Tree Mass - A Seedling Changes Into a Large Tree
EQuIP Rubric for Science Evaluation

Developer/Curriculum: K–12 Alliance
Unit Name: Tree Mass: A Seedling Changes Into a Large Tree
Grade: 6–8
Date of Review: March 2020
Overall Rating (N, R, E/I, E): E/I
Category I: NGSS 3D Design Score (0, 1, 2, 3): 2
Category II: NGSS Instructional Supports Score (0, 1, 2, 3): 2
Category III: Monitoring NGSS Student Progress Score (0, 1, 2, 3): 2

Total Score (0–9): 6

Click here to see scoring guidelines

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

Category I Criteria Ratings		Category II Criteria Ratings		Category III Criteria Ratings	
A. Explaining Phenomena/Designing Solutions	Extensive	**A. Relevance and Authenticity**	Adequate	**A. Monitoring 3D Student Performances**	Adequate
B. Three Dimensions	Adequate	**B. Student Ideas**	Adequate	**B. Formative**	Adequate
C. Integrating the Three Dimensions	Extensive	**C. Building Progressions**	Adequate	**C. Scoring Guidance**	Inadequate
D. Unit Coherence	Extensive	**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	Adequate	**F. Teacher Support for Unit Coherence**	Adequate	**F. Opportunity to Learn**	Adequate
		G. Scaffolded Differentiation Over Time	Inadequate		

Summary Comments

Thank you for your commitment to students and their science education. Achieve is glad to partner with you in this continuous improvement process. The reviewers feel that with appropriate revisions, this unit has great potential to be an example of a high quality NGSS design unit. The reviewers would like to highlight the following strengths:

- The unit has a very strong NGSS three-dimensional design. Emphasis on practices and crosscutting concepts in connection with the disciplinary core ideas is clear and intentional. Students are regularly engaged in the three dimensions. In addition, the color-coded three-dimensional lesson concepts are very helpful for teachers.

- The unit overview, prior learning explanations, and conceptual flow map chart are very helpful and useful for understanding the unit and the individual lessons.
- The lessons are open enough for teacher autonomy but clear and structured enough to give a clear picture of the three-dimensional learning that is taking place.

During revisions, the reviewers recommend focusing on the following areas:

- Structuring the phenomenon and driving question more around student-generated questions or a problem to solve would better engage students with the unit.
- Making more connections to students' lives and communities would help increase the authenticity of the learning for students.
- Using a wider variety of modalities in student tasks could make the learning more accessible to all learners. Differentiation strategies for advanced students could also be added.
- More variety and structure in assessment strategies and feedback would be helpful.
- Adding rubrics and scoring guides for student sensemaking tasks throughout the lessons and unit would be helpful.

Note:

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

Tree Mass

EQuIP Rubric for Science Evaluation

Category I. NGSS 3D Design

Score: 2

__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)

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

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

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

(None, Inadequate, Adequate, Extensive)

The reviewers found extensive evidence that learning is driven by students making sense of phenomena or designing solutions to a problem because the entire unit is focused around the same phenomenon and having students make sense of the phenomenon in their models. Student learning is focused on supporting students to better make sense of the phenomenon and regularly return to the phenomenon to add layers of explanation.

Evidence related to this phenomenon includes:

- Every lesson in the unit relates back to students designing a model to explain where a tree gets its mass and its material to grow. Students revisit their model during every lesson and revisit the initial video showing the phenomenon several times. Student learning is driven by making models, designing investigations, and obtaining information in order to develop their explanations further.
- In Lesson 7.1 (page 4), students ask questions about the phenomenon. In Lesson 7.2 (page 7), students return to the questions that were generated in the first lesson and continue to add additional questions to their list. Students continue to ask questions about how plants get and use matter and energy in Lesson 7.4 as well as investigate their previous questions to help them make sense of the phenomenon.
- Lesson 7.3 step 14: Students are asked what questions they still have and the teacher is told to use the questions to help plan for the next series of lessons.
- Lesson 7.4 step 3: "Direct students to their previous questions (in class chart and their notebooks) and ask them to consider what questions they have developed that relate to how the plant is getting energy or how the plant is using energy to get more matter."

- Lesson 7.5 step 1: "Ask students to refer to the questions generated about trees and the matter they accumulate and consider if there are any new questions they want to add. Add new questions if necessary. This would also be a good time to review the previous class questions and identify those which have been answered and which remain."
- Lesson 7.1 step 6: Students discuss their questions in pairs and their table; step 7: There is a class discussion around what particular question or questions should be investigated.

Suggestions for Improvement

None

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. Provides opportunities to *develop and use* specific elements of the SEP(s). Provides opportunities to *develop and use* specific elements of the DCI(s). 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 because students are regularly engaged in the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts throughout the unit as they make sense of the central phenomenon.

Science and Engineering Practices (SEPs): Adequate

The reviewers found adequate evidence that students have the opportunity to use or develop the SEPs in this unit because students **develop and use models**, **plan and carry out investigations**, and **obtain, evaluate and communicate information** at a grade-appropriate level in multiple lessons in the unit.

Examples of student engagement with the SEPs claimed in the documentation include:

Developing and Using Models

- *Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. Develop and/or use a model to predict and/or describe phenomena.*
    - In Lesson 7.1 (pages 9–10), students create "a model and their model should include both drawings and words. Their model should represent their initial ideas about the focus

question related to the tree mass." Students construct individual models then construct a group model.
- In Lesson 7.2 (page 5), after students plan a possible investigation to identify elements that enter a system, students then are instructed to refocus on their group model. Students are asked "What evidence would improve their model?" On page 7 step 13, students are directed to "look at their initial model from day one and add any new ideas or wondering they have to their model."
- In Lesson 7.3 (page 5), students create models of historical investigations they are reading about.
- In Lesson 7.4 (page 10, step 18), students are asked to "record their new ideas about plants, matter and models into their notebook. Students then are asked to consider what questions they have now about how plants get/use energy and matter, the relationship between matter and energy, their models or any thoughts about the phenomenon."
- In Lesson 7.5 (page 5 step 5), students review a flow chart to help them answer questions related to the process that plants use to live and grow. "...Remind students that they have used and developed models before. Ask students 'What do you remember about how they have used or developed models throughout the learning sequence? How have your models changed to improve their ability to describe the phenomena? What aspects of your models have been useful?'"
- In Lesson 7.6, students apply the information they have obtained and evidence they have collected to develop their model deeper and add in invisible aspects of the process including energy inputs and outputs and gases being exchanged.

