EQuIP Rubric for Science Unit Peer Review Panel Feedback

Overall Rating:
E
Example of High-Quality NGSS Design

Unit Name: Interactions Unit One
Grade Level: 9, 10

Category I. NGSS 3D Design

Unit Criteria	Evidence of Quality? None	Inadequate	Adequate	Extensive
A. **Explaining Phenomena/Designing Solutions**: Making sense of phenomena and/or designing solutions to a problem drive student learning.				X
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*.				X
i. *Provides opportunities to develop and use specific elements of the SEP(s).*				X
ii. *Provides opportunities to develop and use specific elements of the DCI(s).*				X
iii. *Provides opportunities to develop and use specific elements of the CCC(s).*				X
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.				X
D. **Unit Coherence**: Lessons fit together to target a set of performance expectations.				X
E. **Multiple Science Domains**: *When appropriate*, links are made across the science domains of life science, physical science and Earth and space science.			X	
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.			X	

Category I Rating: 3 — At least adequate evidence for all of the unit criteria in the category; extensive evidence for criteria A–C

Criterion A.

Specific evidence from materials and review team consensus reasoning:

The anchoring phenomenon and the investigation-level phenomena are a common shared experience. The use of a Driving Questions (DQ) board keeps the phenomena (unit, investigation and activity) in focus. The anchoring phenomenon, "Why do some clothes stick..." truly drives all of the learning and sense-making in this unit.

Investigation 1: After discussing the anchoring phenomenon (Why do some clothes stick together in the dryer?), students observe the Van De Graff generator and pie pans and generate questions about the demonstration.

Investigation 2: Students observe a pointer moving around the Van De Graff generator and generate questions about its behavior.

Investigation 3: Students combine two different liquids expecting the volume of the two separate liquids to be equal to adding both separate volumes together. The volume of the two liquids combined is actually less than calculated.

Investigation 4: Students make indirect observations using a “mystery box.” Students connect this activity to scientists making indirect observations of the atom and making conclusions about its structure.

Investigation 5: No new phenomena are introduced in this investigation as this set of activities circles back to previous phenomena.

The lessons build toward an understanding of the anchoring phenomenon.

Activity 2.3: Franklin’s Bells – Students observe this demonstration and make sense of the mechanisms behind the movement of the ball.

Activity 3.2: Mixing Liquids – This experiment helps students to make sense of the particle model because in a mixture, different particle shapes may more efficiently pack together.

Activity 4.2: Mystery Box – This activity helps students makes sense of how indirect observations of atoms led to discoveries about atomic structure.

Suggestions for improvement:

Consider having students ask the questions based on the images of the clothing coming out of the dryer or the hair standing on end to make a stronger personal connection to the phenomena.

Criterion B.

Specific evidence from materials and review team consensus reasoning:

Numerous examples of opportunities for students to develop and use elements of the Science and Engineering Practices (SEPs) exist in this unit. All of the activities are at the grade-appropriate level for a high school student and aid in student sense-making of the anchoring and lesson-level phenomena.

Activity 1.3 – Students create a model for the tape and water bottle activities and identify the components, relationships and connection to the phenomenon.

- **Developing and Using Models**
  - *Element: Develop, revise and or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system*

Activity 1.4 – Students design an investigation to determine the charge of the tape strips from a previous investigation.

- **Planning and Carrying Out Investigations**
  - *Element: Plan an investigation individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems*

Activity 2.3 – Students use information gained from previous activities to create a revised model that includes electric fields and forces.

- **Developing and Using Models**
  - *Element: Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system*

Activity 3.2, page 21: “Ask students to recall the differences between the continuous and particle models of matter. Remind them that in science, when there are different ideas or models, evidence needs to be used to make a decision about which model best explains or accounts for observations. In this activity, students will test the continuous and particle models by determining which one can best explain what happens when water and ethanol are mixed.”

- **Developing and Using Models**
  - *Element: Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria*

Activity 3.3, page 47: “Write a scientific explanation that answers the question, *How is it possible to compress a given amount of air into a smaller space*? In your explanation, be sure to include the following: Claim, Evidence, Reasoning”.

