How Do Things Inside Our Bodies Work Together to Make Us Feel the Way We Do?

EQuIP Rubric for Science Evaluation

Developer/Curriculum: OpenSciEd
Unit Name: How Do Things Inside Our Bodies Work Together to Make Us Feel the Way We Do?
Grade: 7th
Date of Review: July 2019
Overall Rating (N, R, E/I, E): E/I
Category I: NGSS 3D Design Score (0, 1, 2, 3): 2
Category II: NGSS Instructional Supports Score (0, 1, 2, 3): 2
Category III: Monitoring NGSS Student Progress Score (0, 1, 2, 3): 3
Total Score (0–9): 7

Click here to see scoring guidelines

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

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

Summary Comments

Thank you for your commitment to students and their science education. Achieve is glad to partner with you in this continuous improvement process. The unit is excellent in multiple ways including being coherently designed such that the unit will support students in developing and using the three dimensions to make sense of phenomenon. There are substantial and varied ways for students to share their thinking, along with a variety of assessment opportunities throughout the unit.

Many of the suggestions for improvement in this document focus on helping to further refine the unit in the spirit of continuous improvement. Only a few significant areas of concern remain. During revisions, the authors should pay close attention to the following areas: 1) differential treatment of DCIs, SEPs, and CCCs with regard to building and communicating learning progressions, 2) use of the crosscutting concept patterns, 3) clarity of graphs, and 4) increasing the use of student questions to drive the unit. Additionally, there is a misalignment between the claims (i.e., stated performance expectations and elements) and the design of the unit that should be adjusted. Fixing these issues will increase learning outcomes for students.

A couple minor notes on usability:

- Whenever possible, indicate for teachers where they can find each student-facing handouts (i.e., student procedures, references, or printed handouts), including page numbers. This information would be useful for teachers in the "Learning Plan Snapshot" for each lesson (page 34 for Lesson 1) and/or in the "Materials preparation" section for each lesson (page 36 for Lesson 1). A more detailed table of contents for the Student Handbook (with the title and page number of each item) may also be useful to teachers. Finally, consider providing references to specific areas of the Teacher Handbook in case teachers need additional support in some areas. For example, in the Lesson 1 "Materials Preparation" section (page 36), consider referring teachers to the Teacher Handbook section about Driving Question Boards (Teacher Handbook page 20).
- In all lessons with investigations, consider the ways that a student will navigate between the various resources available to them. These resources include the instructions on the Slides, Student Procedures (Student Handbook), References (Student Handbook), Student Handouts, and the investigation materials themselves. This could become overwhelming and confusing as students are directed from resource to resource. For example, in Lesson 3, the Slides, the Student Procedures (Student Handbook, pages 11+), the References (Student Handbook, pages 63+), and the Student Handout (MR.L3.HO1) are all available to students, but do not always match in terms of Lesson "Part" numbers, titles, etc. Not all resources have all the parts (i.e., students' Part 6 is on the Handout but not in the References). Also consider potential confusion between how the student-facing materials present lesson "parts" and how the Teacher Edition presents lesson "parts" (such as Teacher Edition, Lesson 3, Page 70).

All evidence refers to the Teacher Edition unless otherwise stated.

Note that in the feedback below, black text is used for either neutral comments or evidence the criterion was met and purple text is used as evidence that 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.

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. Through Lesson 10, learning is driven by students making sense of the anchor phenomenon. However, beginning in Lesson 11, the focus is shifted to learning the DCI content, and only infrequent connections are made back to the anchor phenomenon (although investigative phenomena are still largely used to drive sense-making).

Examples of evidence that learning is driven by making sense of phenomena include:

- Throughout most of the unit, students are trying to make sense of M'Kenna's (a middle school girl) illness that causes her to get sick after eating. Throughout the unit, students learn more information about how different parts of the body work, and how changes in structure and function can affect them.
  - Students are told about the case by the teacher, and then listen to an audio clip (Lesson 1 page 38). Students get a copy of M'Kenna's doctor's note with all of her symptoms listed. Students are then asked to think about the symptoms and write down what they wonder about M'Kenna and her symptoms. Guidance is provided to the teacher (page 39) about what the unit is focused on helping students figure out: "We want students to figure out how M'Kenna's body is being affected—what's the underlying cause? —and that the body systems must be interacting or connected somehow" (page 39). Students refer back to the doctor's note on several occasions throughout the unit. For example:
    - The doctor's note is revisited in Lesson 7 (Slide A), Lesson 9 (Slide D), Lesson 10 (Slide B), and *Lesson 13 (Slide K).*
    - In Lesson 7, students use M'Kenna's doctor's note to address the question "does our model fully explain all of M'Kenna's symptoms?" (Slide H). The unexplained symptoms are the basis for the following lessons.
  - Lesson 7 begins by pulling together what students have figured out so far about the phenomenon.
  - By the end of Lesson 8, students have figured out a plausible diagnosis to explain a part of the phenomenon.
- While the phenomenon of M'Kenna's illness drives much of the unit (i.e., it's an anchoring phenomenon that students continue to come back to throughout the unit), lessons also have

investigative phenomena that drive student learning within the lesson. Typically, these experiences are still connected back to the anchoring phenomenon. For example:

  - In Lesson 3, students observe a new investigative phenomenon in the dialysis tubing experiment. Students make sense of what they observed (e.g., page 82) and connect what they figured out to the anchor phenomenon with the help of the teacher.
  - In Lesson 11, students begin to make sense of an investigative phenomenon: a flame goes out quickly if a fire is burned in a closed container. They eventually connect this phenomenon back to the anchor phenomenon.
  - In Lesson 12, students begin to figure out the respiratory system. However, the connections between these lines of inquiry and the unit anchor phenomenon are relatively weak and infrequent compared to those used in the first 10 lessons of the unit. Students do much of the sense-making in this lesson without connecting back to the anchor phenomenon.
  - Lesson 12 (e.g., page 271) includes a focus on helping students understand the connection between exercise and increased energy needs before helping students make the connection between exercise and the anchor phenomenon.
  - Lesson 13 connects the learning from Lessons 11 and 12 back to the unit anchor phenomenon.

- Lesson 14 connects to the DCI topic from a few lessons prior, but not to a phenomenon.
- Lessons 14 and 15 do not connect to the anchor phenomenon and instead seem to provide opportunities to transfer what students figured out through making sense of the anchoring phenomenon to other organisms.
- Throughout the unit, students use a Progress Tracker. At the end of Lesson 1, students are told that “as we investigate what is going on with M’Kenna, we are going to keep track of how our model changes and develops over time. To do this, we are going to use a Progress Tracker…. This is a tool designed to help us keep track of ideas we figure out from each lesson. In the ‘What I figured out column’ you can draw pictures or write in words, bullet points, or whatever way is most meaningful for you. Individually take 3 minutes to think about what you figured out last class. You can draw from anything we’ve done so far.” Students add to their Progress Trackers at the end of most lessons (it is at least an optional activity in all lessons), ensuring that student attention is turned back to the anchor phenomenon.
  - At the end of Lesson 5, although using the Progress Tracker is only optional, students are asked to respond to the prompt: “How does what we figured out today help us figure out what might be going on with M’Kenna?” At the beginning of Lesson 6, students add to their Progress Tracker based on what they figured out in Lesson 5.
- Student questions and prior experiences related to the phenomenon motivate sense-making and/or problem solving. Much of this evidence is related to generating the Driving Questions Board and revising it throughout the unit.
  - After the phenomenon is presented in Lesson 1, students engage in a class discussion with a stated goal “to generate a range of ideas to cultivate curiosity and uncertainty” about the phenomenon. Key ideas about the purpose of the discussion – why the phenomenon should invoke curiosity – are provided to the teacher so that they can attend to whether these ideas emerge during the discussion: “It is weird that most of her symptoms…” and “The weight loss seems odd…it is more difficult to figure out why she is losing weight” (page 40). Questions are provided to the teacher to facilitate this discussion.

- In Lesson 1 page 46, students are asked to think about their prior experiences with phenomena related to the anchoring phenomenon. After the class shares examples, the teacher is told to say, "maybe if we can figure out how M'Kenna's symptoms are connected, we can figure out how other symptoms in our bodies [the prior experiences] might be connected, too." The driving question is then changed to a more general question to incorporate student curiosity about their prior experiences.
    - In Lesson 1 page 47, the class develops a Driving Question Board. The teacher is told to remind students that "we are going to try to capture all of our questions…so that we can use our questions to guide our investigation into what is going on." Students then generate a list of questions they have about M'Kenna's case and other related cases. Student questions are clustered, and students are asked to propose investigations for the rest of the unit that will help them answer their questions.
    - At the end of Lesson 3, students return to the Driving Question Board to see if there are questions they are "wondering about now" and connect those questions to ideas they want to investigate next.
    - In Lesson 7 page 162, Lesson 8 page 185, and Lesson 9 page 201, the students return to the Driving Question Board to identify the question they have answered. In Lesson 9 page 202, students ask new questions to drive the next half of the unit, adding the new questions in clusters to the Driving Question Board. On page 203, the teacher is told that returning to the Driving Question Board can help "when you feel your students are not feeling like they are in the driver's seat or begin to lose connection to our driving question." In Lesson 14 page 309 and in Lesson 15 page 321, students return to the Driving Questions Board to evaluate which questions the class has answered.
    - The Teacher Handbook (pages 20-21) provides teachers with general guidance on establishing the routine of using the Driving Questions Board.
    - In Lesson 1, Part 8, the teacher supplies the driving question for the unit, not the students (Teacher Edition, page 47).
    - Lesson 7 is a particularly important opportunity for students to interact with the Driving Question Board. After modeling a healthy digestive system based on all previous learning and identifying the parts of M'Kenna's system that are not functioning well, students each choose a question from the Driving Questions Board that they believe has been answered and provide the answer. Remaining unanswered questions form the basis of the following lessons.
- In much of the unit, the teacher is provided with guidance to facilitate student discussions that lead to students suggesting further investigations or data examination. The teacher is therefore positioned as the supplier of the data and experiments that the students suggest rather than as the driver of the learning, which positions the students to engage in sense-making. For example:
    - In Lesson 2, the teacher is prompted with, "if the idea of figuring out what happens to the food comes up naturally in the discussion, continue to push on the idea by using the prompts below. If the idea hasn't already come up, you may utilize the prompts below to motivate looking more into the small intestine."
    - In Lesson 3, the teacher provides a lot of the experimental design, but facilitates students in the process of realizing why it is the best available design to help them investigate what they want to investigate.
    - Lesson 4 is focused on the investigation ideas that students proposed, which were based on the questions students asked.

- At the end of Lesson 4 (page 105), the teacher helps to generate student curiosity about some of their data analysis results, leading into the next lesson. The teacher then suggests an investigation related to the student discussion. At the beginning of Lesson 5 (page 112), the teacher tries to elicit the student response: "We want to figure out what is happening to the complex carbohydrates in the digestive system." Students are asked on page 113 "to recall, from our previous investigation, what we decided we needed to figure out today." Students are then reminded of their Ideas for Investigations Board to see if any could be helpful that day.
- On page 120, the teacher prompts students to come up with investigation ideas.
- On pages 135–136, students are facilitated to suggest what kind of data to look for next.
- On page 159, students are facilitated to suggest what kind of evidence is missing and therefore what can be looked at next.
- On page 181, students are facilitated to discuss what they need to know next.
- On page 203, students are facilitated to think about what they still can't explain and to come up with new overarching questions for the second half of the unit.
- On page 217, the teacher proposes an investigation after students express that they need to know more about that topic.
- On page 220, the teacher tells the student that they have an article that could give clues about what students were wondering about.
- On page 222, the teacher facilitates students to figure out part of the experimental design that would need to be used.
- On pages 241–242, students are encouraged to notice and question why their flames went out so quickly and then the teacher facilitates students to suggest how they could find out what is in the air.
- On page 259, the teacher facilitates students to suggest evidence that could be collected.