- *Evaluate limitations of a model for a proposed object or tool.*
  - In Lesson 7.2 (page 5), students are encouraged to "consider their current model of the system and look for areas where their model may be limited. What evidence could they provide to improve their model?"
  - In Lesson 7.4 (page 4), students "continue to consider the limitations of their models to decide what additional evidence they need to revise and improve their models."

<u>Planning and Carrying Out Investigations</u>

- *Plan an investigation individually and collaboratively and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurement will be recorded and how many data are needed to support a claim.*
  - In Lesson 7.2 (student worksheet page 8 and 9), students plan an investigation in which they must identify their independent, dependent, control variables, methods of measuring, and data to be collected in order to test where material for the plant is coming from.
  - In Lesson 7.4 steps 6–11, students plan an investigation to help explain what gases are exchanged in plant growth. Students decide on their independent variables, dependent variables, control variables, methods, etc.

- *Collect data to produce data to serve as the basis for evidence to answer scientific questions.*
    - In Lesson 7.4 steps 12–15, students collect and report data from their designed experiments using bromothymol blue to help answer the question of what gases are used by the plant.

Constructing Explanations

- *Construct an explanation using models or representations.*
    - In Lesson 7.7 (page 4), students revise their model where they use evidence and reasoning to support their details in the model. On page 5 (step 10 B), students "construct a brief description of their model to show how a tree gets mass to develop into a large tree."

Obtaining, Evaluating, and Communicating Information

- *Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).*
    - In Lesson 7.3, students critically read four short adapted texts to obtain scientific information to describe patterns in or evidence about the natural world. The texts summarize historical experiments that investigate the variables that were present in the students' planned investigations. Students summarize and communicate for each article what the method was, the data collected, and the results including inputs, outputs, variables, energy, etc. to provide evidence for what provides the mass for a growing tree.
    - In Lesson 7.5, students are given a one-page document describing the process of photosynthesis. Students annotate and use the information in the article to modify their input-output models to explain the central phenomenon.

Disciplinary Core Ideas (DCIs): Adequate

The reviewers found adequate evidence that students have the opportunity to use or develop the DCIs in this unit because students engage in the DCIs at a grade-appropriate level regularly throughout the unit.

Examples of student engagement with the DCIs claimed in the documentation include:

LS1.C Organization for Matter and Energy Flow in Organisms

- *Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.*
    - In Lesson 7.4, students build upon the learning about the learning from Lesson 7.3 where they learned that plants need sunlight to add mass, but soil and water are not part of the additional mass. In pages 4–5, step 4, students engage in a "discussion about gases and how to find out more about them." "If students bring up these gases, acknowledge the

idea and suggest that we need additional data to understand that better." Later in the investigation, students investigate the gasses that are exchanged within the plant. In pages 9–10 step 17, "students should include ideas about how matter moves into and out of the plan in different conditions (the plan absorbed CO2 when placed in sunlight but not when placed in the dark."
    - In Lesson 7.5, page 7, step 17, students "take their carbon dioxide and water molecules apart and try to create the sugar molecule described in the reading."

PS3.D Energy in Chemical Processes and Everyday Life

- *The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen"*
    - This element is found throughout the unit and is the central theme of the lesson, particularly in Lessons 7.4 and 7.5 in which carbon dioxide and the rearrangement of atoms is addressed in student models. Students are also further developing the knowledge that they have previously learned and are building on it by providing deeper explanations of how the matter and molecules are being rearranged in the three. Parts of the DCI are addressed at a 9–12 grade band level.
    - In Lesson 7.4, pages 9–10 step 17, "students should include ideas about how matter moves into and out of the plan in different conditions (the plan absorbed CO2 when placed in sunlight but not when placed in the dark."
    - In Lesson 7.5 page 6 (step 12), students work with "atoms" to try to arrange molecules of carbon dioxide and water on the "inputs" side of H1. Bonding rules are not focused on this point but to "represent the matter that creates water and carbon dioxide and to physically represent how they are arranged during photosynthesis."

Crosscutting Concepts (CCCs): Extensive

The reviewers found extensive evidence that students have the opportunity to use or develop the CCCs in this unit because students regularly engage with crosscutting concepts at a grade-appropriate element level. There is a reasonable match between the claimed CCCs and the CCCs found in the student tasks. The developers also identified areas where students would be working with CCCś from the 3–5 band to help develop and scaffold components such as energy and matter. Energy and matter elements are addressed at the 3–5 grade band level in Lessons 7.1 through 7.4; students are later working with the 6–8 grade band level in Lessons 7.5 and 7.6.

Examples of student engagement with the CCCs claimed in the documentation include:

Cause and Effect

- *Cause and effect relationships can be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause.*

- In the majority of the lessons, students are asked to think about how different aspects of their model could cause other changes (effects) in the tree system. Some examples include:
  - "How might the color change (effect) help us understand the phenomenon (what cause)?" (Lesson 7.4, step 5e) This element is met at the 3–5 grade band as students identify, test, and explain cause and effect relationships.
    - "Ask students if their models explain how changes in the variables would lead to growth over time. How might changes in one part of a plant cause large changes in another part?" (Lesson 7.4, page 9, step 17c)