- **Engaging in Argument from Evidence**
  - *Element: Make and defend a claim based on evidence about the natural world that reflects scientific knowledge and student-generated evidence*

Activity 4.3, page 40: “In this activity, they will use a simulation of Rutherford’s gold foil experiment to test whether the positive charge distribution within an atom is consistent with the plum pudding model. This simulation will provide evidence for a small, dense, positive nucleus surrounded by electrons.”

- **Constructing Explanations and Designing Solutions**
  - *Element: Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources*

Activity 5.1, page 19: “Have students consider whether what they’ve learned about atomic stricture so far helps them answer these questions. Ask students what additional questions they could explore in order to answer these questions.”

- **Asking Questions and Defining Problems**
  - *Element: Ask questions that arise from careful observation of phenomena, or unexpected results to clarify and/or seek additional information*
  - *Element: Ask questions that arise from examining models or a theory, to clarify and/or seek additional information and relationships*

Activity 5.3, page 40: “Draw a model that explains why both positively and negatively charged pieces of tape stick to the wall (on the non-sticky side of the tape. Explain your model.”

- **Developing and Using Models**
  - *Element: Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system*

Numerous examples of opportunities for students to develop and use elements of the Disciplinary Core Ideas (DCIs) exist in this unit. All of the activities are at the grade-appropriate level for a high school student and aid in student sense-making of the anchoring and lesson-level phenomena.

<u>PS1: Matter and its Interactions, PS1.A Element 1: Activities 4.2, 4.3, 4.4, 5.1, 5.2, 5.3, and 5.4</u>
4.2 - Students use a simulation that models JJ Thomson's cathode ray investigation to investigate charge relationships in atoms. Relevant excerpts: "What evidence did Thomson have to support his conclusion that electrons were negatively charged?" "What evidence... to support ... electrons were part of all atoms?"

	4.3 - Students experience a simulation that models Rutherford's gold foil experiment and clearly see that atoms have positively charged parts as well. Relevant excerpt: "What do Rutherford's results and the relationships shown in the simulation tell you about the positive charges inside an atom?" <u>PS1.A Element 2: Activities 5.1 and 5.2</u> 5.1 - Using a periodic table and a simulation, students investigate what makes one element different from another. Relevant excerpts: "Explain what happens to an atom when the number of protons, neutrons, or electrons changes, while the number of the other two particles stays the same." "Find oxygen on the periodic table, Why do you think the 8 represents the number of protons and not the number of electrons or neutrons? A periodic table game reinforces understanding of how to read the table. 5.2 - Building on 5.1, students focus on what change in composition gives an atom charge. Relevant excerpt: "How could you change the overall charge of an atom without changing the atom's element?" reinforces the big ideas about the periodic table. <u>PS1.A Element 3: Activities 1.2, 1.3, 4.1, 5.3, and 5.4</u> 1.2 - Relevant excerpts: "Use the simulation to identify patterns in how two charged objects interact." "Use your observations from the tape activity, the magnet tests and the patterns you identified from the simulation to explain what may have caused the pieces of tape to interact. Support your explanation using the results of the magnet test and your observations of the different conditions in the simulation." "A simulation is a type of model, and a model must connect to a phenomenon. How does this simulation relate to the phenomenon you described with the T and B tape strips?" "Return to the investigation - level driving question: Why do some things stick together and others don't?" 1.3 - Students continue their investigation into charge, looking at how uncharged (neutral) objects react with charged objects. Relevant excerpt: "Based on your observations, predict what will happen if any charged object is brought close to a neutral one. Include evidence from your observations." 4.1 - Relevant excerpt: "Draw what you think an atom looks like." 5.3 - Relevant excerpts: "Use the simulation to explore how the electric field of a charged object affects an atom." "Draw a model that explains why both positively and negatively charged pieces of tape stick to a wall." "Return to the driving question of the unit, "Why do some clothes stick together when they come out of the dryer?" “Return to other class questions students posed throughout the unit and see if their models can help them answer ..." 5.4 - Students apply ideas they have developed throughout the unit. Relevant excerpt: "Review your model of the pie pans and Van de Graff generator from Inv. 1 and revise it by adding ideas that you have learned since then. Create a series of drawings that show why the pie pans behaved the way they did. Be sure your new drawings include some atomic - level details." **Numerous examples of opportunities for students to develop and use elements of the Crosscutting Concepts (CCCs) exist in this unit. All of the activities are at the grade-appropriate level for a high school student and aid in student sense-making of the anchoring and lesson-level phenomena.** Investigation 1: Students participate in investigations and demonstrations to determine the patterns in how charged objects interact. • **Patterns**

