Garbage Unit
EQuIP Rubric for Science Evaluation

Developer/Curriculum: New York University-Science and Integrated Language (SAIL)
Unit Name: Garbage Unit
Grade: 5
Date of Review: July 2019
Overall Rating (N, R, E/I, E): E
Category I: NGSS 3D Design Score (0, 1, 2, 3): ***2***
Category II: NGSS Instructional Supports Score (0, 1, 2, 3): ***3***
Category III: Monitoring NGSS Student Progress Score (0, 1, 2, 3): ***3***
Total Score (0–9): ***8***

Click here to see scoring guidelines

This review was conducted by 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	Adequate	**A. Relevance and Authenticity**	Extensive	**A. Monitoring 3D Student Performances**	Extensive
B. Three Dimensions	Extensive	**B. Student Ideas**	Extensive	**B. Formative**	Adequate
C. Integrating the Three Dimensions	Extensive	**C. Building Progressions**	Adequate	**C. Scoring Guidance**	Adequate
D. Unit Coherence	Extensive	**D. Scientific Accuracy**	Extensive	**D. Unbiased Tasks/Items**	Extensive
E. Multiple Science Domains	Extensive	**E. Differentiated Instruction**	Adequate	**E. Coherence Assessment System**	Adequate
F. Math and ELA	Adequate	**F. Teacher Support for Unit Coherence**	Extensive	**F. Opportunity to Learn**	Extensive
		G. Scaffolded Differentiation Over Time	Extensive		

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. It is obvious that this unit was thoughtfully crafted, and it has many strengths. In many areas, this is an exemplary model of three-dimensional science as evidenced by the rating of extensive in several categories. Some strengths of this unit are its coherence due to the selection of an anchoring phenomenon, the use of a Driving Question Board, the connections of the lessons to the anchoring phenomena, the wealth of information provided to the teacher in order to carry out three-dimensional lessons, and the thorough assessment system, which provides ongoing frequent windows into student thinking. The featured SEPs are clearly developed over time as the lessons progress to gradually move from guided teacher support for students working collaboratively as a class, to students working in groups, to groups and individuals providing peer feedback, and then to students working individually. The lessons are engaging and structured in a way that supports students in making sense of challenging content while developing skills in the featured SEPs and CCCs. It is evident that the authors have a strong understanding of how to provide three-dimensional NGSS learning experiences for students and frequently convey this understanding to teachers through their lesson design.

This unit would benefit from additional investigations that increase opportunities for students to make sense of the key underlying concept that matter is made of particles. This can be done by investigating phenomena that provide visual evidence which could lead toward which could lead towards a class discussion in which students figure out the concept before being told this information. In doing so, the depth of understanding students develop and internalize in explaining many related scientific ideas may increase. This unit would also benefit from strengthening the guidance that is provided to teachers in the incorporation of math and ELA standards, assessment, and differentiation. Support could be provided for teachers so that they are better able to help students make connections from cross-curricular concepts to the phenomena. Teacher supports in assessment could be used to help teachers modify their instruction based on student responses. Clearly identifying where assessments take place would also improve teacher support opportunities across the unit. Lastly, teachers would benefit from support for how to differentiate instruction for additional sub-groups of learners, such as students who have already met the performance expectations.

Note that in the feedback below, black text is used for neutral comments or evidence the criterion was met and purple text is used for evidence the criterion was not met.

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.

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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 and/or designing solutions to a problem because the materials are organized such that students figuring out a central phenomenon drives the learning across the unit. The focus of most of the lessons are to make sense of the phenomena. However, there are some key points in the unit in which students are not engaged in sense-making in order to develop a deep understanding of critical science concepts.

Student learning is focused on supporting students to better make sense of the phenomenon. For example:

- Lesson 3-3 pages 9–11: Students work on revising their models to include particles leaving the open landfill bottle system.
- Lesson 4-1 pages 4–8: Students combine substances that react to form a new substance. They use this to figure out the source of the smell coming from the landfill bottle and to further refine their models.

Students regularly build on what they have learned from smaller phenomena or problems to explain a broader science topic. For example:

- Lesson 2-2 page 11: There is the option for teachers to create a visual display with their students that tracks the phenomena and what students have figured out. This is optional and can be done at the end of every lesson beginning from this point. However, because this task is only optional, some teachers may not have students participate in this activity. Students could benefit from this at the end of every lesson to help them recognize what they learned and what investigations/phenomena they will need to make sense of in the next lesson to better understand the anchor phenomenon.
- Lesson 3-1 page 6: Students observe the landfill bottles again and ask further questions related to "What happens to our garbage?" such as "Why can we smell something?" and "Is a smell something or nothing?"

Students regularly return to the phenomenon to add layers of explanation based on learning, or regularly build on what they have learned from smaller phenomena to explain a broader science topic. For example:

- Lesson 3-2 page 3: Students review questions from prior lessons to develop the question: "What is that smell?" Students make further observations: 1) the smell emanating from an opened scented container, 2) a video showing a balloon being punctured and the impact on balancing a scale, and 3) compressing air in syringes.
- Lesson 4-2 page 9: Students connect the sub question "What causes changes in the food materials in the landfill bottles?" to answer the unit Driving Question "What happens to our garbage?"

Some of the student learning across the three dimensions targeted by the unit is in service of students making sense of phenomena. In several lessons, students "figure out" the underlying scientific concept (DCI) through reasoning about the evidence they observe during investigations. However, there are points where the opportunity to figure out the concept(s) is not given to students and the teacher "tells" students the content.

- Lesson 2-3 page 3: While discussing the sugar water investigation, the teacher and students discuss the results, and use reasoning from those results to "figure out" ideas of conservation of matter in that the sugar and all the water are still present in the mixture. However, student reasoning to "figure out" is not engaged to make sense of the key scientific idea that "matter is made of particles too small to be seen." Instead, students are told that scientists have developed a model of what happens to matter when divided into smaller and smaller pieces or mixed, and then are provided a text that tells" them this key idea.
- Lesson 2-3 page 4: The teacher is told to describe to the students that scientists developed models of what happens to matter when it is divided into smaller pieces and what happens when different types of matter are mixed together. Students discuss what they learned about what happens when solids are mixed with liquids. Students are told to read an article, *What is Matter Made of?* The teacher then tells the students that matter is made up of very small particles.

Student questions or prior experiences with the phenomena create a need for the students to engage throughout the materials. Materials provide structured support for teachers to draw out these connections from students and use these connections to motivate student learning.

- Lesson 1-1 page 10: Students are given a homework assignment asking them what their families do to get rid of garbage. Students come in the next day, work in pairs, and discuss the similarities and differences between how their families get rid of garbage.
- Lesson 2-2 pages 2–3: Student questions from Lesson 2-1 are used to introduce the question: “Do materials change if they are crushed?” Students observe properties of a can before and after it is crushed to determine that the properties remain the same. Students tear paper into small pieces to observe before and after properties.

Suggestions for Improvement

- The reviewers responded to previous suggestions about providing samples of teacher facilitation of discussions surrounding student questions driving learning. The developers indicated that this occurs in professional development. Adding these kinds of supports to the materials so that they are able to stand alone would allow teachers to have an easier time facilitating tasks. Consider including any material that will be delivered in teacher workshops in the printed lessons.
- Consider removing the optional choice from the “Tracking What We Figured Out” display. This would allow students to make connections to the next lessons and figure out for themselves which direction the lessons would have to go in order to find answers to the anchor phenomenon. To provide an option for how this is done, a suggestion for teachers to use this or a similar method for students to track their “figuring out” journey could be added.
- Currently, student reasoning to "figure out" is not engaged to make sense of the key scientific idea that "matter is made of particles too small to be seen." However, supporting student “figuring out” of this key conceptual idea of the particle nature of matter would be extremely helpful as it is foundational and is the underpinning understanding that is needed in order for students to visibly explain many other fifth grade conceptual ideas, including the following:

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- PS1.A - The Structure and Properties of Matter
  - Matter of any type can be subdivided into particles that are too small to see, but even then, the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5-PS1-1)
  - The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2)
- PS1B - Chemical Reactions
  - When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4)
  - No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) (5-PS1-2)
- LS2.A Interdependent Relationships in Ecosystems
  - The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as “decomposers.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1)
- LS2.B Cycles of Matter and Energy Transfer in Ecosystems
  - Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases and water from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)
- LS1.C Organization for Matter and Energy Flow in Organisms
  - Plants acquire their material for growth chiefly from air and water. (5-LS1-1)
- ESS2A Earth Materials and Systems
  - Earth’s major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth’s surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)
- Crosscutting Concept of Energy and Matter

- Matter is transported into, out of, and within systems. (5-LS1-1)

In addition, a deep understanding through sense-making of the concept of matter being made of particles is essential for understanding and explaining scientific concepts in all future grades, making it an essential scientific idea for students to "figure out" before being "told." Therefore, consider providing investigation and reasoning opportunities for students to "figure out" this idea. For example:

- The addition of a couple of other investigations following the sugar water investigation could provide the evidence needed for students to begin the reasoning process that leads to the idea of solid and liquid matter being made of particles.
- One possibility is using graduated cylinders to measure separate amounts of water and rubbing alcohol, then combining them into one graduated cylinder. Students could use their observed evidence that the combined volume does not equal both volumes added together to lead towards "figuring out" that pieces of one of the liquids must be fitting between pieces of the other liquid. This can be combined with the sugar water evidence to further develop the idea of pieces of one substance fitting in between pieces of another substance.
- A follow up investigation could involve groups using a swab to swipe a streak of rubbing alcohol onto a surface and observing it gradually disappearing. Students can be guided to use the evidence of the rubbing alcohol disappearing a little at a time to further reason that the liquid alcohol is not just one continuous substance, but pieces of a substance. This evidence, combined with the mixed alcohol and water as well as the sugar water can provide the substance for "figuring out" that "liquids and solids are made of particles too small to be seen."
- After carrying out a couple of investigations of the above nature, students could then read the text provided in the lesson to help clarify what they have begun "figuring out."
- Following the text with the activities already included in the lesson (particle video, physical student model, etc.) would provide further visual and concrete experiences for students to deepen their understanding and ability to visibly explain this concept.
- Also, by using different investigations, students could recognize the patterns between each and how those patterns contribute to a larger idea that matter is made up of smaller particles that cannot be seen.
- Consider adding the idea that "liquids and solids are made of particles" to the "Figuring Out" chart.

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: Extensive

(None, Inadequate, Adequate, Extensive)

The reviewers found extensive evidence that the materials give students opportunities to build understanding of grade-appropriate elements of the three dimensions.

Science and Engineering Practices (SEPs): Extensive

The reviewers found extensive evidence that the materials provide opportunities to develop and use specific elements of the SEPs. Students progressively engage in elements of the practices of Developing Models and Engaging in Argument from Evidence at a deeper level as the lessons progress. Students develop their capacity for using elements of the practice of Asking Questions of phenomena and learn to improve their questions and generate additional questions as they encounter new phenomena. An element of the practice of Planning and Carrying Out Investigations is present with some evidence of student choice. In addition, elements of the practice of Constructing an Explanation are present in some lessons. All of the activities are at the grade-appropriate level for a fifth-grade student and aid in student sense-making of the anchoring and lesson-level phenomena.

Asking Questions

- *Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.*
    - Lesson 1-1 pages 9–10, 15–17: Students ask questions about garbage after watching a video. In pages 15–17, students analyze their questions to determine which can be investigated in the classroom. Students group similar questions and determine a question that connects all the questions to create the Driving Question Board for the unit. “Which of your questions do you think we could investigate further by an investigation we can carry out in the classroom? Can you refine or simplify any of your questions so that we could investigate them directly?” “Is there one big question that connects all the questions?” (page 15)
    - Lesson 2-1 page 10: Students are asked “What do you think will happen to the different garbage materials over time? Why do you think that?” Students talk in triads and then record their predictions.

Developing and Using Models

- *Collaboratively develop a model based on evidence that shows relationships among variables*

  - Lesson 4-2 Pages 11-12: Students develop a class consensus model of the landfill bottles. The model shows the relationship between different variables such as weight and the decomposition of food material. Evidence that is added to the model comes from previous investigations with the landfill bottles and agar plates.
- *Develop and/or use models to describe and/or predict phenomena.* and *Develop a model using an analogy, example, abstract representation to describe a scientific principle or design solution.*
  - Lesson 2-3 pages 3–4: Students develop an individual model in their notebooks to describe both solid and liquid matter as they mix together.
  - Lesson 3-2 pages 4–5, 11: "Students…develop a model to show their initial idea about the smell and the air" (page 5). "Draw their individual models in their [notebooks] of what gases would look like when enlarged." Later, students revise their individual models of air and gas. Students "talk in groups about what they might change or add to their models" (page 11).

Planning and Carrying out Investigations

- *Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.*
  - Lesson 3-1 page 3: Students observe and record changes in the properties of garbage materials. The teacher checks students' understanding by asking, "How does the data we are collecting in the classroom relate to the landfill we saw during the field trip?" Students respond that the data collected can be used to serve as evidence for what most likely happens in a real landfill.
  - Lesson 4-2 pages 6-12, and 27 (student page: Investigation Observations): Students observe and record the changes that occur as microbes multiply over the course of 2-3 days and use the observed evidence to construct an explanation and revise models.

Constructing an Explanation

- *Identify the evidence that supports particular points in an explanation.*
  - Lesson 4-2 pages 7–8: Students complete a Claims, Evidence, Reasoning document and discuss how the student-generated evidence supports the claim. "Now let's see if we can connect our claim to the evidence to support our explanation of why certain materials in the landfill bottle broke down. Facilitate a class discussion of how the evidence supports the claim. Ask, how does your evidence support your claim?" (page 8)
- *Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.*
  - Lesson 4-2 pages 7–9: Students describe the changes in their landfill bottles and then are guided to use their observations to write an explanation using evidence.

Engaging in Argument from Evidence

- *Support an argument with evidence, data, or a model.*
  - Lesson 2-2 pages 6–10: In this lesson, students are introduced to making a claim and using evidence and reasoning to support their claim. The teacher directs the students during this lesson.

- Lesson 3-3 pages 5–7 and Lesson 4-1 pages 6–8: The students are again asked to make a claim and support it with evidence and reasoning. Students work in groups and are guided by the teacher.
- Assessment, Task 1: Students are expected to individually make a claim and support it with evidence.

Disciplinary Core Ideas (DCIs): Extensive

The reviewers found extensive evidence that the materials provide opportunities to develop and use specific elements of the DCIs because numerous opportunities for students to develop and use elements of the DCIs in both physical science and life science are embedded throughout this unit. The activities are at a grade appropriate level for a Grade 5 student and aid in sense-making of the anchoring and lesson-level phenomena. Student understanding of the DCIs is deepened as the lessons progress, connecting prior ideas to new ideas through each activity.

PS1.A: Structure and Properties of Matter

- *Different kinds of matter exist. You can distinguish materials by their observable properties. (Grade 2)*
  - Lesson 1-1: Students sort garbage into categories according to its properties.
- *Measurements of a variety of properties can be used to identify materials. (Grade 5)*
  - Lesson 4-1 pages 3–5: Students observe a reaction in which the mixing of two substances forms a new substance with different properties.
- *Matter of any type can be subdivided into particles that are too small to see, but even then, the matter still exists and can be detected by other means. Measurements of a variety of properties can be used to identify means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.*
  and
  The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.
  - Lesson 2-2 page 3–9: Students measure the properties of matter, including weight, before and after it is crushed or torn. "When materials are crushed in a landfill bottle, does the type of materials change? When materials are crushed in a landfill bottle, does the amount of materials change? (page 3) "When materials are crushed, the type of material does not change. When materials are crushed, the amount of material does not change." (page 8) Notebook Entry - "Imagine that we tear a piece of paper into very small pieces. Then we tear the paper into even smaller pieces until we can't see the pieces any more. Is the paper still there? Support your answer with evidence from the investigation." (page 9)
  - Lesson 3-2 page 3–8: Students participate in investigations in which they observe smells and the behavior of air when compressed. "Why can I smell the pizza in the lunchroom from the hallway? Students make initial attempts to make visible their understanding of smell and the air. (page 3)

"Are gases something, or nothing?" (page 6) "Why can't you push the plunger all the way down?" (page 8)

PS1.B: Chemical Reactions

- *No matter what reaction or change in properties occurs, the total weight of the substances does not change.*
    - Lesson 4-1 page 3: Students mix different substances and observe what occurs." What happened to the properties when we mixed sugar and water? (the properties of the liquid (taste) changed.)" "What happened to the weight of the sugar water before and after mixing? (The weight stayed the same.)" "What did we figure out from the investigation? (We figured out that matter is conserved. The matter did not disappear.)"

PS1.B: Chemical Reactions

- *When two or more different substances are mixed, a new substance with different properties may be formed.*
  and
  No matter what reaction or change in properties occurs, the total weight of the substances does not change.
    - Lesson 4-1 pages 3–5: Students observe a reaction in which the mixing of two substances forms a new substance with different properties.

LS2.A Interdependent Relationships in Ecosystems

- *Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plant parts and animals) and therefore operate as "decomposers…"*
  and
  Matter cycles between the air and soil and among organisms as they live and die
    - Lesson 4-2 pages 3–5: Students investigate what causes the smells in their landfill bottles, figuring out that microbes provide the process that causes the food material to break down and rot.

Crosscutting Concepts (CCCs): Extensive

The reviewers found extensive evidence that the materials provide opportunities to develop and use specific elements of the CCCs because of the following reasons based on evidence: Students engage in numerous opportunities to develop their thinking using elements of the CCCs of Systems and System Models, Patterns, and Energy and Matter. Some lessons use elements of the CCCs of Scale, Proportion, and Quantity, and Cause and Effect. Students use elements of the CCCs in order to explain the data they collect as they look for patterns, to support their claims with evidence, and to construct, discuss, and explain models. The use of the CCCs is at a grade-appropriate level for Grade 5 students.