Energy and Matter

- *Matter is conserved because atoms are conserved in physical and chemical processes. Within a natural or designed system, the transfer of energy drives the motion of matter.*
  - Students are asked to include how energy changes or inputs (sunlight) causes the movement or rearrangement of matter/atoms in Lesson 7.4, 7.5, and 7.6.
  - "Ask students to think about the models they created. How do the models describe how the tree is getting energy to gather more mass. What parts of their model are they satisfied with and what parts do they think need more information? What did they include in their models about energy?" (Lesson 7.4, step 2)
  - "Advise students to consider whether the transfer of energy if affecting the motion of gases in and out of the plant (system) when they select a question to investigate." (Lesson 4, step 6)
  - "As students work with their paper models, ask students to consider how the materials in the original CO2 and water were rearranged. Facilitate small group discussions as you rotate around the room. How has the matter they started with changed? As matter has rearranged, what has happened to the original oxygen, hydrogen and carbon atoms? How is energy involved in this process (beginning, middle and end)?" (Lesson 7.5, step 1)
  - "In particular, ask the students to think of the tree as a system and to reflect on where the energy for this system comes from and where it goes. Then, ask the students to think about where the matter comes from in this system and where it goes." (Lesson 7.6, step 2)
  - Students are building on prior knowledge (3–5 grade band) of how energy can be transferred in Lesson 7.1, how matter flows and can be tracked in Lesson 7.2. The students develop the concept that matter is conserved through physical and chemical processes and in Lesson 7.5, characterize the input chemicals and the resulting output chemicals through modeling and eventually include the new learning in their revised model.

Systems and System Models

- *Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.*
    - In Lesson 7.3 step 7, students create models of individual reading investigations. Students facilitate thinking with various questions including:
        - What inputs were manipulated? Controlled? Measured?
        - What outputs were manipulated? Controlled? Measured?
        - What forms of energy are involved in this system?
    - In Lesson 7.5 (page 5: step 6) students identify inputs and outputs of the process. In step 9, students generate consensus around the inputs that contribute to new mass during growth.
    - Lesson 7.6 step 6: "Next, instruct students to share their new models with another student. Tell students that when they share they should explain how their models show how what inputs, processes and outputs are occurring."
    - Students begin the unit by developing a model of how they think a tree obtains its mass (Lesson 7.2). In Lesson 7.4, students start looking at how energy and matter flow into and out of the system and use this information in their investigations.

Suggestions for Improvement

SEPs

When students are constructing their models, consider supporting students to construct an explanation based on their model. Another option could include allowing students to construct explanations of peer models during the process.

DCIs

The reviewers recommend making additional connections to how matter is cycled and flows in and out of organisms. The lessons currently focus on how energy and matter flow in and out of plants; consider expanding to the flow of energy through an ecosystem. More emphasis on the sugars produced by the plants could strengthen student understanding of the DCIs claimed. While students currently focus on the inputs and outputs, an understanding about the material built by the plants is not developed very deeply.

CCCs

- Explicitly discussing the use of the crosscutting concepts would help students build capacity to use the crosscutting concepts in different circumstances.
- Consider creating tasks where students use cause and effect relationships from their experiments to predict potential phenomena.

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 because every lesson contains a student task in which they are using all three dimensions to help develop their models and deepen their understanding of the central phenomenon.

The following student sense-making tasks of the phenomenon included elements of all three dimensions:

- 7.1 – Students develop a model to explain where all the matter in a tree comes from when it begins as a small seedling: “Develop a model to describe the observable and unobservable variables that explain how trees rearrange matter to support growth.”
- 7.2 – Students plan an investigation that would provide evidence to explain where all the matter in a tree comes from when it begins as a small seedling.
- 7.3 – Students obtain and evaluate information about historical investigations that sought to explain where all the matter in a tree comes from when it begins as a small seedling.
- 7.4 – Students conduct an investigation to produce data to explain that carbon dioxide gas is involved when plants gain matter (live and grow). Note that this CCC is used at the Grade 3–5-level.
- 7.5 – Students develop a model to explain how plants use energy from the sun to recombine carbon dioxide and water in carbon-based organic molecules like sugar and oxygen.
- 7.6 – Students develop a model to explain where all the matter in a tree comes from when it begins as a small seedling.

Suggestions for Improvement

- Consider including three-dimensional performances that require students to use the crosscutting concepts that are not embedded naturally in the DCIs.
- In Lesson 7.4, consider including the transfer of energy as a driver for carbon dioxide adding to the system’s mass.

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

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

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

Rating for Criterion I.D. Unit Coherence: Extensive

(None, Inadequate, Adequate, Extensive)

The reviewers found extensive evidence that lessons fit together coherently to target a set of performance expectations. Each lesson begins by revisiting the phenomenon and initial student models and initial student questions. Each lesson builds on what the students have learned previously and students develop an increasingly sophisticated model for the plant growth as they move through the lessons. In the final lesson students compare their initial and final models and what differences they saw based on what they have learned throughout the unit.

The unit includes the following claimed Performance Expectation:

- Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms (emphasis is on tracing movement of matter and flow of energy).

Students demonstrate the achievement of these performance expectations by modeling carbon dioxide and water used in photosynthesis to create glucose and oxygen. Student's models are revised as they add their new learning about the matter and energy going into the tree, out of the tree inside the tree.

Suggestions for Improvement

Consider adding guidance and instruction for how teachers can deal with students' unanswered questions or new questions that could lead to new investigations.

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

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

The reviewers found adequate evidence that links are made across the science domains when appropriate because the crosscutting concepts are intentionally and explicitly used to make connections across the science disciplines addressed in the lesson. For example, connections to Physical Science 3.D and Life Science LS1.C are made. In Lesson 7.4 step 17, students construct models and may "start to include reference to particles in their models and arrows to show how specific particles are moving in the plant with arrows or other drawing to explain how plants use energy to grow" (LS1.C and PS3.D). In Lesson 7.5, students use the CCC that matter is conserved in chemical processes by showing that carbon dioxide and water are rearranged in the photosynthesis process to create oxygen and glucose. The students construct models of glucose and water and rearrange them to form glucose and oxygen. Students add this process to their model to understand how matter and energy flows into, out of and within the system.

Suggestions for Improvement:

Consider providing students more opportunities to make connections to show how ideas from different domains work together to explain phenomena.

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

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

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that the materials provide grade-appropriate connections to mathematics, English language arts (ELA), history, social studies, or technical standards because every lesson in the unit includes a list of what Common Core State Standards (CCSS) are connected with the learning from that lesson at the beginning of the teacher guide for that lesson.