- In some instances, the design of the lesson presents a barrier for students to engage in sense-making. Often the sense-making in these examples is not directly connected to the investigative or anchor phenomenon. Examples can be found in other criterion (such as the accuracy and appropriateness of graphs noted in II.D). A specific example regarding sense-making can be found in Lesson 3:
  - It is claimed that students will figure out that they "…saw glucose on the outside of the bag (that was not there before)." Students collect enough data to possibly figure out that one of the two types of food molecules that started in the bag was later outside the bag, but the design requires students to be told how indicators respond to glucose and starch in order to figure out that it was glucose on the outside of the bag. In general, the steps and sequence of the investigation may not be conducive to making sense of what happened to the glucose and starch. Students did not test the water on the outside of the bag for the presence of glucose and starch before the experiment. Furthermore, they do not test what either indicator looks like in the presence of known glucose or starch molecules. They only test known plain water after they have set up the experiment. They move directly from this to testing the samples from the experiment after they have been sitting since the day before. As such, the samples must be considered unknown, including the sample of what is inside the bag as it could have change over the course of the night. The instructions on the Teacher Edition (page 81) do not provide enough support for teachers for this critical part of the experiment. The role of heat in this experiment (adding near boiling water) is also not clear in either the

teacher or student materials. Another claim is that students will figure out that "...the mass of the system we started and ended with didn't change;" however, data on mass is not collected by the students during the investigation.

- A major difference between the dialysis tube model and the small intestine is that the model represents a "batch" type system (the material does not move through) while the small intestine is a continuous process. Students must understand how the passing of time (1 day) represents the time it would take the "food" to move along the small intestine. They might be confused about whether the dialysis tube represents the beginning or middle of the small intestine and must explicitly understand that the time in the experiment (beginning, end) represent the locations in the intestine (beginning, middle). As designed, it is not clear that students would make sense of this time factor.

Suggestions for Improvement

- In Lessons 11 and 12, adding more frequent connections (e.g., class discussions) between the DCI focus and sense-making of the anchor phenomenon would help students feel better oriented and would increase their understanding of what they are learning.
- More opportunities for students to develop their own questions (see more details in I.D) would also strengthen this criterion to ensure "student questions and prior experiences related to the phenomenon or problem motivate sense-making and/or problem solving."
- In lesson 2, consider providing students with more information about the "healthy person" whose images and data they are comparing with M'Kenna's. This hypothetical healthy person should be described as similar to M'Kenna in as many ways as possible (age, gender, race, dietary intake, etc.) in order to eliminate these variables for students. This will support students in their sense making and developing the appropriate SEPs and CCCs.
- Lessons 2–6 represent a significant block of instruction without giving students the opportunity to revisit "M'Kenna's Doctor's Note." Consider giving this artifact a place of prominence on the Driving Question Board and/or adding specific references to this artifact in additional lessons, such as:
  - Lesson 3, Slide O
  - Lesson 6, Slide M
  - Lesson 12, Slide R
- Consider adding and expanding opportunities for students to connect their prior experiences to the phenomena in this unit. Specific suggestions include:
  - Provide opportunities for students to form connections to prior science instruction, especially in life science and physical science. Having students make their ideas visible in these areas will guide teachers in their instruction and support student sense-making across multiple units and years. This is especially important for the specific prior learning highlighted in the Teacher Edition (page 14).
  - Personal connections to what they experience (increased breathing and heart rate, etc.) when they exercise would be useful when explaining the cardiovascular symptoms.
  - There are numerous other opportunities to connect to students' experiences with cooking, eating, vomiting or experiencing other symptoms on M'Kenna's report, going to the doctor, having medical tests, etc.
- For Lesson 3:
  - Testing the indicators in four conditions (plain water, glucose water, starch water, and glucose/starch water) should be done earlier in the lesson so that students can

understand why the experiment is designed the way it is and what they should be looking for in testing. See detailed comment above.
    - Part 6 (Questions) Consider asking a question here that allows students to directly connect the graphs from Lesson 2 to the investigation in Lesson 3. To do this, be sure to emphasize that starch is a complex carbohydrate, which is briefly mentioned in the Teacher Edition (page 79) but is not in any of the student-facing materials. This kind of question is a great support for students as they learn to construct explanations from multiple sources and types of evidence. This has relevance to Category I.D of this rubric because it would tie the lessons together in a more deliberate and coherent way for students.
    - Student Handout 1, Part 5, the headings say "Color of Outside Liquid…" but they should say "Color of Inside Liquid…" This could lead to substantial misunderstanding on the part of students.

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

Rating for Criterion I.B. Three Dimensions: Adequate

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that the materials give students opportunities to build understanding of grade-appropriate elements of the three dimensions. While there were occasions that claimed elements were not found in the materials, there were sufficient opportunities throughout the unit for students to develop and use the grade-appropriate elements of the three dimensions to make sense of phenomena.

Science and Engineering Practices (SEPs): Adequate

The reviewers found adequate evidence that students have the opportunity to use or develop the SEPs in this unit because an adequate number of SEP elements were used by students in the unit. However, there was a significant mismatch between the elements claimed and used in the unit, particularly for the SEP of Analyzing and Interpreting Data. The following elements were claimed or used in the unit:

- **Asking Questions and Defining Problems**
    - *Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.*
        - In Lesson 1, when students create the Driving Question Board, students are instructed to write questions about how the different symptoms they observed may be connected (page 47). The teacher is told that student questions should seek to determine additional information based on their observations, and the teacher is provided with guidance on how to help students ask better questions in the "Assessment Opportunity" section (page 48).

        - In Lesson 9 page 202, students are asked to reorganize their old Driving Question Board questions, think about what they've already answered, and to add new questions.
    - *Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.*
        - In Lesson 9 page 205, students discuss their current models and explanations and come up with questions about what they still don't understand.
- **Developing and Using Models**
    - *Develop and/or use a model to predict and/or describe phenomena.*
        - Students use this element in Lesson 1 when they create initial models to describe the phenomenon of M'Kenna's simultaneous symptoms in different body systems.
        - In Lesson 1 of the teacher edition, the materials provide teachers with information on helping students engage in modeling, stating, "when engaging in modeling, the key should be on explaining the 'how and the 'why' of a phenomenon, not just the 'what.' To help students focus on the 'how and the 'why' for M'Kenna's case, remind students to focus on explaining what might be causing M'Kenna to have symptoms in all these different parts of her body rather than trying to 'diagnose' what condition she has" (page 41).
            - A support such as this may allow teachers to help students develop their ability to model as opposed to only asking them to use the practice of modeling.
    - *Evaluate limitations of a model for a proposed object or tool.*
        - In Lesson 3, students are asked to identify limitations of the dialysis tubing as a representation of the small intestine (page 78). When students discuss the tubing setup, they discuss it as something that would allow them to model a body process, albeit with limitations. The teacher also provides explicit guidance to students about why representations or models with limitations are still useful. However, the model in Lesson 3 is of body systems, not of a proposed tool or object. Identifying limitations of models is a 3–5 grade band practice.
    - *Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.*
        - In Lesson 3, students use dialysis tubing as a model of the small intestine to generate data about what happens to food particles in the small intestine.
    - *Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.*
        - In Lesson 7 page 150, students pull together the models they have developed so far in the unit into one model that incorporates all the information, including about molecules that act differently in M'Kenna digestive system in contrast to a healthy one. The students also revise their models after a gallery walk of other student models (page 156).
        - In Lesson 7 page 161, the teacher is told that they are assessing student performance in this element, but they are solely given guidance about DCI information and not SEP content.

        - In Lesson 13, students develop consensus models that show the relationships between different body systems and processes. The models allow students to predict what would happen if one part of the body system does not function.
        - In the Lesson 15 Summative Assessment, students use this element when they develop a model to explain how bears use stored food to survive during hibernation.
    - *Develop a model to describe unobservable mechanisms.*
        - This element is not claimed in the unit but is used in Lesson 5 page 124 when students develop models, using investigation evidence to describe that chemical reactions occur in the mouth.
- **Planning and Carrying Out Investigations**
    - *Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.*
        - In Lesson 3, students conduct an investigation where they are facilitated to understand the purpose of the investigation, the merits of the investigation design, and how to improve the design to ensure that they can collect the data they want (page 80). However, the design of the investigation is mainly provided by the teacher.
        - In Lesson 5, students conduct an investigation, the design of which is mostly provided by the teacher, but students contribute to thinking about the investigation design and are facilitated to understand the purpose of the investigation (page 123).
    - *Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.*
        - In Lesson 10, students make observations and collect mass data during a simple investigation in which fats burn. They are then asked to use their data to answer questions, including: "What clues does this give you about what might be happening to food inside our bodies and M'Kenna's body when it is used for energy? Or what new questions does this raise for you?" However, since sample student answers are not provided, there isn't evidence that students would be using this middle school element rather than the related Grade 3–5 SEP element.
    - *Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.*
        - Although not claimed in the unit, there is an opportunity for students to begin building toward this element in Lesson 11 page 236 when the teacher is told, "you may want to introduce the idea of running a control condition…" and on page 244 when the teacher is given the option of having students suggest control conditions. Additionally, suggested prompts such as, "How could we measure if something is coming out in the closed and open systems?" encourage students to thing about how to take measurements including the tools that they will need (a scale in this case). Note that it isn't clear how students are going beyond the Grade 3–5 level, however.

- **Analyzing and Interpreting Data**

- *Distinguish between causal and correlational relationships in data.*
    - In Lesson 2 page 61, students are asked if the organ structures are causes or just coincidences. Distinguishing between causal and correlational relationship is more complex than identifying that something is a coincidence. While this question does get students to recognize that the relationship may be causal or not, it doesn't support them in meaningful understanding of correlation. There is also a side bar note related to this element, but the note focuses more on CCC element language and doesn't make explicit connections to the activity content.
    - In Lesson 5, the teacher note on page 117 provides rationale to the teacher about why this practice element is important to students' sense-making. On page 118, the teacher discusses this idea directly with the students and sample student responses show student use of the element.
- *Analyze and interpret data to provide evidence for phenomena.*
    - This element is claimed in Lessons 2 and 4 but doesn't seem to be fully used. When they use the I^2 strategy on page 62 and on page 99, students are instead using this Grade 3–5 element because they are not explicitly determining whether the relationships in the data provide evidence for the phenomenon. Instead, students are using the Grades 3-5 element: *Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.*
    - In Lesson 12, students analyze the results of the BTB investigation to provide evidence that carbon dioxide is released by the body.
- *Analyze and interpret data to determine similarities and differences in findings.*
    - This element is claimed in Lesson 2, but students do not use this element in this lesson. When students look at the differences between the digestive system images on page 59, they are instead using the K–2 element: *Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.*
- *Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials).*
    - In Lesson 4 page 98, teachers are told to guide students to the understanding that their bar graphs have limitations because we don't know how the data were measured and don't know absolute numbers of food molecules. However, students themselves don't necessarily show that they understand or are using this element. In addition, the sample student responses analyzing these graphs don't show student understanding that conclusions cannot be drawn from a single trial – therefore students do not show understanding that the bar graphs have limitations.
- *Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.*
    - This element is claimed in Lesson 6 when students analyze six different graphs. However, each of the six different graphs includes a very small data set, and together, the data sets do not qualify as "large data sets." Additionally, the different locations in the digestive systems could be seen as either temporal OR

spatial in nature, but that is not explicitly discussed in student or teacher materials.

