGORY

UNIT SCORING GUIDE – CATEGORY I (CRITERIA A-F)

UNIT SCORING GUIDE – CATEGORY II (CRITERIA A-G)

UNIT SCORING GUIDE – CATEGORY III (CRITERIA A-F)

OVERALL SCORING GUIDE

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)

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

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

Media Mayhem

EQuIP RUBRIC FOR SCIENCE EVALUATION

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)