- In Lesson 7.2, students plan an investigation using template H1 where they are producing clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. The teacher also asks clarifying questions during the development of the investigation (page 6) to ensure that the investigation is appropriate and has the necessary parts.
- In Lesson 7.3, students analyze past science investigations relating to their driving questions. Students do close reading of the various texts to determine the scientists' findings and apply this information to their own questions and potential investigations.
- In Lesson 7.5, students read about photosynthesis while annotating the text. Students use the text to draw connections in their model and their investigations.

Suggestions for Improvement

- Guidance for explicit instruction that matches the cited CCSS could be helpful in the lessons' teacher instructions. When utilizing productive talk in the classroom (discussions), consider ensuring that students have support to engage in discourse at the level described in the claimed CCSS. For example, to use ELA-LITERACY.SL.7.1B students need to "follow rules for collegial discussions, track progress towards specific goals and deadlines and define individual roles as needed." However, explicit teacher support for helping students progress in this area was not identified in the current lessons.
- Using information sources with more variety (such as newspaper articles, scientific journals, etc.) and including rigorous writing assignments would strengthen the connections to the Common Core.

- Explicitly giving examples or suggesting the type of verbal discourse would help move this rating to extensive.

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

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

Category II. NGSS Instructional Supports

Score: 2

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*

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.

- Students experience phenomena or design problems as directly as possible (firsthand or through media representations).
- Includes suggestions for how to connect instruction to the students' home, neighborhood, community and/or culture as appropriate.
- 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 Authority: 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. Students experience the phenomenon through a media presentation and are presented with a question of how a tree gains its mass. Students authentically investigate this question through research, modeling, further questioning and testing and then modify their initial model with their new learning. Student questions help to drive the lessons and additions were made to this version of the unit to make connections more personalized. However, this is only done at the very start of the unit when the phenomenon is introduced. There is little connection to the students' lives, community, neighborhood or culture throughout the unit. Students' prior experience with plants, growing materials, or previous lessons are not continually drawn on to connect the learning to the students' lives. The driving question for the unit is also given to students by the teacher and not based on student-developed questions. Please see suggestions for improvement following the evidence.

The following related evidence was found in the materials:

- Lesson 7.1 step 4: "Ask students to think about questions they have about what they saw in the video...record those questions in their notebooks." step 5: "Ask students to consider where have they seen or heard of similar phenomenon?...If needed, consider taking students on a short walk around campus to observe plants on the school yard or present photos of plants in a nearby park." "If students are not engaging with the phenomenon, consider bringing in a small seed and a large piece of wood. Let students hold both the seed and the piece of wood and compare the mass of each."
- An anchoring unit question is present but is given to students by the instructor.

- A tree growing from a seed is a common phenomenon to which most students will have a connection.

Suggestions for Improvement

- Having students connect the phenomenon to their community or to a real-world problem that would require an understanding of plant growth to solve could move the rating for this category to Extensive. For example:
  - In the Lesson 7.2 page 6 teacher note, a community question could be added for the students to answer when creating their investigation. This could include "why is it important for us as scientists to figure out how trees gain their mass?" How could our research positively benefit our community?
  - In the final revised model or during final questions, students could write, model, or describe how their research could impact their community or how they will personally grow plants in the future (e.g., how this has changed their outlook on the importance of plants for their personal lives and community).
- Consider allowing students to construct questions to drive instruction throughout the unit.
- The connection between the phenomenon and students' lives could be explicitly drawn upon throughout the unit to improve student connection to the learning. For example, for those students who have experienced growing plants, they could be asked to describe what they did to help the plant grow.
- In Lesson 7.1 step 4 and step 5, consider changing the suggestions into a part of the normal instruction to allow the students more opportunities to engage with the phenomenon, make connections, and motivate their learning through these connections.

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

Rating for Criterion II.B. Student Ideas: Adequate

(None, Inadequate, Adequate, Extensive)

The reviewers saw adequate evidence that the materials met this criterion. The materials provide students with opportunities to both share their ideas and thinking and respond to feedback on their ideas because constant classroom discourse occurs where students express and clarify their reasoning, share ideas with their group and justify their reasoning for their thinking. Students model how they think a tree gains its mass and adds to their model as their understanding deepens and they add more to their model (like including the matter movement at the molecular level and how the tree takes in and releases particular types of gases). The teacher constantly elicits student ideas through questioning within their models, historical readings, and investigation. However, students are not engaged regularly in multiple modalities of feedback. Students receive mostly verbal feedback from the teacher and their group members. There are opportunities where ideas are discussed as a class but little opportunity for students to provide feedback and for the students to utilize the feedback to construct new learning (Lesson 7.4, step 10). In addition, classroom discourse as well as student artifacts do not currently include clarification of the student's reasoning behind their answers.

The following areas are where the reviewers found evidence related to this criterion:

- Lesson 7.1 step 5: "Ask students to share with a partner. When pairs have had a chance to discuss, ask students to share some of the questions they developed with the class. Chart student questions on the board and ask students to consider what questions they could investigate further by conducting investigations in class. Provide a few minutes for students to discuss the questions charted. When students are ready, facilitate a conversation about possible investigation questions. As students suggest questions, ask them for details about how the question might be investigated. Continue eliciting student ideas and identifying questions students suggest for investigation. Identify possible questions on the list, either with a checkmark or circle the question."
- Lesson 7.2 step 5: "In their small groups (3–4 students) ask the students to think about how they would plan and carry-out an investigation to test their ideas of which elements are entering the system such as soil, water, nutrients, etc. Ask students what information they would want to gather to improve their models. Allow teams time to discuss their ideas and generate consensus. Tell the student to record their ideas in their notebook. "
- Lesson 7.2 step 8: "Allow time for the groups to share their ideas with the whole class. If you observed particularly useful conversations regarding variable control or tools from the small group, you can ask those teams to share some of their discussion. After a few teams have shared their ideas, tell the students to listen to the ideas of the other students so they can add new ideas to their notebook."
- Lesson 7.3 step 8: "Ask a few groups to share their thinking or you may select groups to share based on conversations you had while they working."
- Lesson 7.4 step 10: "Once students have completed their plan, direct table groups to swap their plan with another group. Tell students to provide feedback to the other group on their investigation plan. Student teams should record their questions and suggestions on post-it notes on the other team's plan.....give students a few minutes to consider the feedback and revise their plans before bringing it to you for approval."
- Lesson 7.5 steps 2 and 3: Students reflect on their models using guiding questions and then discuss with a peer and then record their ideas in notebooks.
- Lesson 7.5 step 9: "Once students have completed their charts, create a class consensus chart on a doc cam or board. Rotate from group to group and ask teams to share one post-it note from anywhere on their chart. As groups share, ask the class if they agree or disagree with the suggestion. Generate consensus around the inputs."