Patterns

- *Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena and designed products.*
  and
  Patterns can be used as evidence to support an explanation.

- Lesson 1-1 pages 4–6: Students sort garbage into categories according to its properties. “What patterns do you observe across the categories?” “What patterns do you observe within each category?” (page 6) However, this is evidence for patterns in the K-2 level patterns element. Patterns at the Grade 3-5 element of patterns should explore the similarities and differences between patterns and not between objects or data.
- Lesson 2-2 page 6-7: Students discuss patterns they found in the collected data by noting similarities and differences. “Possible patterns identified: Pattern 1: No change in the properties of color, texture, or reflectivity for any of the materials; Pattern 2: No change in the property of weight for any of the materials.” Students then use these patterns to form a claim and explain that changes in the shape of a material does not change the weight or the material itself.

Systems and System Models

- *A system can be described in terms of its components and their interactions.*
    - Lesson 1-1 pages 11–13: Students identify the components of a “system” of home garbage. Relevant quotes: [After listing the items that are connected to a home garbage system] “All of the components you just named…are called components. When components work together, they make a system.” “What did we do today? (We developed a system model of school, home, and community garbage.)” “Why was it helpful to think about garbage as a system? (Because it helps us think about the components and relationships we are interested in learning about.”
    - Lesson 2-1 pages 9 and 11: Students set up the landfill investigation with some groups creating an open system, and other groups creating a closed system. “...how can we control the matter going into and out of the landfill bottle?” (page 9) The teacher is asked to solicit student responses to the landfill bottle as a system. Expected student responses are “Components of the system: bottle, soil, garbage materials, water, air ...Open or closed system” (page 11). Students develop a model of the landfill bottle system and revisit it in future lessons.
    - Lesson 3-3 Pages 11-12: Students develop a class consensus model of the landfill bottles. The model represents the interactions between rotting food and gases produced to make visible the flow of matter into and out of the system.

Energy and Matter – Flows, Cycles, and Conservation

- *Matter is made of particles.*
    - Lesson 2-3 pages 2–10: Students engage in an investigation, observe a physical model, and participate in acting out a model. Through these experiences, they gather evidence that matter is made of particles, even though we cannot see those particles.
    - Lesson 3-1 pages 5–6, and Lesson 3-2 pages 3–4, 7–10: Students ask questions and discuss smell traveling a distance from its source, view the effects of a punctured balloon, breathe deeply, and compress air in a syringe as they discuss questions such as: “Why can I smell the pizza in the lunchroom from the hallway? “What did you feel moving into and out of

your lungs? "What does this tell us about air?" "Why can't you push the plunger all the way down?

- *Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.*
    - Lesson 4-1 page 3: Students mix different substances and observe what occurs." What happened to the properties when we mixed sugar and water? (the properties of the liquid (taste) changed.)" "What happened to the weight of the sugar water before and after mixing? (The weight stayed the same.)" "What did we figure out from the investigation? (We figured out that matter is conserved. The matter did not disappear.)"

Cause and Effect-Mechanism and Prediction

- *Cause and effect relationships are routinely identified, tested and used to explain change.*
    - Lesson 4-2 pages 7-9: Students construct an explanation in the form of a Claim, Evidence and Reasoning written response. Within the reasoning portion, students refer to the growth of microbes in the agar plates as a possible cause for food changing in the landfill bottles.

Scale Proportion and Quantity

- *Natural objects exist from the very small to the immensely large.*
    - Lesson 3-2 Page 4: Students develop a model in response to an investigation and teacher prompts: "Remind students about their models for solid and liquid matter as being made up of particles too small to see. In solids and liquids, the particles are bunched together so we see the collection of them, even if we cannot see the individual particles." After asking students to imagine a tool like a very powerful microscope, the teacher states: "Now we are going to try to make a model for gas, that is a diagram that shows what we would see if we had such a tool. Since we cannot see many gases, we know that we could only see the gases at a scale that is very, very small—too small to see with our naked eye. What would that enlargement look like? "Students draw models that show their thinking about their ideas about particles too small to be seen.

<u>Suggestions for Improvement</u>

SEPs

Consider increasing the use of elements of the practice Planning and Carrying out Investigations throughout the unit by providing opportunities for students to have more input into the actual planning of the investigation, including choice of materials. As was done with some of the other practices, consider including instructional segments that help students become aware of and use some of the essential aspects of Planning and Carrying Out Investigations, such as identifying and controlling variables, and then over time, applying their understanding to planning future investigations.

DCIs

Consider the use of the activities mentioned in the feedback on Criterion I.A to allow students to come to their own understanding of the particle nature of matter.

CCCs
No suggestions

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 and designing solutions to problems. Throughout the unit, students use all three dimensions to develop their understanding of science ideas. The dimensions are intentionally integrated and teacher notes remind the teacher about what specific elements of a DCI, SEP, and CCC are being used. The student tasks build the understanding needed to eventually explain the phenomenon. Within the unit, additional lesson level phenomena are presented. As students use SEPs and CCCs to explain these phenomena, the big science ideas present in the anchor phenomenon emerge.

- Lesson 2-1 page 13 Class Check: Exit slip includes questions that address all three dimensions. “What is the system we are investigating? What are the initial components of the system? What data are we collecting? What questions about garbage will this investigation help us answer?”
- Lesson 2-3 page 3–8: Students follow up their investigation with sugar and water from the previous lesson with three-dimensional thinking about matter through questions and by developing different ways to model that thinking using analogous examples such as ping pong balls and marbles, demonstrating with their bodies in a limited space, and scientist models. “*When you mixed the sugar into the water, where did the sugar go? Does that mean the sugar ceased to exist? What further evidence could you find that shows the sugar is still in the water?* (page 3) “*What happened to the volume? Where did the marble go?”* (page 5) “*How does your model show that both solids and liquids are made of particles too small to see?”* (page 8)
- Lesson 3-3 page 7: The sample argument for Claim 2 includes aspects of the DCIs, SEPs, and CCCs. Several other examples of supporting an argument with evidence using all three dimensions occur in the unit.

Each lesson describes three-dimensional Learning Performances in the Lesson Overview section as well as Evidence Statements in the Closing the Lesson section, and the student activities, for the most part, correspond with these statements. The SEP, CCC, and DCI elements are clearly indicated for each lesson. Teacher background notes and explanations within the teacher instructions for facilitating student tasks clarify and further develop specific elements of the three dimensions to ensure that the student learning experiences are conducted in a three-dimensional manner.

- Lesson 1-1 page 1: At the beginning of each lesson, three-dimensional Learning Performances are provided. Example Learning Performance: "Students make observations of the properties of materials in the lunch garbage to identify the materials and decide how to sort the materials into categories" (page 1). Each lesson lists at least one three-dimensional learning performance which corresponds to the student activities.
- Lesson 2-2 pages 11–12 and Front Matter page 19: Near the end of each lesson, at least one three-dimensional "Evidence Statement" (written by the developers for each lesson) is provided that "describes the observable aspects of student performance that provide evidence of meeting the lesson's learning performance(s)" (Front Matter, page 19). Example Evidence Statement: "Students argue that the patterns in weight data serve as evidence that matter continues to be present even when it changes appearance or seems to disappear (conservation of matter)" (Lesson 2-2 page 11). Each lesson lists at least one Evidence Statement that corresponds to the student activities/artifacts and a Learning Performance.

Suggestions for Improvement

Developing the suggestions for improvement in Criterion I.B will further enhance the three-dimensionality of each lesson.

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 because in most cases, student questions drive the current lesson and questions unanswered by the sense-making opportunities in that lesson drive the next lesson. Student questions are answered by connecting evidence from investigation to science ideas and concepts. Students revisit the driving question/unit phenomenon multiple times, taking stock of how well they can explain the phenomenon, creating key linkages across the unit. Students revisit their original questions while also having the opportunity to develop new questions.

Garbage Unit
EQuIP Rubric for Science Evaluation

i. Unit coherence is clearly evident throughout the lessons. Lessons build on each other as questions raised in previous lessons are addressed in subsequent lessons. Students regularly revisit the anchor phenomenon to connect with what they figure out with the investigative phenomena. For example:

- Lessons 2-1, 3-1, and 3-3: Students revisit the landfill bottle Investigation that corresponds with the anchoring question "What happens to our garbage?" to record properties of garbage materials and apply what they have learned through the investigative phenomena to figure out the changes occurring in their landfill bottles.
- Lesson 2-1 page 13: "Connecting to the Next Question" section: "Close the lesson by: 1. Reminding students that they will be collecting data while their investigation will continue for several weeks. 2. Directing students to the other question on the board for Lesson 2-2. …Next time, we will answer this question."
- Lesson 2-3 page 10 "Connecting to the Next Question" section: Students connect to ideas from previous lessons with these prompts: "Can we apply our new understanding that matter is made of particles too small to see? Are the materials in a landfill made of particles too small to see? [Connecting the lesson activities to the anchor phenomena] Are the materials we placed in our landfill bottles made of particles too small to see?"
- Lesson 3-1 page 2: Students connect to the original driving question with these prompts: "What is our driving question that we are trying to figure out? "What investigation are we carrying out to figure out what happens to our garbage?
- Lesson 3-3 page 3: Students begin the lesson by first revisiting what they have done in previous lessons. "Remind students of the driving question. Review: our driving question is a big question, and the big question has sub-questions connected to it. One of our first sub-questions was: … For the past two weeks, we have been… Today we will record a third set of observations and measurements…" (page 3).