        - This element is claimed in Lesson 10, when students analyze a small data set of M'Kenna's weight and height over time. This data set is not what the Framework and NGSS intended by "large data set," and students are therefore using a related Grade 3–5-level element: *Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.*
        - This element is claimed in Lesson 12 when students analyze a picture of the respiratory system. However, students are not analyzing large data sets.
    - *Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.*
        - In Lesson 8 (beginning on page 181), students create data tables data that have three variables and line graphs of two of the three variables.
    - *Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible.*
        - In Lesson 10 page 218, the teacher is told to help students learn about percentiles and median as concepts. Students then use the concept of percentiles to analyze a growth and weight chart.
- **Constructing Explanations and Designing Solutions**
    - *Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.*
        - This element is claimed in Lesson 11, where students describe some scientific principles that they have figured out related to food burning (page 253). However, what they are doing is developing a model and not constructing an explanation of the relationship between the variables, because they are not explaining or predicting a particular phenomenon.
    - *Construct an explanation using models or representations.*
        - In Lesson 13, students are asked to use one body system as a model to write an explanation for how a shortage of food entering M'Kenna's bloodstream is connected to symptoms in her body related to that body system.
    - *Apply scientific ideas, principles, and/or evidence to construct, revise, and/or use an explanation for real-world phenomena, examples, or events.*
        - In the Lesson 15 Summative Assessment, students use this element when they use evidence and the scientific ideas they have developed throughout the unit to construct and explanation of how bears obtain energy to survive without eating during hibernation.
- **Engaging in Argument from Evidence**
    - *Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.*
        - This element is claimed in Lesson 3, in which students make a claim and provide evidence to support their claim that their observations of molecular models help explain what they observed in the dialysis investigation. However, no reasoning is required of students (only claim and evidence), so students are unlikely to be using this middle school-level element.

- In Lesson 7, students develop a consensus class model of a normal digestive system and discuss how M'Kenna's digestive system is likely different. They are told to support their ideas with evidence, and sample student responses include reasoning to support their models and ideas (e.g., page 159)
      - In Lesson 8 page 184, students are asked to argue from evidence about which diagnosis they think best explains M'Kenna's symptoms, and to also argue for why it is not one of the other diagnoses.
  - *Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.*
      - In Lesson 7, students are facilitated to provide critiques about peer models by citing relevant evidence (page 156).
      - In Lesson 8 page 185, students are asked to "compare and critique their peers' arguments based on how well their evidence supports their explanation."
      - In Lesson 14, students receive support to provide feedback and critiques to peer arguments.
- **Obtaining, Evaluating, and Communicating Information**
  - *Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).*
      - In Lesson 10, students read an article "Kids Burn More Fat, and Need More Fat, Than Adults" (Student Guide page 101). They are supported to understand what they read and answer questions about it (i.e., determining central ideas and obtaining scientific information). However, the article they read is a general news article and not a scientific text (e.g., journal article) adapted for classroom use and students are not expected to read the text critically.
  - *Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.*
      - This element is claimed in Lesson 12, but students do not use information from written text in the lesson.

<u>Disciplinary Core Ideas (DCIs): Adequate</u>

In Lessons 1–3, students lay the groundwork for building an understanding of the DCIs, but do not actually begin building toward any of the DCIs until Lesson 4. Early lessons in the unit do not directly address the DCIs though they are laying the groundwork for the rest of the unit and for learning the DCIs. For example, lesson 2 does address structures/organs of the digestive system but the digestive system is not situated as a subsystem of the body that interacts with other subsystems nor are the organs situated as groups of cells and tissues that are specialized for particular functions.

LS1.A Structure and Function *In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.*

- Students work toward this element in Lessons 4 and 6 when they look at data of food molecules at different points in the digestive system.
- In Lesson 7, students bring the ideas together to create a model of what a digestive system does to digest food.

- In Lesson 8 page 177, the class explicitly discusses the body as a system and that the digestive system is a subsystem.
- Tissues are discussed in Lesson 8. On page 176, there is a note that students should come to the unit with prior knowledge of cells from their sixth-grade work, as the unit does not discuss cells.
- In Lesson 12, students extend their understanding of body organization to the respiratory system, and on page 269 there is an optional activity for extending the understanding of the hierarchy between organs, tissues, and cells to the circulatory system. On page 275, sample student responses specify how different body systems may interact.

LS1.B Growth and Development of Organisms *The growth of an animal is controlled by ~~genetic factors,~~ ~~*~~ food intake, ~~and interactions with other organisms, and each species has a typical adult size range~~.*

- Students begin to build toward this element in Lesson 10 when they notice that M'Kenna has stopped growing, and learn more about it through an article explaining the relationship between fat and growth.
- In Lesson 13 page 290, the teacher points out that food molecules can support growth. The student models produced in Lesson 13 show food molecules being used for growth.
- It should be noted that this DCI is in the Framework but not in the NGSS.

LS1.C Organization for Matter and Energy Flow in Organisms *Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy.*

- Students begin to build toward this element in Lesson 5, when they are presented with evidence that food is broken down in the mouth.
- In Lesson 10, students begin to build an understanding that fat is "burnt" in chemical reactions.
- In Lesson 11, students figure out that chemical reactions involving food produce carbon dioxide, water, and energy.
- In Lesson 14, students find out that the same processes happen in other organisms.

PS3.D Energy in Processes and Everyday Life *Cellular respiration in ~~plants and*~~ animals involves chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials.*

- Students begin to build toward this element in Lesson 11 when they figure out that chemical reactions involving food produce carbon dioxide, water, and energy.
- In Lesson 12, students figure out that animals breathe out carbon dioxide after cellular respiration happens. The learning leading to this DCI element is less connected to the anchor phenomenon than is the learning for the other DCIs.

Crosscutting Concepts (CCCs): Adequate

The reviewers found adequate evidence that students have the opportunity to use or develop the CCCs in this unit because an adequate number of CCC elements is used by students; however, there was a significant mismatch between what was claimed and what was actually used by students. In addition, not many opportunities are provided for students to develop the CCC elements in the unit.

The reviewers found the SEP and CCC elements document very helpful, which lists claimed CCC elements for each lesson. In particular, the rationale section of the document is very useful. The following elements were claimed or used in the unit:

- **Patterns:**
    - *Patterns can be used to identify cause and effect relationships.*
        - This element is claimed in Lesson 2, and the teacher is told, "students should use the patterns they have identified in the data and images to begin to identify

cause and effect relationships in order to explain the differences between the healthy digestive system and M'Kenna's." However, the actual student prompts and sample student responses don't show any evidence of use of this element, as students are only identifying patterns and creating hypothesis about the causes of the patterns in the data (not cause and effect relationships in the body).

- *Graphs, charts, and images can be used to identify patterns in data.*
  - In Lesson 2 pages 62–63, students examine graphs of post-digestive system food molecules present in healthy intestines versus M'Kenna's. This is stated to be an opportunity to look for patterns in data, but as the sample size is n=1 for the control and n=1 for the variable, a true pattern cannot be determined. Misconceptions might arise if students think n=1 is sufficient to determine a pattern (rather than simply a hypothesis that there might be a pattern). Note that the SEP and CCC elements document accurately identifies what students are doing as identifying "similarities and differences."
- *Patterns in rates of change and other numerical relationships can provide information about natural and human-designed systems.*
  - This element is claimed in Lesson 4, in which students examine bar graphs of relative amounts of food molecules in a healthy person versus M'Kenna. However, the graphs don't show patterns. The sample size is n=1 for the control and n=1 for the variable, a true pattern cannot be determined. If something is measured one time, it is not a pattern. In addition, the lesson mentions "rate of change" several times (e.g., page 104) even though the graphs don't include any rate data.
  - This element is claimed in Lesson 5, and page 116 says that, "students should use patterns of changes in the data to identify that a chemical reaction is occurring in the mouth." However, students don't discuss the only pattern available in the data—that many of the students in the class had the same taste change experience (the teacher is not asked to collect or help the students collect this data). Instead, each student is only asked to analyze what is happening in their own mouth one time, or what is shown on one bar graph that doesn't include information about how many trials it represents.
  - This element is claimed in Lesson 6, where students are asked to look for "patterns in food molecules" (page 137). However, there is no evidence that students are pulling out patterns from the similarities and differences. On page 138, students determine patterns in what happens to large molecules (e.g., fats and proteins) and what happens to small molecules (e.g., amino acids and glucose) during digestion.

- **Cause and Effect:**
  - *Cause and effect relationships may be used to predict phenomena in natural or designed systems.*
    - This element is claimed in Lesson 1. However, there is a note that students are purposefully using Cause and Effect elements below grade level. This element should therefore not be claimed in this lesson.
    - In the Lesson 7 assessment scoring guidance on page 170, the teacher is told that students need to make "viable cause-and-effect connections between the evidence and the disease." In the sample student answer on page 171, students

use this element content to eliminate a disease from M'Kenna's possible diagnosis. However, it seems that students are using cause and effect to help explain phenomena (i.e., M'Kenna's disease) and not make predictions.

    - In Lesson 12, students determine a cause and effect relationship between exercise and glucose usage. They use the relationship to make a prediction and then analyze data to check their prediction.
    - In Lesson 13, students use their understanding of cause and effect relationships between different body systems and processes to build a model that they then can use to predict what would happen if one of the systems didn't function properly.
    - Although not claimed in the lesson, students use this element in the Lesson 15 Summative Assessment when responding to the question, "Make a prediction about food availability in North Carolina in the last few years. Use your model to support your prediction."
  - *Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.*
    - In Lesson 5 page 118, sample student responses show students recognizing that correlation doesn't necessarily imply causation. In addition, the teacher is told in the "Additional Guidance" section to help students recall the differences between causal and correlational relationships.
- **Systems and System Models:**
  - *Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.*
    - In Lesson 1, when comparing student models, the teacher instructed to talk about how the system models show connections or interactions between body systems. However, the section "Supporting Students in Three-Dimensional Learning" claims that students are using a "lens of systems and systems thinking," even though there is no evidence that students are using this concept as such a lens, particularly for this element.
    - In Lesson 2, students discuss the digestive system and its different parts (organs). They also look at substructures of one organ. However, there isn't evidence in this lesson that students are thinking of individual organs as systems and substructures as sub-systems.
    - In Lesson 4, students discuss and interpret data from different organs in the digestive system, but do not discuss them from the perspective of this element.
    - In Lesson 6 page 140, the students analyze their data and discuss that each organ in the digestive system has a different function. Similarly, in Lesson 7, students create a combined model of the digestive system that includes different organs. They might therefore think of the organs as sub-systems, but they may also not be and instead are thinking of the organs as parts of the digestive system which would make this more aligned with the 3–5 grade band, "a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot."
    - In Lesson 8 page 183, an example Progress Tracker entry shows students writing, "the body is organized into systems and subsystems. So, body system > digestive system > small intestine…"

        - In Lesson 9 pages 204–205, sample student responses suggest that students are considering the possibility that the digestive system interacts with other body systems.
    - *Models can be used to represent systems and their interactions – such as inputs, processes and outputs – and energy, matter, and information flows within systems.*
        - In Lesson 1, when comparing student models, the teacher facilitates the class to begin to think about the similarities and differences between the inputs and outputs in the system models. However, the section "Supporting Students in Three-Dimensional Learning" claims that students are using a "lens of systems and systems thinking," even though the evidence is weak that students are using this concept as such a lens. They may instead be beginning to build an understanding that could later be used as a lens.
        - In Lesson 3, students modify their models of the small intestine to include processes and outputs related to matter flowing in the system (e.g., page 87).
        - Although not claimed in the lesson, students use part of this element in Lesson 5 (page 124) when they develop a model, including inputs and outputs, to show what is happening in the mouth when food is introduced.
        - In Lesson 7 page 150, students develop a model to represent the inputs, processes, outputs, and matter flows within the digestive system.
        - In Lesson 7 page 161, the teacher is told that they are assessing student performance in this element, but they are solely given guidance about DCI information and not CCC content.
        - In Lesson 13, students create a consensus model in which they represent different body processes, inputs, and outputs.
    - *Models are limited in that they only represent certain aspects of the system under study.*
        - Although not claimed in the lesson, students use a similar idea in Lesson 2 page 58 when they discuss whether organ diagrams look the same as organs do in the body.
        - This element is claimed in Lesson 5 but not used.
- **Energy and Matter:**
    - *Matter is conserved because atoms are conserved in physical and chemical processes.*
        - Although not claimed in the lesson, students use this element in Lesson 5 pages 115 when they talk about what happens in physical and chemical processes. On page 121, students use this concept to make sense of hypothetical experimental data.
        - In Lesson 10, students discuss what happens to materials when they burn, with the understanding that matter doesn't just disappear—it must be going somewhere.
        - Although not claimed in the lesson, students use this element in Lesson 11 when they discuss the closed vs. open system investigation plan (e.g., page 237).and when they discuss where the carbon dioxide and water that increased after burning food came from (page 251).
        - Although not claimed in the lesson, students use this element in Lesson 13 when they determine whether glucose and fat molecules have the same atoms such that fat could be broken down to be used as energy by the body.
        - Although not claimed in the lesson, students use this element in the Lesson 15 Summative Assessment.