- Lesson 7.5 step 13: "Tell students that each person in the group should share one "consistent" annotation at a time, rotating around until all group members have shared this type of annotation. Next, students should share the information they found that could strengthen their current ideas, rotating around group members as they did before. Finally, students should share their questions about information that was inconsistent with the representations of "inputs" on the chart. As students share their annotations, check that students are citing specific textual evidence to support their analysis of what the text says. Students should add or edit the molecules on the input side of H1."
- Lesson 7.6 step 7: "As students are listening to their partner share, encourage students to provide feedback to each other. If necessary, provide sentence stems as a table handout or on a chart to support student discussion and feedback. Possible sentence stems include:
  - I agree with your idea about _______ because ________.
  - Can you tell me more about ______?
  - I disagree with __________because_________________.
  - I want to build on your idea about______:______."

Suggestions for Improvement

- Including a larger variety of modalities of feedback—beyond verbal feedback—would be helpful. For example, models could be reviewed and critiqued by classmates and classmates could add suggestions to the models by using post it notes..
- More explicit guidance for the feedback processes would be helpful. The reviewers recommend teaching the students how to give feedback or including feedback protocols such as how students should support their reasoning with evidence. Giving students opportunities to reflect and apply the feedback that they receive to their product (models, writings, reflections) would also be helpful. Students currently are able to react to feedback in Lesson 7.4 step 10. This could be extended to give students more frequent opportunities to express and clarify their reasoning and to share and discuss their ideas while receiving direct feedback that allows them to describe connections and disparate ideas.
- Consider asking students to provide reasoning as to why they made the changes they did to their initial model over time.
- Student models could include elaborations of reasoning behind their answers and show how this thinking develops and changes over time as the students' understanding deepens. Lesson 7.5, page 11.

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

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

Rating for Criterion II.C. Building Progressions: Adequate

(None, Inadequate, Adequate, Extensive)

The reviewers saw adequate evidence that the unit identifies and builds on students' prior learning because the materials make clear the expected level of proficiency students should have with all three dimensions for the core learning in the unit and provide suggestions for adaptation if students are below this level. In the Title/Acknowledgements/Intro/Narrative document in the Unit Overview section, prior student learning for the unit is defined. In addition, there is a progression narrative for each of the three dimensions in this document in which the student growth in each dimension is described throughout the unit and how the lessons build off each other in this aspect. Materials are designed to build upon the typical levels of proficiency that students at this grade level have with each of the three dimensions. There are no specific suggestions for lesson adaptations if students are above the targeted level for the performance expectations.

Examples of evidence related to this criterion include:

- Lesson 7.1 step 13: "Prior knowledge should be evaluated in all three dimensions. For example, consider student models. Were they able to describe the phenomenon accurately using words and pictures? Do their models show visible and invisible components?..."
- Lesson 7.2 step 7: "...students may need support in identifying independent and dependent variables in their designs..(3–5 grade band).
- Lesson 7.2 step 10: support/suggestions for teacher ensuring students are planning an investigation at the 6–8 grade band.
- Lesson 7.3 step 14: suggestions of common student misconceptions that may show up and how the reading addresses them.
- Lesson 7.4, note after step 8: "This is an opportunity for students progressing more rapidly or slowly with the SEP through the complexity of the investigation design. Since students will conduct this investigation, the sophistication of data collected, complexity of design can be adjusted."
- Lesson 7.4 step 14: "In the 3–5 band, students make observations and/or measurements to produce data to serve as the basis for an explanation. In this lesson, students are extending that previous learning to use data to serve as the basis for evidence to answer a scientific question."
- Lesson 7.5 step 10: "Middle school students often fail to see material from the air (CO_2) as having enough mass to contribute to growth in plants. They also do not always understand that plants are chemical systems, converting matter taken in from the environment into food molecules. Manipulating the physical models is a strategy to help students understand what happens to the

matter that is taken in by plants, how it is converted to new molecules, and how this increases the mass of the plant."

- Lesson 7.5 step 14: "End the lesson by explaining to students that this unit is building on their previous lesson related to PS1 and extending their understanding of how Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms PS1.A"

Suggestions for Improvement

Consider providing specific suggestions for lesson adaptations if students are above the targeted level for the performance expectations.

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

Rating for Criterion II.D. Scientific Accuracy: Extensive

(None, Inadequate, Adequate, Extensive)

The reviewers saw extensive evidence that all science ideas included in the materials are accurate and there is strong support for teachers to clarify potential alternate conceptions that they (or their students) may have. Supporting evidence includes:

- In Lesson 7.3 page 7 Teacher Note: Support was added to help teachers clarify alternate conceptions that the students might have from the readings and how they are addressed in the readings.
- In Lesson 7.5 page 9, there is a note about how students may have "lingering alternative conceptions" and provides strategies to help alleviate this.
- The documents provided for Lesson 7.3 and Lesson 7.5 provide simplified but accurate information concerning historical experiments on plant mass gain and on the process of photosynthesis.
- In Lesson 7.5 step 20: "Students may have lingering alternative conceptions or fragile understandings at this point. The reading and the previous activities are intended to address lingering alternate conceptions like confusion between energy and food, plants getting food from the environment rather than combining matter internally, and that CO_2 from the air is too small to become tangible matter."