Throughout the unit, In the lesson section "Introducing the Lesson," students are frequently reminded about the phenomenon and discuss questions that have been answered in the previous lesson. This activity provides a link between prior learning and the new question they will address in the current lesson.

ii. Performance Expectations are clearly stated for each lesson, and corresponding Evidence Statements link the Performance Expectations to student artifacts and activities.

- Lesson 3-2 pages 4–5: Students reflect on their models for solid and liquid matter that show that matter is made of particles too small to be seen. Then students develop a model about their ideas about smell and air/gases and connect those ideas to the previous model showing matter as particles. Teacher notes explain that "This is the first of several models in the lesson, which will eventually be incorporated into the class consensus landfill model."

Each lesson includes features, such as an Overview section and sections that provide instructions for teaching, that often place the student learning within the context of what was previously learned and/or where the learning will go to.

- Lesson 2-2 page 1: “Lesson 2-2 provides students additional data to support the DCI…” which is referring to data from the Lesson 2-1 student investigation.
- Lesson 3-2 page 1: “This lesson introduces a new sub-question, ‘What is that smell?’ This builds on Lesson 2-3’s understanding of solids and liquids by similarly introducing gases as matter made of particles too small to see” (page 3).
- Lesson 2-3 page 8–9: Students revise their model of solids and liquids based on new evidence from the previous and the current lesson.

Suggestions for Improvement

i. At the end of each lesson (starting in Lesson 2-2), there is an optional visual display that can be added in the classroom titled, “Tracking What We Figured Out (optional)” (Lesson 2-2, page 11). This is a great tool that can be used by teachers and students to help the class make progress towards answering the driving question. A sample visual display is included in each lesson. Additionally, there is a graphic organizer that students can complete individually to accompany the class display. The graphic organizer tracks what the students asked, what they did, what they figured out, and what new questions they might add to the Driving Question Board. (Lesson 2-2, pages 24–25). This tool is a great asset to students as it helps them reflect on what was figured out and think about what direction they need to go next time they do science. Removing the “optional” label of this graphic organizer would therefore enhance all learners’ experiences throughout the unit and improve coherence.

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: Extensive

(None, Inadequate, Adequate, Extensive)

The reviewers found extensive evidence that links are made across the science domains when appropriate because the unit focuses on core ideas from two disciplines. It clearly conveys how ideas from different domains are connected and how ideas from different domains can be used together to explain phenomena.

i. In this unit, physical and life science core ideas are thoughtfully connected and used together to explain phenomena. The anchor phenomenon question along with the landfill bottle investigation require conceptual understanding from both physical and life sciences to develop an explanation or construct arguments. The use of both science domains flows naturally through the sequence.

- Lesson 4-2 page 10: Students investigate the rotting process in the landfill jars. In order to explain the smell emanating from the open system jars, they must connect the ideas they have learned about gas matter (physical science) with the role of microbes in the decomposition process (living matter).

ii. The application of the Crosscutting Concept of **Matter and Energy** connects these critical concepts about matter.

- Lesson 4-2 page 11: Thinking through the Crosscutting Concept lens of Energy and Matter further clarifies the interactive nature of these two domains. Students revise their models to show that the decomposition produces the smell from the landfill bottle and that the smell travels to their nose because of the particle nature of matter.

Suggestions for Improvement

Consider inserting a lesson section in which students discuss the interconnections they are using in both life and physical science so that they can realize that they are using ideas from both domains.

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. The developers effectively developed and used ELA standards in focus areas like reading, writing, and speaking. Students are also using math skills in order to explain the results of investigations and better understand the phenomena. However, teacher support is not incorporated within the lessons in a manner that helps the teacher see how the ELA or Math Standard is employed at the point of use.

In this unit, writing assignments are varied in structure and purpose and are rigorous. There are grade level writing standards incorporated into the unit and are used in multiple ways to help students make connections back to the phenomena.

W.5.2 Write informative/explanatory text to examine a topic and convey ideas and information clearly.

- Lesson 1-1 page 14: Students write and revise their own questions.
- Lesson 2-1 page 7: Students summarize their investigation plan, identify components, and describe the data they will observe and record. They explain what they think will happen to the landfill bottle systems.

- Lesson 2-3 and other lessons: Students write responses to questions about their investigations in the section called "Investigation Questions".

W.5.2.E Provide a concluding statement or section related to the information or explanation presented

- Lessons 2-2, 3-3, 4-1, and 4-2: Students progressively develop their skills in constructing arguments with teacher guidance in the beginning lessons to a gradual release to individual explanations in Lesson 4-2. They develop skill in arguing from evidence to support or refute a claim. They gain practice in connecting their claims and evidence with reasoning.
- Lesson 4-2 page 8: Student groups write a claim and evidence for an explanation, and then evaluate an exemplar to determine if the claim answers the question and if the evidence is linked to the claim. After a class discussion, students write their own version of the reasoning that connects the claim with the evidence.

Students use grade level reading skills to develop understanding and explanations of scientific concepts/phenomena/results. However, the reading materials are not varied and do not go beyond traditional types of informational text.

R1.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.

- Lesson 4-2 page 6: Students read a text selection on decomposers and use the information in the article to answer questions. The reading is at an appropriate level for Grade 5 students.
- Lesson 2-3 page 4 and 19: Students read a text selection titled, "What is Matter Made of?" and share the information they obtain as well as their reactions to the article.

Although both reading selections are grade-level appropriate and help to understand scientific concepts, there are no other forms of reading materials that can be used by students. The two passages are very similar in format, style, and tone.

Students have multiple opportunities for high-level verbal discourse in a variety of formats and scenarios.

- Lesson 2-1 page 8: A discussion prompt with teacher guidance is provided in the whole group format. Students are asked to think about properties and weight as data.
- Lesson 2-1, page 12: A "Pass the Marker" strategy for group work that supports student discussion is described, promoting students listening and representing what another student is saying as well as to prevent one student dominating the discussion.
- Lesson 2-2, page 4: While groups of students are engaged in discussion and sharing ideas, the teacher is asked to point out a group with disagreements and use this group as an example to explain how, "we disagree in science."
- Lesson 4-2, page 11: Students are reminded of their classroom norms while speaking in a discussion. Students are told that disagreements are useful and that students must state claims with evidence to support their arguments.

Students use grade level math skills to explain/understand the scientific concepts/phenomena/results however, teacher support is not always provided to help students make connections between the math skills and the phenomena they are explaining.

5.NBT.3.b

Compare two decimals to thousandths based on the meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

- Lesson 3-2 page 8: Students "use the lowest mark on the plunger as the stopping point of the measurement and describe the milliliter marks as increments of ___ mL."
- Lesson 3-3 page 3: Students measure and record the weight of the landfill bottles. The electronic scales will measure to the hundredths place. The students then determine if the landfill bottles have gained weight, stayed the same weight, or lost weight.

MP2 Reason abstractly and quantitatively

- Lesson 2-3 page 3: Students are asked to work in groups to discuss if sugar disappears in a sugar water mixture. Evidence students use in their discussion comes from an investigation with results that indicate that sugar does not disappear in water when mixed because the weight of the sugar water mixture is equal to that of the sugar and water separately.
- Lesson 2-3, page 5: "When observing marbles added to a container of ping pong balls: "What happened to the volume?" "Where do the marbles go?"

Suggestions for Improvement

- Consider providing reading materials that go beyond informational reading selections and include news articles, journal articles, infographics, websites of scientific entities, or other various types of texts.
- Consider identifying within the lesson the location where math practices are being utilized in the student thinking and discussions during activities. Providing teachers with clear instructions on how the math skills from the CCSS connect back to the phenomena/concepts/results would be helpful.

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

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

Category II. NGSS Instructional Supports

Score: 3

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 Authenticity: Extensive

(None, Inadequate, Adequate, Extensive)

The reviewers found extensive evidence that the materials engage students in authentic and meaningful scenarios that reflect the real world.

Students have multiple opportunities to ask questions and those questions are used to focus learning.

- Lesson 1-1, pages 13–16: The class discusses the components of the garbage system and students ask additional questions about garbage. The questions are sorted into groups that will lead to lesson-level questions.
- Lesson 2-1, pages 3–4: "Guide students to think about the question. *Our driving question is a big question. In our discussion, we found that the big question has sub-questions connected to it. One sub-question is, do garbage materials change in a landfill?"*
- Lesson 2-2 page 3: Students return their attention to the driving question board to choose another student-generated question to answer.
- Lesson 3-3 page 3: Students focus on the driving question board to determine which student questions should be answered next.

The materials use real-world examples that connect to students' everyday lives.