	- *Element: Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.*
	
	Activity 2.2: Using an electric field model, students explain the relationship between the distance separating two charged objects, the amount of charge on those objects, and the strength of the forces experienced by those objects.
	- **Cause and Effect**
	  - *Element: Cause-and-effect relationships can be suggested and predicted for complex natural and human-designed systems by examining what is known about smaller scale mechanisms within the system.*
	
	Activity 3.2, page 26: "What patterns do you see on the class data regarding observations of mixing water + water, ethanol + ethanol, and water + ethanol?"
	- **Patterns**
	  - *Element: Empirical evidence is needed to identify patterns.*
	
	Activity 4.4, page 68: Students complete a pencil drop test to simulate the pattern of electrons in an atom. "What patterns do you notice? What is similar across these papers?"
	- **Patterns**
	  - *Element: Empirical evidence is needed to identify patterns.*
	
	Activity 5.2, page 29: "As a class, build a consensus about the patterns in the data. Tabulate the data from rows 5 and 6 to share with the class. Encourage students to look at the collected data in terms of pairs of objects. Help students conclude that if one object becomes positively charged, then the other object becomes negatively charged."
	- **Patterns**
	  - *Element: Empirical evidence is needed to identify patterns.*

	Suggestions for improvement:
Criterion C.	**Specific evidence from materials and review team consensus reasoning:** **Integration of the three dimensions is pervasive. Every activity describes a Learning Goal that is three-dimensional. The DCI, SEP, and CCC for each activity is indicated.** At the beginning of each Investigation and at the beginning of each Activity, the three dimensions are identified and "how this investigation builds towards" the CCC, DCI or SEPs are clearly defined. For example, in the unit of study, students **Ask Questions** and **Develop Models** (SEPs) to explain electric attraction and repulsion (DCI) between charged objects and between charged and neutral objects. This enables them to **Engage in Arguments from Evidence** (SEP), and, using observed **Patterns** (CCC), explain the unit phenomenon: "Why some clothes stick together when they come out of the dryer?" Relevant excerpt from Activity 5.4, Part 3: "Write a complete scientific explanation that

	answers the question, Why do some clothes stick together when they come out of the dryer? Be sure to include a claim, evidence and reasoning in your answer." There are multiple ways this could be worded using several different SEPs, DCIs and CCCs.
	Suggestions for improvement:
Criterion D.	**Specific evidence from materials and review team consensus reasoning:** **Unit coherence in this lesson is exemplary. Models from each investigation build on the models from previous investigations. Students often return to the previous model(s) and evaluate and revise with new understandings in mind. There is a clear path for students to develop proficiency in the targeted set of performance expectations.** Investigation 2, page 2: “Students build upon their model of electrostatic interactions from Investigation 1 by including electric fields to explain how attraction and repulsion can occur through space.” Investigation 5, page 2: “In Investigation 4, students constructed a model of atomic structure based on historical evidence. In Investigation 5, students will build upon that model by using simulations to collect evidence related to how changing the composition of an atom affects its identity.” Activity 5.2, page 25: “Return to the class data from Activity 1.4 when the class determined the charge of the T (top) and B (bottom) pieces of tape used throughout investigation 1 to remind students of the objects being used as a reference.” The primary performance expectation that students build proficiency towards is *HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.* Other performance expectations are supported throughout the unit of study as well.
	Suggestions for improvement:
Criterion E.	**Specific evidence from materials and review team consensus reasoning:** **A few examples exist of connections to other science domains, but the reviewing team felt that it was not appropriate to expect multiple domains for this unit.**

	Activity 2.2: Slight connections between bees being attracted to flowers and attraction between positive and negative charges. Activity 4.1: Connections are made between the size of cells and the size of an atom.
	Suggestions for improvement:
Criterion F.	**Specific evidence from materials and review team consensus reasoning:** **Students are assigned readings throughout the Interactions Unit and probing questions are used to connect readings to classroom investigations. Students also complete claim, evidence and reasoning (CER) writing.** CCSS.ELA-LITERACY.RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. CCSS.ELA-LITERACY.WHST.9-10.1.B Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns. **Mathematics connections are minimal. The strongest math connection comes from an optional activity in the unit.** Points for Consideration for Investigation 3, page 6: “..in addition, in math class they learn that there is always another number between any two numbers so they may extrapolate incorrectly.” Activity 4 includes optional instruction on metric units and scientific notation. (This is an 8^{th} grade math standard.) CCSS.MATH.CONTENT.8.EE.A.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

	Suggestions for improvement: Consider adding the mathematics and English/language arts (ELA) content standards to the teacher materials. Look for opportunities to expand the math connections.