Suggestions for Improvement

Giving students more opportunities to interact with scientific documents, primary sources, or information in other media formats could enhance the evidence for this criterion.

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

- Appropriate reading, writing, listening, and/or speaking alternatives (e.g., translations, picture support, graphic organizers, etc.) for students who are English language learners, have special needs, or read well below the grade level.
- Extra support (e.g., phenomena, representations, tasks) for students who are struggling to meet the targeted expectations.
- 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 saw adequate evidence that the materials met this criterion because the unit provides a variety of differentiation strategies with examples and guidance for use that support reading, writing, listening or speaking that are integral to the sense-making. In addition, the unit also addresses the needs of English language learners (ELs) and students who are below grade level. However, the reviewers found very little evidence of differentiation for students who have already met the standard or who have high levels of interest.

Evidence related to this criterion includes:

- In Lesson 7.1 page 3, alternate forms of communication are suggested to help students to communicate their ideas. The materials include suggestions on how to check in and progress monitor for EL students.
- In Lesson 7.2 page 4 step 5, options of different modalities (drawing) are an included suggestion to help EL students.
- In Lesson 7.3 page 4, there are multiple strategies suggested to support students with linguistic scaffolds. Strategies include providing sentence starters during a class discussion. When students are engaged with the historical readings of the lesson, previewing and annotation strategies are identified as instructional supports. On page 6 step 11, when students are sharing their responses it is suggested to pre-set students about ideas that they could possibly share with peers or co-share with a table partner.
- In Lesson 7.4 page 6, suggested visual aides are provided for students for the BTB investigation.
- On page 9 step 15, a resource with a URL is provided where sentence frames can be found to help support EL students.
- In Lesson 7.4 page 7, suggestions are made to differentiate activities for students moving more rapidly or slowly with the SEP.
- In Lesson 7.5 page 7, alternate readings have been provided to students who may struggle with reading the text.
- In Lesson 7.6 page 5 step 10, there is an optional "third part to the assessment which could be

used to extend assessment for an advanced class of students." However, this is currently the only opportunity for extension in the unit.

Suggestions for Improvement

- To move the rating for this category to extensive, consider providing suggestions for enriching or extending the content for gifted or high interest students.
- Consider providing instructional supports for EL students or those who are not at grade level for Lesson 7.6. For example, checklists for the model or sentence starters for the brief description could be provided.
- Consider reviewing the reading level of the alternate text provided in Lesson 7.5 handout H2b.

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

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.).

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 saw adequate evidence that the materials met this criterion because each lesson begins and ends with teacher instructions on revisiting students' models of plant growth, the class list of questions, and developing new questions or needed revisions on student models. In some lessons, strategies to ensure sense-making is linked to elements of the three targeted dimensions are provided.

Examples of evidence related to this criterion include:

- Lesson 7.4 step 15: "At this point, students should have a conceptual idea that some matter (CO_2) moves into a plant in the presence of light energy (Energy and Matter). They may start to include reference to particles in their models and arrows to show how specific particles are moving into the plant with arrows or other drawings (Modeling) to explain how plants use energy to grow (LS1.C & PS3.D)."
- Lesson 7.5 step 11: "Before proceeding to the next part, make sure students understand that the physical models of carbon dioxide and water represent the inputs of photosynthesis and connect these inputs to previous models of energy flow (in particular Lessons 7.3, 7.4) and evidence gathered through investigations (7.3 and 7.4). Students should also recognize that energy from sunlight is necessary for the matter to "break" apart. If these concepts are not clear to students, stop and direct students to review their notes and previous models to clarify these ideas."

- Lesson 7.6 step 3: "Tell the students that they will be revising their model to include the ideas they have gained through the series of explore/explain/evaluate lessons. Remind them to include the parts of the process that are not visible, including parts of the system or processes that are too small to be seen. The goal is that the models are three dimensional including concepts about modeling (SEP), photosynthesis (DCI), and energy and matter (CCC). As students work, ask them to think about the how their model represents the interactions of the "tree" system. How does their model represent the flow of matter into, within and out of the tree?"

Suggestions for Improvement

- More teacher support for ensuring student sense-making is linked to all three dimensions could help the rating for this criterion move to Extensive.
- The reviewers suggest providing students with the opportunities to cultivate new questions that lead to future investigations. For example, at the end of the historical readings, students could create new questions from things they have discovered in the reading concerning the tree mass (such as considering that gas has mass and that the tree is taking in and releasing gas).

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: Inadequate

(None, Inadequate, Adequate, Extensive)

The reviewers saw inadequate evidence that the materials met this criterion. In the Title/Acknowledgement/Intro/Narrative document, progressions for each SEP, DCI, and CCC are described and explanations for how each lesson develops these further is described. For the general population of students, there is evidence of scaffolding over time and gradual release of supports where students were responsible for the development of more sophisticated models over time. However, the scaffolding is provided to support the general student and is not specific for diverse needs and ability levels. The supports are not explicit in how to support all students in building understanding and proficiency in the SEPs over time and to make progress towards making sense of how trees gain their mass.

- In Lesson 7.1, students create a model of how a tree gets its mass but there is no explicit scaffolding for students with diverse backgrounds. When students revise their model in later lessons there is no explicit scaffolding for students of diverse needs and ability levels.
- In Lesson 7.2, students plan out an investigation to determine what variables could affect the mass of the tree.
- In Lesson 7.3, students read texts to obtain information about previous scientist's experiments. Some scaffolding is provided for ELLs.

Suggestions for Improvement

More explicit support within each of the lessons on scaffolding and supporting student growth in the practices would be helpful. Consider adding learning experiences that target students with diverse needs and abilities so they can connect to and make progress over time toward common learning goals.

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

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

Category III. Monitoring NGSS Student Progress

Score: 2

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*

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: Adequate

(None, Inadequate, Adequate, Extensive)

The reviewers saw adequate evidence that the materials met this criterion because several student artifacts are used in the unit to monitor and assess students' three-dimensional performance.