- *Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.*
    - In Lesson 11 page 250, sample student responses are shown related to this element, such as, "we were able to burn the fat and transfer energy as light and heat."
    - In Lessons 13 and 15, students create a model that shows energy being released when chemical reactions happen with food. Similarly, in Lesson 14, students argue about the similarities between how different animals take in food and produce energy. However, in all of these cases, it isn't clear that students will think energy is driving the cycling of matter versus matter driving the release of energy.

- **Structure and Function:**
  - *Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function.*
    - This element is claimed in Lesson 2, in which students begin to hear about this element when the teacher uses language about "structures" relating to the source of the problem, but students do not use the element at this point. In fact, a case could be made that students are building toward this K–2-level element: *The shape and stability of structures of natural and designed objects are related to their function(s).* This CCC category is also alluded to at the end of Lesson 2 (page 63: "Students should use observations of data and images in the lesson to identify patterns based on similarities and differences in both structures (endoscopy images) and functions (food data) to compare how a healthy person's digestive system is functioning differently from M'Kenna's"), but this grade-level element is not used because students are not yet talking about connections between structure and function, let alone showing evidence that they realize they can analyze structures to determine how they function.
    - In Lesson 3, students analyze the function of dialysis tubing (which acts as a representation of the large intestine) and make connections between the size (structure) of molecules and how they behave in the dialysis investigation. When the students determine that the size of the sugar and starch molecules determines whether or not the molecules go through the dialysis tubing, they are building toward an understanding of the first part of this element.
      - The teacher edition provides teachers with information on helping students engage in using structure and function, stating, "This is a great place to help students begin to see that the structures of organs help give them particular functions. We will continue to build on this idea, and by the end of Lesson 7, we will be able to generalize out that all organs have a particular structure and function. Students should also begin to make connections between food data from the previous lesson and molecular structure of those molecules in this lesson. They should draw conclusions that the structures of those molecules can affect their ability to move through different organs in the digestive system. To support students in doing so, refer to evidence from the investigation about how only certain molecules can move through the dialysis tube

and how that relates to what we learned about the large structure of starch (versus small structure of glucose) …"
        - A support such as this will allow teachers to help students develop their understanding as opposed to only asking them to use it.
    - This element is claimed in Lesson 6, but the lesson only focuses on functions—not relationships between structures and functions.
    - In Lesson 8 page 182, two of the student ideas teachers are told to look for are: "The height of the villi in the small intestine is directly related to the number of cells that allow food molecules to be absorbed into the bloodstream." and "We can assume that M'Kenna's villi are flat based on evidence from the simulation and the endoscopy images, and, therefore, have fewer cells, or doors, to allow food molecules into the bloodstream. The structure of M'Kenna's small intestine has a direct impact on her small intestine's ability to function as a healthy system would."
    - This element is claimed in Lesson 14, in which students read about different animal systems to determine how they function. However, reading about the systems isn't sufficient to make a claim about "analyzing" the systems (related to the second part of the element), and there isn't evidence that students are using any of the ideas from the first part of the element.
- **Stability and Change:**
    - *Stability might be disturbed either by sudden events or gradual changes that accumulate over time.*
        - In Lesson 10, students notice a change in a previously stable growth curve for M'Kenna. However, the specifics beyond change (e.g., that stability might be disturbed by a sudden event) are not discussed or used.
    - *Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale.*
        - This element is claimed in Lesson 11, where students look at stability (mass) and changes (molecular concentrations) in closed systems over time during a fire. However, students don't discuss forces or use this concept generally or as a lens for sense-making.

Suggestions for Improvement

General

- The SEP and CCC element document is a valuable tool for teachers. As it is currently positioned, as a separate document, it might not be seen by teachers. Adding the information into each lesson would provide opportunities for more teachers to see and use the element-level rationale.
- The frequent teacher sidebars about supporting student use of SEPs or CCCs are helpful but would often be clearer if they referred to specific elements—particularly when more than one SEP or CCC element from the same category (e.g., two "Analyzing and Interpreting Data" SEP elements) are claimed in the same lesson. In those cases, it is currently difficult for teachers to distinguish which element they are meant to be supporting in a particular activity.

SEPs

- Throughout the unit, it would be extremely helpful to clarify the use of the word "patterns." Currently, it is very rarely used in reference to true patterns (something repeated or a sequence from which you can draw information) and might cause misconceptions about what patterns are. Very often, the word is used when students are merely looking for similarities and differences between two pictures or two numbers. At the middle school level, students would need to know that the numbers in a graph are reliable numbers (e.g., from multiple trials) in order to consider the difference between two numbers as a pattern.
- To help students understand the limitations of data, it would be helpful in places like Lesson 4 page 99 if students were supported to talk about their "what it means" statements as something like "what I hypothesize" rather than drawing conclusions from one datum.
- The Lessons 3 and 4 bar graphs (e.g., page 98) could be improved by adding a note that the numbers were averaged between multiple measurements. This would allow students to discuss why it is important to have multiple measurements, building on their prior knowledge from Grade 3–5. Alternately, discussion could be added that the lack of multiple measurements is a limitation of the data analysis, and thus of the conclusions that students should draw from the data.
- For SEP elements that are claimed numerous times throughout the unit, clarify how students are developing (not just using) these elements.
- Consider adding the "Identify and Interpret" routine to the Teacher Handbook and referring to this when the routine is used (Such as Lesson 2, Part 6).
- Lesson 5, Student Handbook, Pages 77-80 and Student Handout MR.L5.HO.
    - It is important that the teachers check student procedures in Part 2 of MR.L5.HO before students proceed with the experiment. This could be done after students complete Part 2 or after they have completed Part 3 (predictions), so that they have a chance to explain their thinking and the teacher has a chance to correct any procedural errors. This could be noted both on the student handout ("Stop here and call your teacher over to check your procedures before moving on") and in the Teacher Edition (page 122).
    - The Teacher Edition (page 127) contains typical student responses for the Student handout. It also says that the indicator should always be added last, but it is unclear how students would know this or why this is highlighted as important.
    - Students are told that the food samples have been soaked in water overnight, but not why this was done or how it might affect the results.
- In Lesson 1 (Teacher Edition, pages 43-44) more guidance on creating a consensus model should be given. It is unclear who is going to decide what is consensus, and who is recording the consensus model (teacher, each student, etc.) and where it is being recorded. This initial consensus model is referenced again in Lesson 2 (Teacher Edition, page 57), but it is unclear if this model is in student notebooks, on a poster, etc. and Teacher Edition (page 55) lists the consensus model under "one per group" rather than one per student or one per class.
- In Lesson 8, when students create data tables and line graphs of data that have three variables. However, the example graph on page 193 only shows two of the three variables (i.e., absorption and height), reducing the level of rigor of this performance. If students also graphed the relationship between cells and height, they would have an opportunity to deliberately compare a linear and non-linear relationship addressing more of the stated element "*Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.*"

DCIs

- Ensuring that the DCIs used in the last few lessons of the unit are connected to explaining the phenomenon every step of the way (not just in summary conversations) would help students incorporate the new concepts.
- It would be helpful to add a note to teachers to the effect of: all target DCIs are from the Framework; LS1.A, LS1.C, and PS3.D can be found in the NGSS as included in the materials; and LS1.B came directly from the Framework and is not found in the NGSS.

CCCs

- In Lesson 1, a middle school CCC Cause and Effect element is listed in the SEP and CCC elements document, even though the Rationale section says that students will not yet be using this element (and students indeed don't use it in the lesson). It would be clearer to teachers and administrators if the appropriate elementary-level CCC element were listed instead, acknowledging that students are using prior CCC knowledge.
- In Lesson 8 when students make connections between villi height and the rate of absorption of food molecules, it would be a great opportunity to add a class discussion explicitly about how the following CCC element relates to multiple different phenomena and disciplines: *Complex natural and designed structures/systems can be analyzed to determine how they function.*
- On page 101, teachers are told to prompt students to reflect on the interactions of these organs and how those interactions relate to what they already know about systems. However, the list of suggested prompts doesn't include any prompts about systems or interactions. It would be helpful to provide prompts for teachers to allow them to see what this kind of systems thinking could look like.
- For CCC elements that are claimed numerous times throughout the unit, clarify how students are developing (not just using) these elements.

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: Adequate
(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that student performances integrate elements of the three dimensions in service of figuring out phenomena and/or designing solutions to problems because students have adequate numbers of opportunities to integrate the three dimensions to help figure out the anchor phenomenon or the investigative phenomena. Examples of these opportunities include:

- In Lesson 7 page 150, students develop a model to represent the inputs, processes, outputs, and matter flows within the digestive system.
- On page 161, students are presented with a formal assessment task that is part of their overall sense-making of the phenomenon. The suggested student response to the task (page 171) shows evidence of student use of all three dimensions.
- In Lesson 8 page 182, students analyze data and describe their results. Two of the student ideas the teachers are told to look for are: "the height of the villi in the small intestine is directly related to the number of cells that allow food molecules to be absorbed into the bloodstream" and "we can assume that M'Kenna's villi are flat based on evidence from the simulation and the

endoscopy images, and, therefore, have fewer cells, or doors, to allow food molecules into the bloodstream. The structure of M'Kenna's small intestine has a direct impact on her small intestine's ability to function as a healthy system would."

- In Lesson 8 page 184, the teacher is told that students will be developing three-dimensional arguments. However, an example student response is not given, and the suggested sentence stems don't have any guidance about the use of the CCC. Therefore, it isn't possible to determine whether student arguments would actually use all three dimensions.
- In Lesson 9 pages 204–205, students ask questions that seem to suggest that students are considering the possibility that the digestive system interacts with other body systems.
- In Lesson 10 when making sense of their experimental design, students discuss what happens to materials when they burn, with the understanding that matter doesn't just disappear—it must be going somewhere.
- In Lesson 11, students begin to learn about experimental controls when they discuss the closed vs. open system investigation plan (e.g., page 237), using ideas about conservation of atoms.
- In Lesson 12, students determine a cause and effect relationship between exercise and glucose usage. They use the relationship to make a prediction and then analyze data to check their prediction
- In Lesson 13, students use their understanding of cause and effect relationships between different body systems and processes to build a model that they then can use to predict what would happen if one of the systems didn't function properly.
- There are sections within lessons titled "supporting students in three-dimensional learning." However, the claims in these sections are often incorrect. For example, in Lesson 14 page 307, the teacher is told that students are using two crosscutting concepts lenses, but they are using neither at a middle school level.

Suggestions for Improvement

- Increasing the evidence for the presence of each individual claimed dimension would help strengthen the rating for this criterion. Currently, many SEP and CCC elements are claimed but aren't used at a middle school level.

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: Adequate

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that lessons fit together coherently to target a set of performance expectations because throughout the unit, the teacher prefaces new activities with connections back to prior discussions and student questions. Despite substantial and varied evidence of coherence, many of the lessons did not elicit students' questions preventing the rating from reaching extensive.