- Lesson 3-2 page 4: Students connect the smell from the landfill investigation to other smells they have encountered.
- Lesson 3-3, pages 17–18: This exit slip uses a scenario involving ice cream to ask for students to transfer the learning gained during the lesson to an authentic real-world situation they may have experienced at home.

- In addition, a disappearing puddle of water on the side of the road provides another real-world example. The teacher uses a puddle of water on the Exit Slip 3-3 to assess understanding.

The materials are structured in a way that values the funds of knowledge that students bring to school from their homes and communities as a launching point for learning, balanced with common (firsthand) opportunities to experience the phenomenon in the classroom.

- Lesson 3-2, page 3: As students ponder the smell coming from the Landfill Bottle, they are prompted by the teacher to think about "Why can I smell pizza in the lunchroom from the hallway?"
- Lesson 4-2, pages 3–4: The teacher prompts the students to "Elicit student experiences with rotting food or other materials. Student observations may include food rotting, plants on the ground that are mushy, and leaves in the fall that seem to vanish."

There are places in each lesson where students are asked to make connections to their school, home, and community.

- Lesson 1-1 pages 3–4: Students observe a pile of school garbage in the classroom and relate it to garbage generated at school, at home, and in the community.
- Lesson 3-1, page 6: Students brainstorm situations in their lives where they have noticed smells. "Teacher suggested prompts: Have you ever smelled something like that before: Where?" (The rotting fruit or rotting food in our community, garbage truck, or landfill smells bad.)"

Suggestions for Improvement

N/A

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 about their ideas. The authors have intentionally provided multiple opportunities for students to express their ideas throughout the unit using a variety of modalities. Students learn to give each other feedback and express disagreement in an academic manner by first stating another person's idea to clarify for understanding. Teacher notes help teachers understand that there is a learning progression in developing conceptual understanding that guides where the introduction of science terms should be placed in the lesson so that students are encouraged to first express their ideas without specialized discipline specific terms. Teacher notes also caution teachers about correcting conceptual misunderstandings too soon, which could interfere with students' willingness to share their ideas. Some talking structures are suggested that help nurture equal participation, however, some specific structures are not always provided, such as for "talking in triads" which occurs frequently.

- Front Matter, page 11: In the front matter, the authors give a complete explanation of how both language and the understanding of science ideas develop over time. "As the Garbage unit progresses, students' language use develops in tandem with their science understanding. For example, students use modalities more strategically to communicate the sophistication of their ideas about smell. In their initial models of smell, students represent smell as a cloud or wavy lines. Over the course of the unit, as students build their understanding of the particle nature of gas, they use a strategic combination of drawings, symbols, and written language to represent smell as particles too small to see and moving freely. They use colors and labels to distinguish between smell particles and air particles as well as arrows to indicate particle movement. To scaffold students' strategic use of modalities, the lessons include student work samples as well as guidance to teachers in interpreting and responding to student models.
- "Students also adopt a more specialized register to communicate the sophistication of their ideas about smell. When they first notice the smell coming from the open landfill bottles, students communicate their ideas using a more everyday register (e.g., "The smell stinks!"). Over the course of the unit, as students build their understanding of the particle nature of gas, they transition to a more specialized register (e.g., "Gas is made of particles" and, eventually, "Gas is made of particles too small to see that are moving freely"). To scaffold students' transition to a more specialized register, the lessons include prompts to promote precise language use (e.g., "How are the particles moving?")" (page 11).
- Lesson 3-2 page 3: Students engage in small group discussion about the smell that is coming from their landfill bottles. They are able to express their own ideas before they engage in investigations to learn more about the smell. Students get immediate feedback for their ideas as others in the group ask probing questions and reveal their own ideas.
- Lesson 3-3 page 10: Students engage in a gallery walk, where their task is to observe and provide feedback on the models of other groups, and to use the feedback on their model to make revisions.
- Lesson 4-1 page 9: After the students complete a graphic organizer for writing an argument, the teacher uses a rubric to provide students feedback on the strength of the argument.
- Lesson 4-2 page 11: Students complete a "Self and Peer Check" to provide feedback to another group as they present their model. During this process, disagreements are resolved, and revisions are made to models. Both the provider of feedback and the receiver of feedback benefit from this process.
- Throughout the unit: Students develop models that are continually revised and improved by feedback from peers and the teacher.
- Lesson 2-1 page 10: Students are instructed to "talk in their triads" about what will happen to garbage over time without being provided a structure to ensure access and equity for all students.

Suggestions for Improvement

Consider restructuring some of the lesson segments in which teachers initiate the discussion to provide opportunities for student-to-student initiated discourse.

Although students have extensive opportunities for student talk, discourse structures are minimally-taught. Consider using sentence stems, talk protocols, and other structures designed to promote equitable student talk. Suggestions are available in the Science Talk Primer and in Stem Teaching Tools

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 found adequate evidence that the materials identify and build on student learning in all three dimensions. The unit explicitly displays where the three dimensions are built upon in each lesson. Each lesson notes the typical levels of proficiency that students at this grade level have with each of the three dimensions. Also, each lesson makes 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 above this level. However, it is not explained to the teachers how the prior learning will be built upon. Furthermore, there is not much support provided to the teacher on how to help the student who is not equipped with the prior learning experiences can build toward proficiency.

Prior student learning is stated in the "Building Progressions" section at the end of each lesson as well as within some lessons. The inclusion of the grade band below and above elements for all three dimensions provides teachers with the information needed to figure out where the skills and understandings of students are placed in the overall progression of learning. For example:

- Lesson 1-1, page 7: "Since students should be familiar with some property descriptors from the K–2 grade band, use the responses to determine the extent to which students are entering the unit with the expected prior learning. Specifically, look for the following:
  - Are students able to distinguish materials between categories?
  - Are students able to identify properties of materials within and across categories?"
- Lesson 2-2, page 6: "In fact, being able to distinguish between evidence and opinion is an element for the SEP engaging in argument from evidence in the K–2 grade band. From the K–2 grade band, students should be familiar with making a claim. For the 3–5 grade band, students extend this understanding by providing evidence that supports their claim and reasoning of how their evidence supports their claim. In this unit, students are first exposed to engaging in argument by

co-constructing the arguments. The scaffolds around argumentation are released through the course of the unit so that students argue more independently by the end of the unit".

- Lesson 2-2, page 7: "*You may remember from previous grades that when we have figured something out from an investigation, we make a claim."*
- In Lesson 2-1, students are given some choices in planning their Landfill Bottle investigation. There is an extension (optional) question on the Exit Ticket about fair tests. The developers have used these extensions to provide challenge for students who have already mastered the standards. During Lesson 2-2, page 3, there is an option of discussing the idea of fair tests. Participation in this aspect of Planning and Carrying Out Investigations is important for all students. The developers have outlined a logical progression for the practice of argumentation in Lesson 2-1, pages 6–7, but have not outlined a similar progression for the practice of Planning and Carrying Out Investigations.
- In the use of some of the CCCs, the teacher is provided with information about prior learning. For example, in Lesson 3-2, page 6, the developers discuss the CCC of Scale, Proportion and Quantity. Teachers are cautioned that students may not have had exposure to this in the previous grade band. "As students are developing their initial models, you may guide students to think about what the wavy lines or clouds would look like if students could "zoom in" on them. By guiding students to "zoom in" on a gas, students are progressing to the Middle School expectation for the Scale, Proportion, and Quantity CCC, *Phenomena that can be observed at one scale may not be observable at another scale."*
- However, the lessons use several CCCs for which no progression of learning is provided. For example, in Lesson 4-2, page 4, the CCC of Cause and Effect is used. "Describe, *Understanding the relationship between cause and effect is an important scientific idea. Cause and effect is a crosscutting concept. What are the changes that you observe in the landfill bottles?* (the smell, some materials appear to vanish, mold grows, the properties of the food materials change). *Our new question, what causes changes in landfill bottles? is about the cause of these changes*. *When we figure out the cause*, *we can explain why these changes to garbage materials happened."* There is no guidance for the teacher to use examples or other devices to help children understand these terms.

Suggestions for Improvement

- Consider adding a description at the beginning of the Building Progressions section for each lesson that provides a clear explanation of how the prior learning will be built upon. This addition will help teachers know what is being done in the lesson to move students along the progressions that are listed for the prior grade band toward the current grade band. This description could include an explanation of the prior knowledge and skills (from previous grade experiences) that are needed before the unit begins and that will lead toward engaging in the practices, thinking using the CCCs, and developing the grade level science concepts.