The following list shows where there is evidence for this criterion:

- In Lesson 7.1 on page 6 step 10, students' prior knowledge is assessed while reviewing their models. There are several guiding questions provided that an instructor could use to assess students when looking at individual student models. For example: "What are the parts (components) that are part of this process? Are any of these parts invisible? If so, how did you/could you represent the "invisible" parts on your model?...How is the matter transported into, out of and within the tree or system?"
- In Lesson 7.5 on page 8 the materials state that teachers should "Facilitate small group discussions and as you rotate around the room." Later, (step 21) the materials include questions such as "how do you know?" and "what evidence can you use to support that idea?" when listening to the student discussion. Later in this lesson, students are again revising their models to include how molecules are rearranged to create new materials during the process of photosynthesis.
- Since student assessment is mostly verbal (students discussing their investigation with their group and discussing their investigation among other groups), it is difficult to monitor individual student progress for all students and observe if all three dimensions are being met.

Suggestions for Improvement

- The reviewers suggest providing more frequent opportunities for students to produce individual differentiated artifacts as this would allow teachers to more frequently assess individual progress in utilizing the three dimensions.
- The reviewers suggest using multiple modalities for assessment tasks to keep the tasks and investigations sufficiently supported, engaging, and rigorous for all learners.

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 saw adequate evidence that the materials met this criterion because throughout the lessons, oral questioning in small and large group settings is used to formatively assess student learning. Guidance for teacher questions is provided throughout. Some guidance is provided for teachers for when students are not reaching the learning target based on these oral questions. Students are also assessed using exit tickets and drawn models on handouts and in their science notebooks.

Evidence related to this criterion includes:

- In Lesson 7.1 step 9: "Record if students are using observations from the video or the list of related phenomena in their models (evidence), if the models contain visible and invisible components, and if the models show relationships. If this is the first time students have made a model, they may need some encouragement to record their ideas. Remind students that this model will represent their initial thinking and there will be opportunities to add or revise their models later. This is also an opportunity to assess students' prior knowledge related to the CCC Energy and Matter. For example, are students including both energy and matter elements in the model? Is matter represented as particles in any part of the model? Are there indications that matter is changing form or transported through the system?"
- In Lesson 7.2a explain/explore on page 4 step 6, students are engaged in a class discussion. Students are considering what they need to do in order to develop an investigation plan. The materials draw attention to the elements of the K–2 and 3–5 bands and suggests eliciting student ideas. Here, it is noted "If students are not aware of these components of the practice, you may need to adjust the lesson to address where students are in the practice of planning and conducting an investigation." However, no specific instructions or guidance for how to adjust the lesson are provided.
- Students investigations are checked on throughout the lesson and the teacher constantly circles groups and asks clarifying questions to assess. For example, in Lesson 7.3a step 3, it states, "As students work, visit each group and listen to their discussion and review their work on the group poster. If there is no evidence on the group paper that students have considered how the investigation can provide evidence about how the transfer of energy is driving the motion of matter flowing in the tree (system), facilitate their thinking with a few questions:" The questions are then listed.
- In Lesson 7.3, the H5 handout allows students to record their thinking on each of the investigations they read about. This document can be used as a formative assessment of student learning.

- Lesson 7.3 step 14: "Exit Ticket: Tell students that now that we have learned about results from investigations done in the past, what can we say about where a tree's mass comes from? What is a question you still have? Direct students to record their ideas on a slip of paper or notecard and hand it to you as they leave the class. These notecards can provide you evidence of student learning (FORMATIVE ASSESSMENT) and help plan for the next series of lessons. At this point, students should state that plants need sunlight to add mass, but soil and water are not adding to the new mass or growth of the tree."
- Lesson 7.5 step 24: "Individual notebooks could be reviewed to identify trends in student understanding before moving onto the end of the unit. If you find a significant number of students have not reached the expected goal in any of the three dimensions, this is a good time to pause and revisit previous activities or insert additional mini-lessons."
- A majority of the formative assessments were verbal; it was not explicit how formative assessments will be used to inform and modify instruction.

Suggestions for Improvement

- Clear guidance for how to interpret a range of student responses and change instruction based on varied student responses would be needed for an Extensive rating.
- The reviewers suggest utilizing additional multiple modalities to assess students. There are many areas in the unit where students are reflecting on their learning process. Recording and assessing these reflections would allow the instructor to better identify areas where students may need additional support or enrichment. The reviewers also suggest including teacher supports for how to inform and adapt instruction based on these formative assessments.
- When utilizing class discussions as a form of formative assessment, consider identifying specific strategies the teacher could use to assess students—not just what questions to ask. For example, perhaps a talk circle map could be created to show the flow of the conversation and to take notes of the student discourse. The instructor could then identify student participation and misconceptions that are present to ensure equity.
- In Lesson 7.3a explain/explain page 6 step 10, students are reflecting on their model and are instructed that they will be adding to the model throughout the learning experiences. The reviewers suggest utilizing individual student reflection (in a written format) as a form of formative assessment to instruct the learning process.

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: Inadequate

(None, Inadequate, Adequate, Extensive)

The reviewers saw inadequate evidence that the materials met this criterion because a rubric for the culminating model and explanation is provided but no other rubrics and few other scoring guidelines for interpreting student performance in three-dimensional formative assessment are provided.

Evidence related to this criterion includes:

- In Lesson 7.1 step 9: "Record if students are using observations from the video or the list of related phenomena in their models (evidence), if the models contain visible and invisible components, and if the models show relationships.
- In Lesson 7.4 on page 4 there is a text box describing opportunities to assess students' understanding about the crosscutting concept of energy and matter. Here the materials identify aspects to consider when reviewing student models. This includes, "Does the model include a representation that matter is made of particles? Are students thinking about the amount of matter before, during and after the process?"
- "As students work, visit each group and listen to their discussion and review their work on the group poster. If there is no evidence on the group paper that students have considered how the investigation can provide evidence about how the transfer of energy is driving the motion of matter flowing in the tree (system), facilitate their thinking with a few questions:"
- Lesson 7.3 step 14: "Exit Ticket: Tell students that now that we have learned about results from investigations done in the past, what can we say about where a tree's mass comes from? What is a question you still have? Direct students to record their ideas on a slip of paper or notecard and hand it to you as they leave the class. These notecards can provide you evidence of student learning (FORMATIVE ASSESSMENT) and help plan for the next series of lessons. At this point, students should state that plants need sunlight to add mass, but soil and water are not adding to the new mass or growth of the tree."