Category II. NGSS Instructional Supports:

Unit Criteria	Evidence of Quality? None	Inadequate	Adequate	Extensive
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.			X	
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.			X	
C. **Building Progressions**: Identifies and builds on students' prior learning in all three dimensions, including providing support to teachers.			X	
D. **Scientific Accuracy**: Uses scientifically accurate and grade-appropriate scientific information, phenomena, and representations to support students' three-dimensional learning.				X
E. **Differentiated Instruction**: Provides guidance for teachers to support differentiated instruction.		X		
F. **Teacher Support for Unit Coherence:** Supports teachers in facilitating coherent student learning experiences over time.				X
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.				X

Category II Rating: **2**

At least adequate evidence for all of the unit criteria in the category; extensive evidence for criteria A–C

Criterion A.

Specific evidence from materials and review team consensus reasoning:

The unit phenomenon (clothes stuck together coming out of the dryer) is a common experience and supporting phenomena are experienced directly.

Investigation 1: Students observe the Van De Graff generator and pie pans; students generate questions about the demonstration.

Investigation 2: Students observe a pointer moving around the Van De Graff generator and generate questions about its behavior.

Investigation 3: Students combine two different liquids expecting the volume of the two liquids to be equal to adding both separate volumes together. The volume of the two liquids combined is actually less than student expectation.

Investigation 4: Students use a computer simulation and a pencil drop test to determine where electrons are likely to be located in an atom.

Readings were used to help students make connections to home and neighborhood

- Reading in Activity 2.2: How Do Bees Find Flowers electric fields around flowers and transfer of pollen
- Reading 2 in Activity 1.3: Electric Interactions in Everyday life
- Analogy was provided in Activity 4.3, page 46: "…you could tell students a story about a slingshot to shoot stones at a snowbank…"

	The DQ of the unit is: why do some clothes stick together when they come out of the dryer? Most students can relate to this experience.
	Suggestions for improvement: Consider having students generate other examples of static electricity in their lives. What could they have seen or experienced that might be connected to this unit? Students could collect examples as the unit progresses.
Criterion B.	**Specific evidence from materials and review team consensus reasoning:** **DQ discussions at the end of each activity allow students to express, clarify, justify, interpret, and represent their ideas. At this time, students are also reviewing and refining their explanation models. There were minimal opportunities to respond to peer feedback.** Activity 5.3, page 41: "Return to the driving question for the unit: *Why do some clothes stick together when they come out of the dryer*? As a class, discuss how the ideas that students have incorporated into their models of atomic structure and electrostatic interactions can help them answer the question. Return to other class questions students posed throughout this unit, and see if their models can help them answer those questions." Activity 3.1: "What happens to give an object a charge" and "How can charge and neutral objects be attracted to each other?" Non-evaluative debate is encouraged and supported by an investigation that leads to discovery of ideas that help students either confirm their ideas or develop more clear or more correct ideas. Peer feedback in Activity 5.2, page 31: "Students should critique each other's models based on evidence. Remind students that they should use evidence to evaluate their classmates' models."
	Suggestions for improvement: Consider adding more opportunities for peer feedback. Although this would lengthen the timeframe of the unit, students could provide feedback to each other more frequently when they create a model or explanation. Pointing out appropriate places for this to happen in the unit would strengthen the score for this category.
Criterion	**Specific evidence from materials and review team consensus reasoning:** **The most pervasive SEPs in the unit, Using Models and Arguing from Evidence, are taught throughout the unit. The CCCs, Patterns and Cause and Effect, are used**