- Consider including in the Teacher Background and other sections within lessons specific learning that is built upon from a prior grade level in the context of the DCIs, CCCs, or SEPs.
- Consider increasing specific suggestions for moving the use of the Crosscutting Concepts from prior knowledge to specific elements in the current grade span.
- Consider providing charts of the progressions (from the Appendices) for all three dimensions.
- Consider extending explanations of prior student learning within lesson directions, such as in Lesson 1-1 page 6, which describes the prior student learning as an introduction to the ideas of properties and patterns. Adding information such as that in second grade, students explore properties using the CCC of patterns, and explaining how what students do in second grade is built upon in this fifth-grade lesson will make this progression clear. Consider including similar types of information within other lesson instructions to strengthen the building of progressions. Adding similar information into the teacher instructions for more lessons (as the SEP, CCC, and/or DCI are explained) will strengthen the building of progressions.
- Consider adding some instructions within the lesson regarding expected learning from prior grade levels that provide guidance on what to look for in student work.
- Consider including some details in the front matter as well as the lessons that explain the process of how the unit is set within the context of prior learning and building toward the next grade band. This will help to clearly explain how the prior learning will be built upon. For example, currently on page 4 in the front matter of the unit, the development process for the unit instructional materials is described as “For each specific element of each dimension, we identified learning progressions from the previous grade band of K–2, within the current grade band of 3–5, and toward the next grade band of 6–8.” Adding some details about how the process for moving from one grade band to another is incorporated within the unit will strengthen the building of progressions.

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 science concepts are accurate and explained in ways that support teacher understanding as well as student learning. Science concepts and the activities that students use to develop those concepts are grade-appropriate. Phenomena and representations are accurate and grade-appropriate. Background information is provided to clarify potential alternate conceptions the teachers may have. Teachers do call upon students to share their conceptions of the scientific ideas. Support is provided for teachers to clarify these alternate conceptions.

As each investigation progresses, students' conceptual understanding of the particle nature of matter is incrementally developed through "figuring out" how to explain what the evidence may support.

To keep the concepts grade appropriate, these lessons avoid going into details about the names of the particles and more complex specifics about their interactions, in order to develop the "big idea" that matter is made of particles too small to be seen. This unit is designed to develop students' ability to "see the world as particles", which creates a strong foundation to address more complex concepts in future grades and will provide knowledge that will enable students to develop models related to their other fifth grade science concepts throughout the year.

- Lesson 2-1 page 4, Teacher Background: Progression of Introducing Scientific Terms: The authors explain their philosophy about the use of scientific terminology in the Garbage Unit. "In the SAIL curriculum, scientific terms are used after students have experienced and developed an understanding of science ideas. Through their engagement in science, students communicate their ideas. As their thinking becomes more sophisticated, students communicate their ideas with increasing precision and explicitness. Scientific terms, such as matter and gas, are important because of the precision and explicitness they afford. To introduce scientific terms, model how to use them in context for your students. The introduction of DCI terms is intentional to promote progression from everyday/colloquial to specialized/disciplinary language. This progression of language use occurs in tandem with progression of science understanding over the course of the unit" (page 4).
- Lesson 4-2 page 6: After observing microbes multiplying on agar plates, students read a selection that assigns science words to ideas and factors involved in the observations.

Teachers are given the opportunity to clarify potential alternate conceptions throughout the unit specifically in the "Teacher Background" portions of each lesson. Through student predictions, the teacher may gather student conceptions prior to making sense of various concepts. For example:

- Lesson 1-1 page 8: Students make predictions about how materials will change over time and record them in their notebooks. Students discuss their predictions in their groups. However, samples of possible student responses are not provided. Also, the teacher is not provided with direction on how these conceptions will be addressed.
- Lesson 2-1 page 5: In the Teacher Background section, teachers are provided this support concerning alternate conceptions: "Do not further define the term matter. Conventional definitions of matter lead to student misconceptions. For example, the definition that a solid retains its shape leads to a student misconception that clay is not a solid because it changes its shape readily."
- Lesson 2-1 page 7: The differences between the landfill bottle jars is described to the teacher and matter conservation is explained. An explanation for why the open system jar and closed system jar will have different weights is provided.

- Lesson 2-1 page 10: Students are asked to make predictions about open and closed systems. They are asked, "What do you think will happen to the different garbage materials over time? Why do you think that?" Students then discuss these predictions with their partners and record them in their notebooks. However, it is not clear what the students may be thinking at this point in the unit and how the teacher will address these conceptions as learning progresses. Lesson 3-2 page 2: Ideas of gases, volume and pressure are explained to the teacher and how they will see these concepts represented in the investigations that follow is also described.
- Lesson 3-2 pages 5-6: Two examples of possible student models showing student ideas about what gases might look like are included. The teacher background explains that, "...some student models will probably contain particles, but they may also contain other features, such as wavy lines for wind or waves that represent some kind of support structure holding up the particles." Additionally, teachers are given further guidance:" As students are developing their initial models, you may guide students to think about what the wavy *lines or clouds would look like if students could "zoom in" on them."*

Suggestions for Improvement

- Consider providing samples of student responses for predictions or some understanding of what students' conceptions are at certain points of the unit along with teacher guidance on how these conceptions will be addressed.
- Consider clearly identifying in the Teacher Background information when student alternate conceptions are being addressed as well as Teacher alternate conceptions. Clearly explaining/identifying these alternate conceptions as possible student conceptions will further support the teacher in addressing these throughout instruction at the appropriate time of conceptual development.
- Consider addressing student alternate conceptions around the science concept related to signs that a chemical reaction has occurred in Lesson 4-1.

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)*

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The reviewers found adequate evidence that the materials provide guidance for teachers to support differentiated instruction because the unit addresses the needs of English language learners, struggling students, and students who have already met the performance expectations. However, it is not always clear to the teacher how and where these supports are given. Also, there could be additional engagements provided to encourage and motivate students who have already met the performance expectations.

Extensions have been provided to challenge thinking of advanced learners and are followed up with opportunities for students to share what they have learned. However, for students who have already met the performance expectations, the differentiation does not add to the experience for the individual student in a way that is meaningful, respectful, relevant, and engaging; student driven instruction could move students beyond the essential understandings of the lesson.

- Lesson 2-1, page 32. An extension is provided that asks students: "Why is it important that the open and closed systems in our investigation have the same materials? This extension question, although offered as an extension, is an important question for all students to know in regards to fair tests.
- Lesson 2-2, page 11: "Extension: What data could you collect to investigate whether the amount of paper has changed?" This is a good example of a follow-up question asked to advanced learners to share other ideas.
- It is not always apparent to teachers where and why these differentiation ideas are being used throughout the lessons. Because these materials will be used by teachers without additional training by the developers, explicit information about this differentiation process would help guide those teachers in their classroom. Many teachers need to document where and how differentiation occurs in their lessons.

<u>Suggestions for Improvement</u>

- Although the developers have included extensions in many of the "Class Check!" sections, it is not clear how those extensions can be used to provide a challenge for students to develop a deeper understanding.
- Ideas are presented in the Front Matter on differentiation in terms of language design principles and local phenomena. As the developers note, this type of differentiation is supported by research. However, differentiation of this kind may be unfamiliar for teachers. Consider tagging specific places in the lessons where aspects of differentiation are used. As an example, in Lesson 1-1, page 6, students are organizing their garbage into categories. As students discuss their categories, they will use a variety of common words. Consider including in the notes to the teacher the idea that this is an example of the register of *everyday talk*. During that same discussion, the teacher introduces the science word "property." Teachers would benefit from pointing out that this is an example of the register of *specialized talk*. Inserting these kinds of notes would educate teachers about the unit's method of making the lessons accessible to all students.

- Consider the following as a method for differentiation: Instead of the teacher or exit slips asking the guiding questions in the extensions, have the students who met the performance expectations write their own questions based on the lesson phenomena and select what question can be answered and how.

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: Extensive

(None, Inadequate, Adequate, Extensive)

The reviewers found extensive evidence that the materials support teachers in facilitating coherent student learning experiences over time. Students have an opportunity to engage in asking questions about phenomena that they feel they need to address in upcoming lessons, and there is a focus on future investigations answering these student-generated questions. All students are engaged with a phenomenon that is meaningful and relevant; has supports for all students; and that can be explained through the application of targeted grade-appropriate SEPs, CCCs, and DCIs as the central component of learning.

i. The unit provides opportunities for students to generate new questions that can lead toward the next lesson.

- Lesson 1-1 page 16–17: After individual students have generated questions about garbage, the class develops a Driving Question (DQ) board. In this activity, the class classifies questions into categories and then collaboratively agrees on driving questions. Information for the teacher about using the DQ board is included.
- Lesson 2-1 page 13: At the close of the lesson, students are directed to revisit the DQ board and, with the guidance of the teacher, select another question to investigate.
- Lesson 2-2 pages 2–3: In the section called "Introducing the Lesson", the teacher asks questions and connects learning to the previous lesson. "Review the DQ, 'What happens to our garbage?' Our driving question is a big question, and the big question has sub-questions connected to it. Currently, we are carrying out an investigation of landfill bottles to collect data as evidence to answer this sub-question. Do garbage materials change in a landfill at time point 1? Point to DQ Board. Say, 'Another sub-question we asked after our virtual landfill field trip was, what happens to materials when they are crushed in the landfill? You made predictions in your SEN about what would happen to various materials in a landfill. We are going to investigate some garbage

materials to collect evidence about what happens to the materials as they are crushed.'" (pages 8–9)

- Lesson 3-3 page 10: Students open their previously closed landfill bottles and notice an obvious smell. Students are prompted to make observations and then write new questions to add to the DQ Board.

ii. At many places in the unit, teachers are given background information on science ideas and detailed suggestions on how to foster student sense-making.