Suggestions for Improvement

- The reviewers suggest constructing three-dimensional rubrics or providing scoring guidelines to assess student performance for additional formative assessment tasks throughout the lessons, such as the handouts, various stages of the model development, exit tickets, or other tasks. Rubrics and scoring guidelines could include important feedback that could be provided to students to allow them to see what they have learned in all three dimensions.
- Guidance for how to adjust or modify instruction based on rubric or scoring guideline results could be provided for the teacher.

- Student work related to each level of the rubrics provided could strengthen the evidence for this criterion.

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

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

(None, Inadequate, Adequate, Extensive)

The reviewers saw adequate evidence that the materials met this criterion because the text, video, and modeling were accessible for all students, although the assessments offered little modal variety. The scientific language is appropriate for the grade band.

Evidence related to this criterion includes:

- Lesson 7.1 step 4: "Ask students to think about questions they have about what they saw in the video...record those questions in their notebooks."; step 5: "Ask students to consider where have they seen or heard of similar phenomenon?...If needed, consider taking students on a short walk around campus to observe plants on the school yard or present photos of plants in a nearby park." "If students are not engaging with the phenomenon, consider bringing in a small seed and a large piece of wood. Let students hold both the seed and the piece of wood and compare the mass of each." These steps allow students to connect with the phenomenon and make the examples more accessible and unbiased for all students.
- In Lesson 7.3, students are given four historical investigations to evaluate to identify the purpose of the investigations. The adapted texts are appropriate for the grade level this unit has been constructed for.
- Alternative texts are provided to support EL students for Lesson 7.3. Sentence starters, examples of modeling and example written responses to prompts were provided for EL students throughout the lessons.
- The reviewers found that there was a significant emphasis placed on verbal discussion and questioning throughout most of the lessons. This makes the lessons less accessible for students who struggle with verbal expression or listening comprehension.

Suggestions for Improvement

- Consider using a wider variety of modalities to collect information from all students.

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 saw adequate evidence that the materials met this criterion because initial and final student models of plant growth are used as a pre-assessment and summative assessment of student learning. Students are orally instructed to self-assess their models and investigations multiple times in the lessons. A final summative assignment is provided to assess students' overall learning.

Evidence related to this criterion includes:

- Lesson 7.1 page 5: While students engage with the phenomenon, the teacher can "assess students' prior knowledge about developing and using models to determine what knowledge they are bringing into the unit." Statements continue on page 6 explaining what the teacher should be looking for during the pre-assessment. The CCC of energy and matter is also called out as an opportunity to assess students' prior knowledge (page 6).
- In Lesson 7.3, students complete H5 to show their understanding of the investigations and what the conclusions of the investigations were. However, this is done in a group setting, not individually.
- Lesson 7.3: An exit slip is used to assess individual student learning and student questions.
- Lesson 7.4 page 4 teacher instruction box: There is an opportunity to assess what students understand about the CCC of matter and energy. However, the model assessed is created in a group setting, not individually.
- Lesson 7.5 page 10 step 24: "individual notebooks could be reviewed to identify trends in student understanding before moving onto the end of the unit. If you find a significant number of students have not reached the expected goal in any of the three dimensions, this is a good time to pause and revisit previous activities or insert additional mini-lessons."
- Lesson 7.6 step 12: "An optional ending to the unit is to assign a writing prompt that students fill out individually…" This is an optional addition to the summative model and explanation.
- Opportunities for formative assessment through student models and questioning are described in the lessons but could utilize a wider variety of assessment strategies (beyond oral questioning).
- Few opportunities to formatively assess individual student learning are included throughout the lessons (most assessment is done in group settings).

Suggestions for Improvement

- The reviewers suggest utilizing more formal and structured assessments for students beyond oral questioning and group-developed models. This would allow for more effective assessment such as claims, evidence, reasoning written responses and other formative assessment protocols.

- Assessment of individual student progress and feedback on that progress beyond artifacts produced in group settings and in pairs would be helpful.
- A variety of measures of student growth and feedback for the students would be helpful for all dimensions so students are aware of their progress in the learning goals.

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 saw inadequate evidence that the materials met this criterion because students demonstrate performance of practices along with DCIs and CCCs when they revise and develop their models of plant growth (Lessons 7.5 and 7.6), and when they plan investigations (Lessons 7.2 and 7.4) to determine cycling of matter in the plant. However, very few opportunities for students to receive individual feedback on performance and understanding of the three dimensions in these lessons are provided.

Evidence related to this criterion includes:

- There was evidence of students engaging in multiple three-dimensional performances that are opportunities for them to demonstrate learning over the course of the unit.
- Lesson 4 step 10: Students give each other feedback on sticky notes and then incorporate aspects of the feedback into their model.
- Lesson 4 step 17: “Teams represent their new understanding of how trees gain mass, integrating their new data into their model.” Teacher questioning is provided to give students feedback on their model in a group setting.
- Teacher/student feedback is mostly verbal and does not provide many opportunities for students to reflect and apply the feedback.

Suggestions for Improvement

It would be helpful to provide more explicit feedback to the students about what they have learned. The reviewers suggest providing more specific guidelines for teacher feedback (beyond verbal feedback) for individual students on these artifacts as well as more opportunities for students to show their understanding, perhaps in written form not just verbal.

Tree Mass
EQuIP Rubric for Science Evaluation

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

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

Overall Score

Category I: NGSS 3D Design Score (0, 1, 2, 3): 2
Category II: NGSS Instructional Supports Score (0, 1, 2, 3): 2
Category III: Monitoring NGSS Student Progress Score (0, 1, 2, 3): 2
Total Score: 6
Overall Score (E, E/I, R, N): E/I

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

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