Evidence of structures that support coherence are included below as well as information about the lessons helping students develop toward targeted performance expectations:

- The unit claims to build toward MS-PS1-1, MS-PS1-2, MS-LS1-3, MS-LS1-7, and MS-LS1-5. However, the first two performance expectations listed are only used as prior knowledge. Detailed evidence of opportunities to develop and use DCIs can be found in I.A. Collectively, these opportunities support students to be able to successfully perform MS-LS1-3 and MS-LS1-7, and part of MS-LS1-5 by the end of the unit.
- Student questions are elicited and added to the Driving Question Board which is revisited throughout the unit. Examples include:
    - In Lesson 1 (page 47), the class creates a Driving Question Board using students' questions. Student questions are clustered, and students are asked to propose investigations for the rest of the unit that will help them answer their questions. In Part 8 of Lesson 1, the teacher supplies the driving question for the unit, not the students (Teacher Edition, page 47).
    - In Lesson 7 page 162, Lesson 8 page 185, and Lesson 9 page 201, the students come back to the Driving Question Board to see what question they have answered.
    - In Lesson 9 page 202, students ask new questions to drive the next half of the unit, adding the new questions in clusters to the Driving Question Board. On page 203, the teacher is told that returning to the Driving Question Board can help "when you feel your students are not feeling like they are in the driver's seat or begin to lose connection to our driving question."
    - In Lesson 14 page 309 and in Lesson 15 page 321, students return to the Driving Question Board to evaluate which questions the class has answered.
    - The Teacher Handbook (pages 20-21) provides teachers with general guidance on establishing this routine.
- As noted in I.A, students continue to refer back to M'Kenna's doctor's note.
- Throughout the unit, students are frequently reminded about what they had discussed previously and what they had wondered about previously when they start a new activity. The new activities are always connected to the previous discussions. For example, in Lesson 10 page 221, the teacher is told to "help students recall that we were wondering about what happens to fat when it burns. At the end of class we wanted to try to light some fat on fire and see what happens to it."
- Lessons are connected together through student questions or student ideas throughout the unit. For example:
    - Students are facilitated at the end of Lesson 1 (page 51) to propose the topics that will be investigated in Lesson 2. Students are reminded of their decisions from Lesson 1 when they start Lesson 2.
    - At the end of Lesson 2, student questions are elicited, but not explicitly connected to the storyline of the next lesson. Similarly, Lesson 3 does not refer to student questions from Lesson 2.
    - At the end of Lesson 3, student questions are elicited. They are then referred to again in the beginning of lesson 4 as the central focus of the lesson.
    - At the end of Lesson 4, student questions aren't elicited. Instead, the teacher asks the students the questions, which will possibly invoke student curiosity. Lesson 5 is connected to the discussion from the end of Lesson 4.

- At the end of Lesson 5, student questions aren't elicited. Instead, the teacher asks questions of the students that are intended to get them to want to know more and that will be investigated in the next lesson.
    - At the end of Lesson 6, student questions aren't elicited. However, there is a class discussion about what students figured out and the teacher tells the students that they are going to pull those pieces together in the next class.
    - At the end of Lesson 7, student questions aren't elicited, but students are facilitated to be dissatisfied with their information and to think about what else they need to know. In the beginning of Lesson 8, students revisit this discussion about what they need to know next.
    - In Lesson 9, the students are facilitated to come up with new questions that they want to answer. Lesson 10 begins by students discussing what they had figured out in Lesson 9 and what they still want to figure out.
    - Student questions are elicited at the beginning of Lesson 11 (page 235) when referring to what was figured out in Lesson 10.
    - Student ideas and some questions are elicited at the end of Lesson 11 and then reviewed at the beginning of Lesson 12 (page 259).
- Lesson 12 (e.g., page 272) includes a focus on helping students understand the connection between exercise and increased energy needs, which doesn't fit coherently with the rest of the storyline from the perspective of the students until a connection is made later.
- Students use the *Progress Tracker* in most lessons. This helps students check in on what progress they have made relative to what they are trying to figure out. The question of what students were working on/figuring out is provided to students (typically at the end of the lesson but sometimes earlier), and then they are free to document their learning around this question in any way that is useful to them. Some specific examples of where this occurs include:
    - Lesson 2, Part 7 (Teacher Edition, page 63). Slides E and F present a form of the question that is eventually presented by the teacher (Slide K). However, the questions on Slides E and F are part of a series of questions presented by the teacher and will likely not stand out to students as the main motivation for the activities in this lesson or be forgotten from the first to second day of this lesson.
    - Lesson 3, Part 2 (Teacher Edition, page 76) and Part 11 (Teacher Edition, page 86). In Part 2 of this lesson (Slide B), the teacher presents the question that will eventually go on the Progress Tracker.
    - Lesson 4, Slides A and G. In the notes on Slide A, it says "Introduce the lesson question to students, if it does not come up naturally through the review above, "What happens to molecules that don't get absorbed in the small intestine?"

Suggestions for Improvement

- It would be clearer to list MS-PS1-1 and MS-PS1-2 as supporting performance expectations and not include them under the targeted performance expectations that the unit is building towards. While there is a note (on page 15 of the Teacher Edition, but not on page 1) that these performance expectations have been previously developed and are being reinforced here, by listing them as performances the unit is building toward sends a possibly confusing message about their role in the unit.
- It seems like some of the activities in Lessons 7, 8, and the first part of Lesson 9 are repetitive and may cause students to lose interest. Consider ways to make the six days of instruction between these three lessons more streamlined. Most notably, the digestive system model developed in Lesson 7 could be more robust if it is done after the villi investigation in Lesson

8. If this rearrangement is made, then the digestive symptoms will be explained and the Driving Questions Board portion at the start of Lesson 9 will be redundant. Students will then start examining symptoms in other body systems starting in Lesson 9.

- In some cases, it is unclear if student ideas and questions are driving instruction, or if teachers are supplying the questions and motivation for the lesson sequence and activities.
  - Consider the increased role that students could have in formulating the lesson question that goes on the Progress Tracker.
  - Consider providing guidance to teachers on:
    - publicly formulating the Progress Tracker questions at the beginning of each lesson
    - using student-provided language and updating the slides to reflect classroom-specific question formulation, and
    - posting the question prominently throughout the lesson so that students have a direct question to motivate activities and sense-making. This guidance should include specific prompts and strategies to use if students are unable to come up with the "right" question, rather than just having the teacher supply the question if it doesn't "come up naturally."
  - Consider providing students with a list of question words (Who/What/When/Where/Why/How) or question sentence starters if they are struggling to generate questions (Lesson 1, Part 9, Teacher Guide).
  - Consider ways to reduce what the teacher is telling students and decrease the specificity of teacher questions (that is, ask more open-ended questions). In addition, teachers need guidance on what to do if students supply unexpected ideas or fail to supply the expected ideas, questions, or responses. In cases where the teacher must supply questions directly, consider ways for students to analyze or refine the question, or connect it to the phenomenon themselves.

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

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

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

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

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that links are made across the science domains when appropriate because, while the focus of the unit is life science, there are connections to physical science. However, physical science connections are not necessary to explain the anchor phenomenon and students do not learn additional physical science ideas beyond what they learned in previous units.

- Only Life Sciences DCIs were targeted in the unit, but students used prior knowledge from the Physical Sciences DCIs. Some examples show that students are asked to consider why the difference in the molecular structure of glucose and carbohydrates (slides for lesson 3) might be important and to respond to the question "do chemical reactions occur in the mouth?" (page 20 of the student materials).

- The anchor phenomenon could be explained with only Life Sciences DCIs, so other domains were not necessary. However, the connections to physical science are not tangential or superficial and are useful for better understanding the phenomena.
- The CCC element *Matter is conserved because atoms are conserved in physical and chemical processes* was used to make connections between the current learning (Life Sciences) and prior learning (Physical Sciences).
- "*Models can be used to represent systems and their interactions--such as inputs, processes and outputs--and energy, matter, and information flows within systems"* is claimed in Lessons 1, 3, 7, and 13. The body is the system being represented (Life Science), information from several subsystems is examined (Life Science), food is the input (Life Science), processes are chemical reactions to convert food to energy and adsorption (Physical Science), outputs include poop, respiration products, and the ability to grow and move (Life Science).

Suggestions for Improvement

- Supporting students to learn new ideas in the physical sciences would improve the rating for this criterion.

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

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

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that the materials provide grade-appropriate connections to mathematics, English language arts (ELA), history, social studies, or technical standards because of the many ELA connections and few mathematics connections.

Examples are organized by mathematics and ELA.

Mathematics

- Prerequisite math concepts for Lessons 8 and 10 are listed on page 15.
- In Lesson 8 page 186, four CCSS.Mathematics standards are listed as connecting to student work in the NetLogo Simulation: 6.NS.C.8, 6.RP.A.2, 7.SP.C.6, and 7.SP.C.8.C
- The teachers' edition has sections in many lessons called *Supporting Students in Making Connections in Math* and *Supporting Students in Making Connections in ELA.*
    - These sections call out specific CCSS connections and also provide a rationale for claiming the connection. For example, in Lesson 10 (page 225) of the teacher materials, it says, "the growth chart analysis activity provides an opportunity to connect to math in several ways, for example, by engaging students in statistics, interpreting a numerical display of data, using graphical trends to predict future data points, and converting between units of measure (kg to lb). There's a connection to CCSS Math 6.SP.B.5.C: "Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered."

    - In this example, students are able to interpret deviation of M'Kenna's growth relative to overall patterns and measure of center.
    - On page 218, the teacher is given direct support for helping students learn mathematics principles related to statistics and percentiles.
- There are numerous issues with the graphs in Lessons 2, 4, 5, and 6 (e.g., missing or misleading axes, titles, legend) that make it difficult for students to summarize the data (6.SP.B.5, see below). More details of these issues can be found in Criterion II.C

ELA

- A note in Lesson 1 (page 52) points out that nearly every lesson of the unit provides an opportunity to connect with CCSS.ELA-Literacy SL.6-8.1: *Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6–8 topics, texts, and issues, building on others' ideas and expressing their own clearly*. For example, students use this ELA standard when they: talk to a partner to brainstorm ideas of how to collect evidence (pg. 19 of student materials), work in a *scientists circle* to have a *building understanding discussion* (pg. 20); develop a consensus model in the *scientists circle* (page 43); and when they create the Driving Question Board (page 48).
- Students read articles "What's Spit?" in Lesson 5 and "Kids Burn More Fat, and Need More Fat, Than Adults" in Lesson 10 with the goal of obtaining information.
    - In Lesson 10 of the Teacher Edition (page 220), the materials provide general reading strategies so that teachers can help students understand the information. On page 225, this is connected to CCSS.ELA-Literacy RST.6-8.2.
- There are many opportunities for students to communicate their thinking through writing, and these opportunities have various purposes such as creating a T-chart with a partner to capture similarities and differences between models (Lesson 1) and writing a response to the assessment question "How does evidence connected to M'Kenna and her disease?" in lesson 8 assessment. Other writing examples include:
    - On page 162, the teacher is told that students are using CCSS.ELA-Literacy WHST.6-8.1.B in Lesson 7 when they write arguments and will be using CCSS.ELA-Literacy.W.6.10 throughout the rest of Lesson 7 and Lesson 8 when they add onto their arguments over several days.
    - In Lesson 14 page 310, the teacher is told that students are using CCSS.ELA-Literacy RST.6-8.1 when they support their arguments. However, the sample student answers shown don't explicitly refer to specific textual evidence to support their analyses—they only summarize their analyses.
    - In Lesson 14 page 310, the teacher is told that students are using CCSS.ELA-Literacy WHST.6-8.1.B when they write arguments, and that they are using CCSS.ELA-Literacy RST.6-8.9 when they compare information from a text to what they learned from the prior lessons. Both of these standards are used by students in the lesson.

Suggestions for Improvement

- When connections to CCSS ELA-Literacy are made in lessons they might be more useful if noted at the relevant point of the lesson rather than at the end. For example, the note on page 88 could be moved to page 81 to help ensure that it is used.
- The types of student readings could be more varied and rigorous. For example, scientific texts simplified for classroom use could be introduced.

- An increased use of CCSS mathematics would increase the rating of this criterion.
- In Lessons 2, 4, 5, and 6, consider clear, unambiguous use of mathematically precise terms such as ratio, rate, and proportion and clear differentiation and explanation of "amount" versus "relative amount." This should include a robust explanation of what "relative amount" means, what the amounts are relative to, what is indicated by the numbers on the axes, and that they are all data are relative to the same "standard" between the various graphs.
- Consider appropriate lessons (such as investigations where students generate data and lessons where students analyze data and graphs that are given to them) for students to use and develop the following:
    - CCSS.MATH.CONTENT.6.SP.B.4: Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
    - CCSS.MATH.CONTENT.6.SP.B.5: Summarize numerical data sets in relation to their context, such as by:
        - CCSS.MATH.CONTENT.6.SP.B.5.A: Reporting the number of observations.
        - CCSS.MATH.CONTENT.6.SP.B.5.B: Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
    - CCSS.MATH.CONTENT.7.RP.A.2.D: Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate.