- Lesson 1-1 pages 5–6: After students have sorted the garbage into categories, the teacher leads the class in a discussion of using patterns to classify matter. The teacher asks the question, "What patterns do you observe across the categories chosen by the different groups?" The lesson provides possible questions for the teacher to ask to help students learn to use the CCC of patterns.
- Lesson 2-2 page 5: Teachers are given information about how to help students make cogent arguments using evidence from their data and reasoning from the knowledge of science ideas.
- Lesson 3-2 page 2: Teachers are provided information about the particle nature of matter and how to clarify student understanding of the science ideas as they modify their models.

Suggestions for Improvement

Students will have questions that do not fit into the flow of this unit. Provide teachers with suggestions on how to deal with these student questions.

Lesson 1-1 page 14: The lesson writes to teachers in the Teacher Background that if students do not come up with some of the needed questions to drive the unit that it is okay and there will be future opportunities to retrieve those questions from students. However, it is not explicit in the other lessons where this happens. Consider adding places in the future lessons where this does happen and directions for teachers on how to update the Driving Question board. Although the worksheet in lesson 2-2 on page 24 asks students to record new questions they come up with, the directions to teachers say this is only an optional activity. Because it is not required that teachers hand this out, they may be missing opportunities to update the Driving Question board.

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: Extensive

(None, Inadequate, Adequate, Extensive)

The reviewers found extensive evidence that the materials support teachers in helping students engage in the practices as needed and gradually adjust supports over time. This unit provides strong student support for the practices of Developing and Using Models and Engaging in Argument from Evidence. Sections of lessons are devoted to helping students grow in their understanding of how to use these practices at a deeper level. Over the course of the unit, support is adjusted for what has been practiced as new areas are supported. Teacher background information and notes provide explanations that help the teacher use the materials in a manner that engages students in the practices, with guided support during the beginning lessons, and gradual increase of student responsibility for using the practices more independently as lessons progress.

Engaging in Argument from Evidence

Early in the unit, students are guided by the teacher to make a claim and support it with evidence. As the unit progresses, students assume more responsibility for this practice. At the end of the unit, students are expected to develop their own claim and provide quality evidence and reasoning to support the claim.

- Lesson 2-2: Students co-construct the first argument with the teacher and groups are guided to make the second argument.
- Lesson 3-3 pages 5–8: After guided summarizing of the data from the landfill investigations, students work as a class, using a graphic organizer, to write an argument based on evidence and reasoning to support a claim that “Some materials change and some materials do not change” (page 5). Next, students work in groups to write an argument using a graphic organizer that answers a different question, with some teacher guidance. After a class discussion, students individually revise their arguments. The teacher provides written feedback on individual arguments.
- Lesson 4-1 page 8: After collecting data from an investigation, students work in groups to make a claim about new substances being formed, working together with support from the teacher to determine which evidence supports the claim, why they chose that evidence, and the reasoning that connects the evidence to the claim. Next, students work individually to complete a graphic organizer with a second claim, the supporting evidence, the reason for selecting the data, and the reasoning that connects the evidence to the claim.

Developing and Using Models

The unit begins with a class-generated model led by the teacher. Students build an understanding and proficiency in the SEPs over time through a variety of student approaches over the course of the unit. At the end, student groups create their own model, look at others’ models to notice how they are the same and provide feedback on other models.

- Lesson 2-1, page 11 and Lesson 3-2, pages 4–5 and 9–10: The practice of Developing and Using Models is explained and supported in a manner similar to the support that is provided for Constructing Arguments with Evidence. Teacher instructions provide students with key information to apply to the practice of developing models. Student groups work on an initial model, share it with the class, and then as a group, revise their models. They revisit their models in Lesson 3-1 after collecting more data from the landfill investigation and continue to develop their models with increased independence, using the models to explain a process with more conceptual depth and detail in Lesson 4-2.

- Lesson 2-3 pages 3–4: After completing an investigation mixing sugar and water, students draw their initial model showing the particle nature of matter.
- Lesson 3-2 pages 4–6 and pages 9–10: Students make a model of how smells can travel through air to reach the nose. After completing additional investigations, students revise their initial model to show gas particles traveling through air.
- Lesson 4-2 pages 11–12: Students revise their models to include the new information about microbes. They then present their models to another group. The class works together to identify parts that need to be present in all models. Together, the class develops a Consensus Model.

Suggestions for Improvement

No suggestions

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

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

Category III. Monitoring NGSS Student Progress

Score: 3

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: Extensive

(None, Inadequate, Adequate, Extensive)

The reviewers found extensive evidence that the materials elicit direct, observable evidence of students using practices with core ideas and crosscutting concepts to make sense of phenomena and design solutions. Tasks routinely and comprehensively provide students with opportunities to make their thinking visible, with varied opportunities and purposes. Monitoring of student progress is supported with explanatory notes to the teacher in the introductory section as well as within lessons. Many of the tasks are three-dimensional. Tasks include notebook entries, Exit Slips, ongoing student models, and graphic organizers for constructing arguments, as well as more formal checks on learning with group, individual, and self and peer check tasks. The check mark symbol helps to identify some opportunities for monitoring student progress. Tasks regularly provide students with opportunities to show facets of understanding—including current understanding and abilities, gaps, and misconceptions—in contrast to just right and wrong answers.

Most formative student tasks within the lessons are three-dimensional and require students to make a connection with the phenomenon. Student gaps and misconceptions are addressed when peer and teacher feedback occur. For example:

- Lesson 2-2 page 9: After completing a CER about what happens when a material is crushed, students complete a checklist to reflect on and improve understanding of writing arguments. Students share their thinking with the class. Students are using observable patterns to argue a claim about conservation of matter.
- Lesson 3-2 page 10: Students revise their initial model of gases in their notebook after additional experiences and discussion within their group. The teacher collects the notebook and checks for understanding of individual students. Students use data from investigations to create a model of the particle nature of gases.
- Lesson 4-2 page 7: During an investigation, students make observations of the microbes on their agar plates. They are prompted to look for patterns as they observe and record the differences in the colonies of microbes.

- The End of Unit Summative Assessment includes 1) three-dimensional tasks and 2) inclusion of tasks anchored in the unit phenomenon and extension tasks. The first three tasks can largely be completed by recalling what has been done in the lesson sequence. The final three tasks ask students to use what they know to explain another phenomenon.
- End of unit assessment task 2, pages 4–5: The task asks students to re-create the model produced by their group during the lesson sequence.
- End of unit assessment task 4, pages 6–7: Students watch a video and observe a different phenomenon. They apply their understanding of chemical reactions and the conservation of matter to this new phenomenon. The questions include recording observations, completing a CER, and writing an explanation. In responding to the questions, students use elements of a DCI, SEP, and CCC.
- Constructs, Scoring Criteria, and Task: pages 18–20: At the conclusion of the section "Constructs, Scoring Criteria, and Tasks" is a matrix showing the specific elements of the SEP, CCC, and DCI that are represented in each of the summative tasks.

Suggestions for Improvement

Consider revising the summative tasks to include all three dimensions and providing teachers with information in the rubrics on how to analyze student responses in all three dimensions.

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 that evaluate student learning and inform instruction because the materials include frequent and varied support for formative assessment processes, but they are not always clearly described and explained.

Formative assessment processes support student thinking across multiple dimensions.

- Lesson 2-3 page 8: As student groups begin to develop a model of solids and liquids, the teacher monitors the groups. Teacher prompts are given that focus on the needed features of the model and connections of the model to the activities done in class. Groups then present their models to the class and share their thinking. This provides another opportunity for the teacher to evaluate student learning.
- Lesson 4-2 page 8–9: The teacher collects a graphic organizer where students have constructed an explanation of their agar plate investigation. A rubric is provided so the teacher can give individual feedback to each student.

Formative assessments include some specific support for modifying instruction based on student responses—at least some sample student responses are provided, and rubrics/teacher materials include some support for shifting instruction based on responses elicited from specific tasks. However, there are not many clear opportunities in some of the lessons that provide explanations about how to modify instruction based upon student responses.

- Lesson 3-3 page 7: Students individually write out their arguments on whether or not the amount of matter changes in a landfill bottle. The students write their CER and a rubric to provide feedback of this is on page 20. No support for shifting instruction is provided to the teacher if the response does not match the rubric.
- Lesson 3-3 page 12, Exit slip does say, "You could also use responses to identify which students may need additional support", but it is not clear what teachers could look for in the responses. There is not a range of student responses provided to the teacher in order to help the teacher shift future instruction.

Suggestions for Improvement

Consider providing clear guidance for how teachers can interpret a range of student responses and change instruction if they find that some or many students are not understanding the science ideas.

Teachers need support in modifying instruction based on feedback from formative assessment. You have noted that:

> "Teachers are given student artifacts (e.g., arguments. explanations, models) to interpret for evidence of engagement in three-dimensional learning. Then, teachers are asked to consider how they would use these interpretations to modify instruction for the class and provide feedback to individual students." from the Blind Response to Reviews.