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

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

Category II. NGSS Instructional Supports

Score: 2

Criteria A-G:

3: *At least adequate evidence for all criteria in the category; extensive evidence for at least two criteria*

2: *Some evidence for all criteria in the category and adequate evidence for at least five criteria, including A*

1: *Adequate evidence for at least three criteria in the category*

0: *Adequate evidence for no more than two criteria in the category*

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

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

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

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that the materials engage students in authentic and meaningful scenarios that reflect the real world because the students are presented with a true story of a girl who is similar in age to the students – who is experiencing illness. The work of figuring out what is making M'Kenna ill is a real and relatable situation, and one that requires use of science in the real-world. Additionally, students are asked to make connections to their own lives.

Examples of evidence of the relevance and authenticity of the materials includes:

- In Lesson 10, students wonder about a new investigative phenomenon (M'Kenna is losing fat). On page 220, the students read an article that is meant to activate their prior experiences with hearing about "burning fat" or "burning calories." On page 221, the teacher asks students about their prior experiences seeing fat burn.
- Materials present phenomena as directly as possible. For example, it would not be possible to experience M'Kenna's illness, but they hear from her and see her doctor's note.
- Students have a few opportunities to relate their prior experiences to the phenomena, including:
    - Lesson 1, Slide I: Students respond to the prompt: "When have you or someone you know experienced more than one of these symptoms happening at the same time like M'Kenna?"
    - An alternative activity in Lesson 3 (Teacher Edition, page 81) allows the option of students bringing food from home. Note, the response to feedback provided by the authors indicates that this is also an option in Lesson 5, but evidence of this was not found in the materials.
    - In Lesson 5 (Teacher Edition, page 114) students chew crackers and make observations about this experience.

- The unit anchor phenomenon is presented as a real story about the same age as the students. Students are engaged in thinking about symptoms that are probably familiar to them. The scenario is therefore authentic and potentially meaningful.
- In Lesson 3, students are given the option to bring in materials from home to test (e.g., page 81).
- The use of poop data in Lesson 4 is likely very engaging for students.
- The Additional Guidance section on page 98 tells teachers to "explain to students that we want to know what happens to a graham cracker when we put it in our mouths," providing a more accessible context for the graphs of different types of molecules students are given.
- Throughout the unit, students get most of their information from data analysis rather than by being told information by the teacher. This is an authentic way to gather information.
- In Lesson 5, students are able to experience a new phenomenon directly, through taste. A video alternative is also provided if the taste experiment is not allowed in the classroom or if there are food allergies.
- The class discussion about spit on page 119 is likely engaging for students. They are asked to talk about their experiences with spit.
- It isn't clear that students will understand the rationale for why they need to add specific organ structures to their models in Lesson 7 page 153. This part of the lesson might seem teacher-driven and inauthentic.
- In Lesson 10, students do an experiment with fire, burning fat. This is likely to be authentically engaging. Students are also allowed to suggest and bring in other sources of fat. Alternative videos are provided in case the in-person experiment is not feasible in both this lesson and in Lesson 11 (e.g., page 244).
- The link between burning fat for energy in the body (without fire), to burning fat with fire, to fire requiring oxygen in Lessons 10 and 11 is slightly inauthentic, as there are not literal fires in the body, and students would be likely to point that out (as is suggested at the end of Lesson 11).
- In Lesson 12 page 260, the teacher is given suggestions for helping students accept or understand the ingredients of carbonated water (rather than just accepting what they are told).
- In Lesson 14, students choose an animal and think about whether their learning applies to it. This connects to their life experience.

Suggestions for Improvement

- Because students using this unit are likely to be in the U.S. and used to discussing their own weight in lbs, it might be helpful to add a couple of translations between M'Kenna's weight in kg and her weight in lbs in Lesson 10. For example, on page 219 in the Suggested prompt section, the teacher could say "If M'Kenna were your patient and you saw a 20 kg difference (that's 44 lbs!), would you be alarmed? Why or why not?"
- More opportunities to connect to the students' home neighborhood, community and culture would increase the evidence for this criterion.
- Providing an opportunity for students to connect their explanation of M'Kenna's illness (the anchor phenomenon) to a question from their own experience would increase the evidence for this criterion.

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

Rating for Criterion II.B. Student Ideas: Extensive

(None, Inadequate, Adequate, Extensive)

The reviewers found extensive evidence that the materials provide students with opportunities to both share their ideas and thinking and respond to feedback on their ideas because there is a plethora of opportunities for students to share their ideas in a variety of ways. In fact, there are structured times in each lesson for students to share their ideas. Examples include:

- The structured times are indicated in the student materials with icons for *turn and talk, with your group,* and *with your class.* Some lessons also include *scientists circle* with goal discussions such as *building understanding discussion.* Additionally, example norms and guidelines are provided to teachers and students to provide structure and support to these interactions so that all students can have opportunities to share their ideas. For instance, on pg. 31 of the teacher handbook, there are example norms and talk moves to support those norms and on page 33 strategies are given for facilitating a *building understandings discussion*.
- Students have opportunities to give and receive peer feedback. For example:
    - In the Assessment System Overview (pages 17–19), teachers are told that students will provide peer feedback to small groups on their arguments in Lesson 14. Indeed, on page 307, students are given peer feedback guidelines and asked to assess each other's work and give feedback on how to improve.
    - On page 156, students are supported to give peer feedback.
    - Students do not have a structured opportunity to respond to feedback.
- Students get feedback from the teacher:
    - In Lesson 4 page 99, teachers are told to provide feedback to students who need help annotating their graphs.
    - On page 161, the teacher is given the suggestion to consider providing individual feedback on students' Progress Tracker updates.
    - Students do not have a structured opportunity to respond to feedback.
- Students justify their ideas. For example:
    - In the discussion on page 101, students are asked to justify their responses.
    - On page 201, students are asked to share their ideas about which Driving Question Board questions have been answered and why (justifying their ideas).
- Students express and share their ideas and thinking. For example:
    - By using the Progress Tracker throughout the unit (e.g., Lesson 1 page 45, Lesson 2 page 63), students think about their learning and express their ideas, sometimes in both words and pictures.
    - In Lesson 1, students are asked to think individually and then talk about what other symptoms they might expect M'Kenna to have (page 38). They then are asked to write what they wonder about M'Kenna and her symptoms, share with a partner, and then share with the whole class. During the class discussion, the teacher is told to "engage the class in building on the ideas present by the first group, offering new ideas or disagreeing with the ideas presented." The teacher is also told to "encourage all students to go public with their ideas and support students as they begin to connect their thinking to the thinking of their peers" (page 40).
    - When the class creates the Driving Question Board (page 47), students are encouraged to generate a list of questions that they have. Their questions are then displayed on the board for the class to see.

    - On page 86, students argue from evidence about why their conclusions help explain their experimental results. They represent their ideas in words and pictures in their Progress Trackers.
    - Throughout the unit, students are asked to share their questions, ideas about data analysis, or how they would currently explain the phenomenon. For example, at the beginning of Lesson 3 (page 75), students are asked to share their ideas about part of the anchor phenomenon with a partner and later with the whole class. Similarly, on page 100, students share their interpretations of the data and make claims about what might be happening. Other examples include page 102, page 151, page 219.
    - On page 134, students are asked to develop arguments to decide with a partner how the Progress Tracker model should be updated.
    - On pages 235–236, students are asked to develop and discuss ideas for redesigning the investigation.
    - On page 241, students share ideas with partners then share an idea they heard their partner share. Students are encouraged to work with and build off peer ideas, adding on, offering alternate explanations, or restating the ideas shared so far.
    - On pages 267 and 275, the teacher is told to make a public record of key student ideas that emerge from the whole class discussion.
    - On page 287, students work in groups to create models, and teachers are given hints to help ensure that all student ideas are represented in the models, including to ask students if their group members' ideas are all represented.
- Students have an opportunity to transfer their learning beyond the phenomenon of M'Kenna's illness in Lesson 15 when they develop a model to explain how bears use stored food to survive during hibernation.

Suggestions for Improvement

- Increasing opportunities for student to receive, and also respond, to teacher and student feedback would support student learning.

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: Inadequate

(None, Inadequate, Adequate, Extensive)

The reviewers found inadequate evidence that the materials identify and build on students' prior learning in all three dimensions because learning progressions focused on DCIs but not CCCs or SEPs.

Examples of prior learning that is identified and built on includes:

- The teacher materials have multiple sections that address prior learning:
    - The section "What should my students know from earlier grades or units to be successful in this unit?" (page 14) lists element-level prior knowledge from all three dimensions.

- The section "What modifications will I need to make if this unit is taught out of sequence?" (page 15) notes what modifications should be made if the unit is taught in a sequence other than the designed sequence.
  - The section, "What are some common ideas students might have?" (page 15) does not identify ideas based on the three dimensions, but does identify common ideas that students may have coming into this learning experience that the unit is designed to build on.
- The Unit storyline section (pages 3–12) describes how students build DCI ideas over time but does not describe building SEP and CCC ideas.
- At the beginning of each lesson, there are sections called Lessons through sections like *Previous Lesson*, *This Lesson, Next Lesson*, *What Students Will Figure Out that* generally make the progression of what is being figured out and the relationship to DCIs clear.
- Additional sections at the beginning of each lesson called *Where We Are Not Going* and *Where We are Not Going* describe necessary and unnecessary prior knowledge, including what DCI understanding will be built during the lesson and unit. However, SEP and CCCs are typically not described as part of what is built during the unit in this section. For example:
  - In *Where We Are Going and Not Going* for Lesson 10 information is provided about prior ideas and learning as well as current and future ideas, stating, "Though students may still have lingering ideas that matter can disappear when it is burned, this lesson will provide additional evidence that maybe something else is happening to it, namely, that it is transformed through a chemical reaction, and the products are going into the air. At this point, it is not important that students identify the products that go into the air, just that the mass decreases. Because we know from previous background that matter can't be destroyed, the matter must be going somewhere. In prior units, students learned that substances have properties that do not change, such as color, odor, and state of matter. They learned that, in chemical reactions, the atoms that make up the molecules of the old substance break apart and rearrange to form new molecules made of the same atoms but in different arrangements; these new substances have new properties, such as color, odor, and state of matter. They also learned that chemical reactions can release or absorb energy from the surroundings. These ideas are revisited in this lesson and in Lessons 11 and 12."
    - This example, like others, provides information about progression of ideas related to DCIs (e.g., chemical reactions) and closely related CCCs (e.g., conservation of matter in chemical processes). However, it does not include information about the progression of practices. It also does not include information about CCCs that are claimed to be in this lesson but are less closely related to the DCI at hand (i.e., stability and change).
- In Lessons 3 and 4, students analyze graphs of food molecules in healthy versus unhealthy digestive systems. However, their data analysis doesn't show evidence that they are using prior knowledge the Grade 3–5 SEP element *Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered,* because student data analyses don't show awareness that the number of trials is not given in the graphs despite a specific class discussion about other possible data limitations.
- In Lesson 5 (e.g., page 115), students explicitly build on their prior DCI knowledge about chemical reactions.

- On page 176, there is a note that students should come to the unit with prior knowledge of cells from their sixth-grade work, as the unit does not discuss cells.
- In Lesson 12 page 266, students use their prior learning about glucose molecules in the small intestine to make sense of how gas molecules could get into the blood from the lungs.
- It is not clear how this unit is designed to build on LS1.C from the 3–5 grade band: "Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion."