Since not all teachers will have the opportunity to participate in professional development for this unit, the use of formative assessment in the unit as intended would be strengthened by including elements of the professional development training materials within the unit. For example, consider incorporating the ideas and examples of student artifacts presented in Professional Development into the materials that will be available to all teachers.

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

Rating for Criterion III.C. Scoring Guidance: Adequate

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence of aligned rubrics and scoring guidelines that would help a teacher interpret student performance for all three dimensions. Clear guidance is provided for teachers to interpret student progress, in relation to both the instructional materials as well as the targeted standards/dimensions/parts of dimensions/learning performance. Rubrics are provided for teacher evaluation of arguments. These rubrics include samples of student responses. In addition, each CER includes information to the teacher about the general kinds of predicted student responses. Information about student feedback is included, but there is little support for teachers to plan alternate instruction. However, minimal guidance is provided to teachers and students about how to address gaps and misconceptions through future instructional experience and other assessment opportunities.

- The summative assessment at the end of the unit includes a detailed set of rubrics to help teachers evaluate student learning. At each level of the rubric, specific examples of student thinking are included
- The Summative Assessment provides scoring guidance.
- Some of the formative tasks provide descriptions that guide their use in shaping instructional decisions.
- Lesson 3-3 page 18: The rubric provided gives teacher guidance to assess and give feedback to students about their arguments about the amount of matter in their landfill bottles. Samples of student work are included to help guide the teacher.
- Summative Assessment: Rubrics are provided for all tasks in the assessment. Sample student responses are included in the rubric.
- Lesson 3-3 page 11: During a gallery walk looking at group models, the teacher checks student work and then prompts students to look at certain aspects of the model by asking questions. This is followed by the class developing a class consensus model. Little guidance is given about what the teacher should do if these ideas do not arise from student discussions or if misconceptions arise during this discussion.
- Tasks are not always three dimensional. Three dimensions are claimed, but not identified inside the tasks. For example, in Constructs, Scoring Criteria, and Tasks, pages 12–15, a table with the dimensions assessed is provided. The element of the SEP and the element of the CCC are not given. The scoring criteria do not give guidance on how the elements of the SEP and CCC dimensions are to be assessed.

Suggestions for Improvement

Consider providing teachers information on how to address gaps and misconceptions through future instructional experiences and other assessment opportunities (explicit coherence in terms of interpreting student progress). One way could be to provide teachers with ideas about additional lesson-level phenomena or investigations to use if students need more experiences to fully understand a science idea.

Consider identifying in the rubrics the three-dimensionality of these tasks.

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: Extensive

(None, Inadequate, Adequate, Extensive)

The reviewers found extensive evidence that the materials assess student proficiency using accessible and unbiased methods, vocabulary, representations, and examples. Representations or scenarios capitalize on the funds of knowledge that students bring with them to the classroom and materials provide clear pathways for students to make connections to their lives beyond the classroom. Multiple modalities are used in the unit including non-verbal modalities, allowing students various ways to convey their understanding. Vocabulary is carefully considered and introduced after students have experience with the science ideas.

- Lesson 1-1 pages 3–4: Students bring their own knowledge and experience to the initial exposure to the phenomenon. “Give students a minute to observe and talk about the garbage without any prompts. To facilitate group discussions about the contents of the garbage, ask the groups to answer the questions: What do you observe? What materials do you observe” (page 4)?
- “As you circulate through the groups, you can use these additional prompts to think [sic] about materials:
    - What is garbage?
    - Where is your garbage from today’s lunch?
    - What materials are in your garbage?” (page 4)

Examples of modalities incorporated into the lessons in the unit include:

- Lesson 1-1 page 6: Students record data in their Science and Engineering Notebook (SEN)
- Lesson 2-1 page 11: Students work in groups to develop a model of their landfill bottles, using pictures and words.
- Lesson 2-2 page 6: Students participate in a small group discussion about the patterns found in the data collected.
- Lesson 2-3 page 7: Students model solids and liquids with their bodies.
- Lesson 3-2 pages 10–11: Students use a computer simulation to add to their knowledge of the particles that make up matter.
- Lesson 3-3 page 10: Students participate in a gallery walk to provide feedback on the models of other groups and to receive feedback on the model made by their own group.
- Lesson 4-2 page 6: Students read and respond to a reading selection about decomposers.

<u>Suggestions for Improvement</u>

No suggestions

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 because multiple forms of assessment opportunities are used in a variety of ways to apply elements of the three dimensions. However, the three-dimensional assessment rationale for teachers is lacking and not all the assessment tasks balance the three dimensions.

Materials include assessments that are consistently designed to connect to learning goals and require students to apply appropriate elements of the three dimensions to make sense of the phenomenon/solve the problem. For example:

- Lesson 3-2 pages 4–5: Students share examples of smells they have encountered and develop initial models of what gases look like when enlarged.
- Lesson 4-2 page 4: Students share their experiences with rotting food or other materials (e.g., leaves in the fall that seem to vanish).

Most of the tasks are multi-dimensional with significant three-dimensional tasks.

- Some of the summative tasks are three-dimensional. Task 2 in the Constructs, Scoring Guide, and Tasks, pages 5–9, asks students to construct a model (SEP) that includes components of the system (CCC) telling what happens in the Landfill Bottles (DCI).
- Other tasks separate the three dimensions or assess dimensions individually. Task 3 in the Constructs, Scoring Guide, and Tasks, pages 9–11, mainly assesses the DCI. The scoring guidance discusses only aspects of the DCI and does not give guidance on the SEP and CCC that were included in the Dimensions Assessed chart.

Independent of whether the assessments seem to target the targeted learning goals, there is inadequate teacher support to know what student learning is being measured, as well as when and what to do with that information.

- Front Matter page 20 and Unit 1 Pre-Assessment: A Pre-assessment has been added; however, the pre-assessment does not include teacher materials that address connections to student learning in prior units or grades in order to gain a better understanding of how each task will measure student learning. Also, the pre-assessment does not provide feedback to teachers to inform instruction and students to inform learning.
- Lesson 2-1 page 9: Students are asked to engage in a discussion on the topic of whether matter can be controlled in the landfill system. The lesson then states that, “Student responses will vary, but some students may suggest closing the bottles. Based on student responses, say, in our

investigation, we will close some of our landfill bottles to make them closed systems." Although the teacher is told to what to do with one answer provided from the student instruction, how to determine student learning, what student learning is measured and what to do with other responses that do not match the script is not clearly explained to the teacher and therefore, makes it difficult to make decisions on how to proceed with instruction in other instances.

- Lesson 3-3 page 3: Students are asked to make predictions about what happens to the properties of materials. Teachers may not recognize what student learning should be used by the students to make these predictions and what to do with the predictions they hear.
- Evidence of development in the DCI and SEP is found in the tasks, but rich immersion into aspects of the CCC are still not evident in many of the assessment tasks. An example of this is Task 6. The developers indicate that the CCC of Systems and Systems Models is being assessed. The prompt for the task does not require the use of the CCC and no directions are given to teachers to assess the CCC. However, the reviewers do note that combining the CCCs is not always a required look for as noted in the TAPS lesson screener.

Suggestions for Improvement

- One of the final tasks as a pre-assessment. A pre-assessment needs to ascertain the thinking and knowledge from previous learning, as well as what students already know about the fifth-grade standards. Consider developing a pre-assessment that also has tasks correlated with the standards from earlier grades.
- Consider indicating in Lesson 1-1 when teachers should use the pre-assessment as well as how to use the results to guide instruction. Include the pre-assessment in the Constructs, Scoring Criteria, and Tasks document. This could be accomplished by referring to where these items are located in the other assessments. Otherwise, although a pre-assessment has been included, teachers may not be aware of its existence for use prior to teaching the unit.

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

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

(None, Inadequate, Adequate, Extensive)

The reviewers found extensive evidence that the materials provide multiple opportunities for students to demonstrate performance of practices connected with their understanding of core ideas and crosscutting concepts. Included in the unit are multiple, linked student performances that provide students with several opportunities to demonstrate understanding. Students utilize multi-modal feedback across a series of student performances to demonstrate new thinking based on peer and teacher feedback and personal reflection.

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These examples combine the student opportunity to show understanding with a variety of methods of peer and teacher feedback:

- Lesson 2-2 page 9: Students work in small groups to improve their arguments. To start, they complete "Self and Peer Check! Arguing from Evidence" where they critique their own work. Then students engage in a discussion about their work.
- Lesson 2-3 page 9: After students construct their initial models of solids and liquids, the teacher collects their notebook to check for their understanding about the particle nature of matter. Individual feedback can be provided at this point.
- Lesson 3-3 page 11: As students do a gallery walk to view models, the teacher circulates through the room to see if models represent gas leaving the open landfill bottle system. Possible questions provide the teacher with a method for determining student understanding.

Suggestions for Improvement

No suggestions.

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

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

Overall Score

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

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

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

Overall Scoring Guide

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

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

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

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