Suggestions for Improvement

- In Lesson 2 page 61, there is a missed opportunity to connect the discussion about cause and effect relationships back to students' prior learning of this Grade 3–5 CCC element: *Events that occur together with regularity might or might not be a cause and effect relationship.*
- LS1.C from the 3–5 grade band – "Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion," – needs to be identified as prior knowledge students would be expected to have. And materials need to clarify how the work of this unit builds upon and moves beyond this prior understanding in a grade-level appropriate way.

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: Adequate

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that the materials use scientifically accurate and grade appropriate scientific information because the unit is generally scientifically accurate. However, the concept of Patterns is inaccurately used in many places in the unit, which could cause confusion. Additionally, some graphic representations are also presented in ways that could be confusing and not grade-appropriate.

Examples in the materials include:

- Overall, the unit is scientifically accurate and uses grade appropriate information and representations. The sections "Where We Are Going and NOT Going" before many lessons remind teachers of assessment boundaries so they know which types of extensions are beyond the middle school expectations (e.g., page 283).
- On pages 83 and 223, the materials provide guidance for throughout about how to help address common preconceptions and avoid misunderstandings (pages 15, 83, and 223).
- In several places in the unit (e.g., page 98), students are asked to notice and discuss "patterns," even though they are only looking at similarities and differences (e.g., comparing numbers from one trial from one sick patient to numbers from one trial from one healthy patient) without understanding whether the numbers are simply error variance.
- On page 98, the teacher is told that students are examining patterns in the rates of change of food molecules. However, they are not given any rate data. Similarly, on page 101 and 104, the teacher asks the students about rates of change.
- A minor note: the sample student response at the top of page 143 is inaccurate, conflating data and data interpretation. The data tables did not show that some organs aren't involved in breaking down or absorbing food molecules. This is an interpretation of the data.

- As noted previously, there are numerous issues with how the graphs are designed (e.g., missing or misleading axes, titles, legends) and discussed that prevents them from being grade appropriate (i.e., difficult for students to summarize the data per CCSS-M.6.SP.B.5).
    - Regarding graphs in Lesson 2:
        - It is not stated that the x-axis is the same relative scale for the two graphs, only that each goes from 0 to 1. It is not clear what "relative" amounts are relative to, and a common interpretation of "relative amount" would lead students to believe that the scale as being from 0 to 100% of the sample, and that this scale could be different between the two graphs. A common interpretation of this "relative amount" would be that all amounts are relative to the amounts in the initial food item. However, students analyze a graph in Lesson 4 ("Graham Cracker Data," Student page 71) where the relative amounts in the initial food item add up to more than 1.
        - The Teacher Edition (page 62, Part 6, end of paragraph 1) says "...decreasing at the same rate…". However, the use of the word "rate" could be confusing to teachers and students because the graphs do not individually represent a "rate", but rather a moment in time. The use of the word "rate" may be appropriate if comparing the first graph to the second graph, but only if we assume that food moves through the healthy person and M'Kenna at the same "rate," which is not a good assumption to make given the symptoms. Consider different ways to explain and discuss these graphs using "percent" and "proportion" rather than "relative amount" and "rate."
        - The graphs all have the same title ("Food Molecules"). Students are unable to quickly determine the content of each graph by the title.
    - Regarding graphs in Lesson 4:
        - The number and type of graphs presented in Lesson 4 differ from the Student Handbook (page 71-72), the Student Handout (MR.L4.HO I2 Strategy.pdf), and the Google Slides (Slides C and D). Not all graphs are shown in all places.
        - In addition, the second graph from Lesson 2 is not included in Lesson 4. This could be a barrier to student sense-making as students try to figure out what is happening in the whole system. Leaving out this previously-considered data could be confusing. For example, when students revisit the Progress Tracker for this lesson (Teacher Edition, page 104), they will be able to provide a more robust answer if they have all of the data available to them.
    - Regarding graphs in Lesson 6:
        - These graphs have many of the same issues as those presented in previous lessons (titles, legend titles, relative amount scales, etc.).
        - In addition, the same data appears with different legend colors in adjacent graphs, which may be confusing to students. For example, in the Student Handbook (page 82), "Mouth" is dark green in the top graph but light green in the bottom graph. The Teacher Edition (page 136) indicates that light green always means "previous amount" and dark green always means "new amount". Those conventions would be fine to use as legend titles, but then the title of the graph needs to be more descriptive.

Suggestions for Improvement

- It would be clearer for teachers and students if patterns were discussed accurately (in a grade-appropriate way) consistently throughout the unit.
- On page 248, it seems unlikely that all students will realize right away that the energy to make light comes from the oil and not from the fire itself. Guidance to help teachers combat student preconceptions about fire would be helpful to add in the lesson.
- On page 286 there is some evidence of a potential student misunderstanding. The sample student response says (when referring to cells using oxygen to burn food): “We inferred that it happens in the body when we exercised and breathed out less oxygen and more water and carbon dioxide.” It might therefore be helpful to add guidance for the teacher to ensure students understand that bodies do this all the time—not just when they exercise.
- In the title and description of Lesson 14, the verb choice (“do/does”) may not be the best fit: “Do all animals **do** chemical reactions…”
- For the graphs used in Lessons 2, 4, 5, and 6, consider changes to both how the graphs are presented and how they are discussed to bring them into closer grade-level alignment with the CCSS mathematics standards and support student sense-making in mathematics. For example:
    - Consider giving these graphs mathematically and scientifically robust titles that allow students to differentiate between the graphs. One option is the standard “Y versus X” title format.
    - For the graph in Lesson 5 (Student Handbook, page 73), consider the legend titles. Both samples represent Graham Cracker. One is “before being chewed” and one is “after being chewed.” The current legend titles of “Graham Cracker” and “Mouth” are potentially misleading.
    - Since the handout for Lesson 6 is asking students to document the change in food molecules, consider modifying the headings on this handout to reflect the two states/locations that are being compared to analyze the change. For example, the first column says “Mouth” for the first column, it is unclear if students should be documenting the change that occurs from the unchewed cracker to the mouth, or from the mouth to the stomach. Since students have discrete rather than continuous data, they can only make claims about what happened between the two discrete data points.
    - Consider ordering the molecules on the y-axis of the graphs (Student Handbook, pages 82-84) in the same order as the student handout for this lesson.
    - Consider providing titles and captions for the endoscopy images (Student Handbook, pages 85-87.
    - Consider modifying the Lesson 2 handout so that both graphs appear on the same page. It will be difficult for students to analyze the graphs if they cannot see them both at the same time (page-flipping).
    - Examine and consider refining the mathematical language and representations in Lesson 2 to support meaningful student sense-making, including the use of relative amount, rate, ratio, proportion, and percent. Detailed feedback on the graphs is provided above.
- Consider changing references to “amount” in the Teacher Edition (page 136, Part 2) to “relative amount” as appropriate.

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

Appropriate reading, writing, listening, and/or speaking alternatives (e.g., translations, picture support, graphic organizers, etc.) for students who are English language learners, have special needs, or read well below the grade level.

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

Extensions for students with high interest or who have already met the performance expectations to develop deeper understanding of the practices, disciplinary core ideas, and crosscutting concepts.

Rating for Criterion II.E. Differentiated Instruction: Adequate

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that the materials provide guidance and a variety of supports for teachers to support differentiated instruction. However, there are limited extensions for students with high interest or who have already met the performance expectations.

Examples of guidance for differentiation includes:

- In the Assessment System Overview (page 17), the teacher is told to determine how much or how little scaffolding their students need.
- Support is provided for students with physical needs. For example, support is provided for hearing impaired students in Lesson 1, page 38.
- Support is provided for students who struggle with the unit expectations. For example:
    - A suggestion is provided for students who need support in writing on page 39.
    - In Lesson 2 page 59, support is provided for students who need extra guidance with image analysis.
    - In Lesson 3 page 80, sentence starters are suggested for students who need more support in writing.
    - In Lesson 3 page 86, sentence starters are provided for student arguments.
    - In Lesson 4 page 99, teachers are given guidance about extra support they can provide for students who need extra support in data analysis and writing.
    - On page 153, guidance is provided to help students who might need extra support before sharing ideas in a large group.
    - Page 180 and 181 provide guidance for how to support students who are below grade level in creating data tables and graphing.
    - On page 185, sentence stems are provided for students to use to organize their arguments in writing.
    - On page 268, teachers are given the idea to show students an image of the different body systems to support students who are struggling with visualization.
    - On page 284, teachers are given the suggestion to either slow down instruction or move ahead quickly depending on student needs.
    - In Lesson 15, a modified student assessment is available for students who need extra support in creating the model.
- Support is provided for English Learners (ELs). For example:
    - Strategies are provided on page 41 for developing vocabulary with ELs.

    - In Lesson 1 page 47, the teacher is reminded to let students ask questions in everyday language (rather than only scientific language).
    - In Lesson 2 page 57, the teacher is told to only introduce new scientific vocabulary after students have used the concept with everyday language first.
    - In Lesson 3 page 76, there is a reminder for teachers to support language learners with new vocabulary.
    - On page 121, the teacher is told to add images of molecules together with the written names of the molecules.
    - On page 179, guidance is provided to teachers about when to add new vocabulary words to the word walls.
    - On page 220, strategies are provided for helping students read for understanding, even when they don't understand all of the words.
    - In Lesson 11 page 248, the teacher is told to draw as well as write the word "fuel" and to ask students to say the names of fuels in their home language. Those home language words are added to the word wall.
    - Reading alternatives are not provided.
- Very few suggestions for extensions are provided:
    - An extension activity (for all students if time allows) is suggested on page 295.
    - An extension activity is suggested on page 306 for students who want to do their own research.

Suggestions for Improvement

- Providing extensions for students to deepen their understanding of the CCCs would be very useful.
- Consider providing reading alternatives.

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

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

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

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

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that the materials support teachers in facilitating coherent student learning experiences over time because there are many supports for teachers to help students understand the coherence of the unit. While many supports are present, the strategies often do not ensure sense-making is linked to learning in all three dimensions.

Examples of supports for teachers to help students understand the coherence of the unit include:

- Teachers are given a lot of support to understand the storyline of the unit, including the unit overview (page 1), the unit storyline (pages 3–12), and the Teacher Background Knowledge (page 13). In addition, each lesson includes summaries of the previous, current, and next lesson.

- Throughout the unit, the teacher is given guidance about how to facilitate students to make sure student discussion leads coherently into the next lesson. For example, in Lesson 1 page 50, the teacher is given suggested prompts that lead students to propose the topic for Lesson 2 investigations.
- The Teacher Handbook (pages 26-28) provides teachers with general guidance on establishing and maintaining the routine of using the progress tracker.
- The sections "Where We Are Going" and "Where We Are Not Going" at the beginning of each lesson are very helpful for teachers to know what is expected and not expected of students at each stage so they can help build knowledge coherently.
- In a few parts of the unit (e.g., page 135), teachers are told that certain activities are very important for student sense-making and should not be skipped. This helps teachers maintain coherence even if they have to skip other sections.
- Teachers are not provided with supports for ensuring that student will use all three dimensions at a grade-appropriate level in all lessons.

Suggestions for Improvement

- Rating would be "Extensive" if students made progress towards elements of each dimension that help the student also make progress on the questions connected to the phenomena. As such, suggestions for improvement in criterion I.A – I.C would also strengthen the evidence for this criterion to increase the rating.

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

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

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that the materials support teachers in helping students engage in the practices as needed and gradually adjusting supports over time. There are some places, though not an extensive amount, where supports are removed throughout the unit. For example:

- When students develop initial models in Lesson 1 (page 41), the teacher is given guidance about how to help students use the models to explain the "how" and "why" of the phenomenon and not just the "what." The teachers give students cues to ensure this focus in their models. Later in the unit, students are expected to create models without this teacher guidance.
- On page 117, the teacher is told that students should be well supported in analyzing graphs in Lesson 5 in order to prepare them for analyzing a longer series of graphs in Lesson 6. Teacher support for graph analysis therefore reduces between Lesson 5 and Lesson 6.
- On page 184 in the Assessment Opportunity section, there is a reference to the scaffolds available for student arguments. The teacher is told that they can be removed if students are ready.

Suggestions for Improvement

- Increasing the relative focus of the unit from mostly building DCI knowledge to equally building all three dimensions would improve the rating for this criterion. If there are more opportunities to engage in the SEPs and CCCs there are more opportunities to scaffold use of these dimensions.

- For SEP and CCC elements that are claimed numerous times throughout the unit, clarify how students are developing (not just using) these elements (also noted in Criterion I.B). Show how student engagement in the practices and crosscutting concepts grow and deepen over time, or how students are reaching mastery of the practice with fewer supports over time.
    - Based on the "Developing and Using Science and Engineering Practices (by Lesson)" document, the following SEP elements are claimed in at least 3 lessons and would be good targets for scaffolded development.
        - **Analyzing and Interpreting Data** "*Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships*" is claimed in Lessons 6, 10, and 12.
        - **Analyzing and Interpreting Data** "*Analyze and interpret data to provide evidence for phenomena*" is claimed in Lessons 2, 4, and 12.
        - **Engaging in Argument from Evidence** "*Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail*" is claimed in Lessons 7, 8, and 14.
        - **Engaging in Argument from Evidence** "*Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem*" is claimed in Lessons 3, 7, and 8.
    - Based on the "Developing and Using Crosscutting Concepts (by Lesson)" document, the following CCC elements are claimed in at least three lessons and would be good targets for scaffolded development:
        - **Patterns:** "*Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems*" is claimed in Lessons 4, 5, and 6.
        - **Systems and System Models**: "*Systems may interact with other systems; they may have sub-systems and be part of larger complex systems*" is claimed in Lessons 1, 2, 4, 7, 8, and 9.
        - **Systems and System Models**: "*Models can be used to represent systems and their interactions--such as inputs, processes and outputs--and energy, matter, and information flows within systems"* is claimed in Lessons 1, 3, 7, and 13.
        - **Energy and Matter:** "*Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter"* is claimed in Lessons 11, 13, 14, and 15.
        - **Structure and Function:** *"Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function"* is claimed in Lessons 2, 3, 6, 8, and 14.
- Consider expanding guidance in the Teacher Handbook on repeated structures and routines (Progress Tracker, DQB). This could include how students should be building proficiency and skill with these routines over time and how teacher support can and should adjust as a result. In addition, consider providing specific references to the Teacher Handbook at appropriate places

in the Teacher Edition (for example, "See Teacher Handbook page ## for more details in implementing this routine over time.")

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

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

Category III. Monitoring NGSS Student Progress

Score: 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: Adequate

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that the materials elicit direct, observable evidence of students using practices with core ideas and crosscutting concepts to make sense of phenomena and/or design solutions because students are required to produce observable artifacts that have evidence of their learning and understanding.

Throughout the unit, students perform three-dimensional tasks from time to time, as evidenced by the sample student answers in the lessons. Examples include:

- On page 161, students are presented with a formal assessment task that is part of their overall sense-making of the phenomenon. The suggested student response to the task (page 171) shows evidence of student use of all three dimensions.
- In Lesson 8 page 184, the teacher is told that students will be developing three-dimensional arguments. However, an example student response is not given, and the suggested sentence stems don't have any guidance about use of the CCC. Therefore, there is no evidence that student arguments would actually use all three dimensions.
- In the summative assessment (Lesson 15), students are given three-dimensional tasks. They demonstrate evidence (based on the sample student answers) of at least two different CCC elements:

- *Cause and effect relationships may be used to predict phenomena in natural or designed systems.*
- *Matter is conserved because atoms are conserved in physical and chemical processes.*

Suggestions for Improvement

- Providing more explicit student answers related to use of CCC elements would help increase the evidence for this criterion.
- Consider adding more opportunities for students to be individually accountable for demonstrating understanding. Although students have opportunities for individual sense-making and reasoning, these seem to be initial ideas that students are not held accountable for as they are followed by group sense-making and whole-class discussions.

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. The materials include assessments that are accompanied by how to interpret those assessments in a way that informs instruction.

The following examples demonstrate how the materials support adjusting instruction based on assessment results:

- In the Lesson-by-Lesson Assessment Opportunities section (page 19), teachers are told that most lesson-level performance expectations (LLPEs) are potential formative assessments. Descriptions of what to look for in each lesson and what kind of feedback to give to students is provided. However, the guidance for Lessons 1 and 4 only focuses on DCIs and SEPs. Guidance is not given for CCCs at a middle-school level. This is also true in the assessment sections of the lessons themselves (e.g., page 48). Guidance for the other lessons includes a mention of all three dimensions, although the references to CCCs are often implicit, and guidance is not often given to look for evidence that students are using CCCs as lenses for sense-making.
- In Lesson 1 page 42, a chart of assessment guidance is provided to show examples of what teachers can say in response to different scenarios of student modeling. Only SEP-related information is provided.
- At the end of Lesson 2 (page 65), an Assessment Opportunity section provides ideas for adjusting instruction according to student responses related to DCIs and SEPs, but not CCCs.
- In the Lesson 6, page 135 Assessment Opportunity, all three dimensions are mentioned but the CCC (Patterns) is not actually used by students at the middle school level and no extra support is given related to the CCC.
- In Lesson 10 page 224, the teacher is given formative assessment guidance about DCIs and CCCs only – not SEPs.
- In Lesson 12 page 267, there is good support for helping students analyze data (DCI and SEP support).

Suggestions for Improvement

- The Lesson-by-lesson Assessment Opportunities section might be more influential on classroom assessment if it were included in the lessons themselves rather than in the front matter, where teachers might forget about it.
- Consider adding more formative assessment support for CCCs.

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 that the materials include aligned rubrics and scoring guidelines that help the teacher interpret student performance for all three dimensions. The materials do contain some guidance, though guidance for some dimensions are not as strong as others. Examples include:

- Example (proficient) student work is shown in the Unit Storyline (pages 3–12), helping teachers see at a glance how student understanding should be progressing in the unit.
- Example student responses to some of the prompts (but not all) are provided in each lesson (e.g., page 39, page 87). These support teachers in knowing whether their students are performing as intended. However, most of these example student responses focus on DCI and SEP performances, without sufficient detail to convey student understanding of middle school-level CCCs.
- The sample student response at the top of page 143 is inaccurate. The data tables did not show that some organs aren't involved in breaking down or absorbing food molecules. This is an interpretation of the data – not the data themselves (also mentioned in Criterion II.D. Scientific Accuracy).
- On page 161, the teacher is given specific things to look for in an Assessment Opportunity. However, the description of what to look for with the SEP and CCC are solely DCI-related and don't provide any guidance about interpreting students' SEP and CCC performance.
- Very minimal scoring guidance is provided for the assessment in Lesson 7 (page 170).
- On page 189 and 315, a rubric is provided for student arguments. The rubric includes criteria relating to all three dimensions but doesn't show representations of what performance looks like at each level ("Missing," "Developing," "Mastered").
- Sample student answers are provided for the Summative Assessment (Lesson 15) that include evidence of student use of all three dimensions.

Suggestions for Improvement

- Providing more explicit student answers related to use of CCC elements would help increase the evidence for this criterion.
- An example student model on page 124 would be helpful for teachers to see the level of detail expected, especially for the student prompt "Support your claim using evidence."
- Example student answers or rubrics for the Lesson 10 "What happens to fat" worksheet would be very helpful, supporting teachers in ensuring that students are using all three dimensions at a grade-appropriate level.

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

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

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that the materials assess student proficiency using accessible and unbiased methods, vocabulary, representations, and examples because assessments are generally accessible and unbiased, though limited assessment methods or modalities in some assessments may not allow all students to demonstrate their understanding.

Examples that demonstrate assessment methods, vocabulary, representations, and examples are accessible and unbiased include:

- In the Assessment System Overview (page 17), the teacher is told to determine how much or how little scaffolding their students need in order to write complex arguments in the summative midpoint assessment.
- In Lesson 2 pages 63–64 and in Lesson 3 page 86, students are encouraged to express their current understanding in both words and pictures.
- In Lesson 15, a modified student assessment is available for students who need extra support in creating the model.
- On page 217, there is guidance for the teacher for helping to lessen potential anxiety that might arise due to the focus on weight gain and weight loss. Similarly, on page 219, there is an animal picture alternative to showing a picture of a human losing weight.
- In informal tasks (e.g., the Progress Tracker) throughout the unit, students are often encouraged to choose the modality of response (words or pictures).

Suggestions for Improvement

- To improve the rating, consider allowing student choice of modalities for responses of the Summative Assessment.

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: Extensive

(None, Inadequate, Adequate, Extensive)

The reviewers found extensive evidence that the materials include pre-, formative, summative, and self-assessment measures that assess three-dimensional learning.

- Pre-assessments:
    - In the Assessment System Overview (pages 17–19), teachers are told that student work available for assessment in Lesson 1 should be considered a pre-assessment. Similarly, teachers are told that part of Lesson 10 can be used as a pre-assessment.

    - In Lesson 1, students begin by writing about where they think M'Kenna's symptoms occur in her body, providing an opportunity for pre-assessment of human body systems. Additionally, they develop an initial model of what they think may be causing M'Kenna to feel the way she does. This provides an opportunity to assess students' ability to develop a model of a phenomenon and may assess their understanding of core ideas.
- Formative assessments:
    - In the Assessment System Overview (pages 17–19), teachers are told that formative assessments are embedded throughout the unit, and also that Lesson 7 is specifically to be used as a three-dimensional formative assessment.
- Summative assessment:
    - In the Assessment System Overview (pages 17–19), teachers are told that Lesson 8 includes a three-dimensional summative midpoint assessment, and that Lesson 15 includes a transfer task that can be used as a three-dimensional summative assessment.
- Self-assessment:
    - In the Assessment System Overview (pages 17–19), teachers are told that Lesson 14 is a designated spot for having students engage in self-reflection.
    - The unit provides a Student Self-Assessment Discussion Rubric, and the teacher is told to use it at least once every other week (page 18).
    - In Lessons 7 and 8, a Self-Assessment is provided that students could use to think about their performance giving and receiving feedback (SEP-related).
    - In Lesson 15 page 322, students are asked to reflect on their experience with the unit and their sense-making.
- The unit includes frequent uses of a Progress Tracker, which can be used for both formative assessment and for student self-assessment (e.g., Lesson 1 page 45, Lesson 2 page 63).
- The unit includes supports to the teacher for understanding the rationale of student three-dimensional performances.

Suggestions for Improvement

N/A

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

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

(None, Inadequate, Adequate, Extensive)

The reviewers found adequate evidence that the materials provide multiple opportunities for students to demonstrate performance of practices connected with their understanding of core ideas and crosscutting concepts. Students have multiple opportunities to demonstrate performance on an adequate number of claimed SEP and CCC elements even if they do not have multiple opportunities to demonstrate performance of all of the targeted or claimed SEP and CCC elements. Students also have extensive opportunities to demonstrate performance on most of the claimed DCI elements. The reviewers did not see much evidence that students had the opportunity to react to teacher feedback.

Opportunities to receive feedback include:

- In the Assessment System Overview (pages 17–19), teachers are told that students will provide peer feedback to small groups on their arguments in Lesson 14. Indeed, on page 307, students are given peer feedback guidelines and asked to assess each other's work and give feedback on how to improve. Students have time to modify their work based on the feedback.
- In the Assessment System Overview (pages 17–19), teachers are also suggested to have peer feedback discussions at least two times per unit, and guidance is provided about how to make peer feedback experiences more valuable for students (page 19).
- In Lesson 11 page 242, the teacher is told that if students don't seem to understand (or convey understanding of) the DCI ideas in the discussion, "have them draw where they think the matter went in both the closed and open systems."
- The summative assessment rubric (page 325) includes space for the teacher to provide feedback.

Suggestions for Improvement

Including additional opportunities for students to react to teacher feedback in the unit would strengthen this rating.

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): 2
Category III: Monitoring NGSS Student Progress Score (0, 1, 2, 3): 3
Total Score: 7
Overall Score (E, E/I, R, N): E/I

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

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

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