	repeatedly and reinforced in multiple places. The overarching DCI, PS1.A, is supported by elements from the 3-5 grade band, thereby adding support and / or filling in gaps for learners. Teacher Preparation sections for each activity include a chart of the three dimensions, the elements, and an NGSS performance expectation reference. **The unit explains how prior learning will be built upon within the unit.** Notes to teachers include connections to prior and upcoming knowledge. For example, in Activity 3.1, page 9: "…we will use the term particles in this investigation… in the next investigation, students will learn that these particles can be called atoms (and in later units, molecules)."
	Suggestions for improvement: This category could be rated extensive if it provided the learning progression from the middle school DCIs, CCCs and SEPs and if it made a note to teachers about what prior learning students should have before beginning this unit.
Criterion D.	**Specific evidence from materials and review team consensus reasoning:** **This unit uses scientifically accurate and grade-appropriate scientific information, phenomena, and representations to support students' three-dimensional learning.** Background knowledge sections are included in each overview to ensure teacher understanding of scientifically accurate information.
	Suggestions for improvement:
Criterion E.	**Specific evidence from materials and review team consensus reasoning:** **There is minimal evidence of alternatives for special needs and English language learner (ELL) students. A few strategies are addressed in the teacher notes, but overall there is not a consistent effort to address struggling learners.** **A few optional assignments are provided, but it is not explicitly stated that they are extensions for students with high interest.** Activity 1.2, page 28: Illustration of sticky tape procedure (from Activity 1.1, page 9) images of static electricity references hair standing on end and styrofoam packing peanuts sticking to cat

Activity 1.1 Reading Passage: Support for struggling readers is provided (habits of good readers, read aloud, marking the text)

Activity 3.3, page 41: “If this is a new framework for students, they will likely need help developing their explanations. In particular, students struggle with differentiating between evidence and reasoning. Use student work to find examples that will help the class understand what is expected for claim, evidence and reasoning.”

Activity 4.1, page 14: Optional activity on metric units and scientific notation but it is not described as an extension for students with high interest.

Activity 5.1, page 15: Optional Periodic Table Game, but it is not described specifically as an extension for students with high interest.

Suggestions for improvement:

More specific notes about accommodating marginalized learners and addressing the needs of advanced learners would be helpful and appropriate.

Some could include:

- modified handouts;
- graphic organizers for writing;
- word banks;
- sentence frames;
- sentence stems;
- leveled articles for different readers; and/or
- alternative assignments.

An extension activity could include having students focus on a problem related to electrostatic interactions and designing a solution.

◡ **Specific evidence from materials and review team consensus reasoning:**

	Each investigation includes an overview of the lesson, connection to performance expectation(s), elements of the NGSS, student targets, and background knowledge. Each activity includes a summary of the activity, a learning goal with clarification, points for consideration, and notes that contain what students are and are not expected to provide. **DQs are used for each Investigation and Activity. These questions are continually refined and revisited throughout the progression of activities. At the end of each investigation, the DQ is addressed one final time before moving to the next investigation.** Activity 2.2 Summary: "In Investigation 1, students identified patterns in the way that two charged objects attract and repel each other. Here, students begin to establish the factors that affect the strength of the interaction." Activity 3.1, page 9: "Start by revisiting the DQ board and the driving question for the unit: *Why do some clothes stick together when they come out of the dryer*?" **The DQs and discussion questions provide teachers with strategies for ensuring student sense making in all three dimensions. Teachers are provided with repeated explanations of what a "student model" should include.**
	Suggestions for improvement:
Criterion G.	**Specific evidence from materials and review team consensus reasoning:** **Modeling is supported extensively in the first investigation and then becomes an expectation over time. Students use techniques of "causal mechanisms" and "chains of events." These techniques are seen in simulations and brought to student attention when individual models are shared. The result is that students learn from each other how best to communicate ideas in models and come to consensus about how to represent certain ideas.** Activity 3.3, page 40: "Previously in this unit, students have been asked to make claims and support them with evidence. Now students will be asked to write complete scientific explanations."
	Suggestions for improvement:

	Category III. Monitoring NGSS Student Progress	None	Inadequate	Adequate	Extensive
Unit Criteria	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.				X
	B. **Formative:** Embeds formative assessment processes throughout that evaluate student learning to inform instruction.			X	
	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.			X	
	D. **Unbiased tasks/items**: Assesses student proficiency using methods, vocabulary, representations, and examples that are accessible and unbiased for all students.			X	
	E. **Coherent Assessment system:** Includes pre-, formative, summative, and self-assessment measures that assess three-dimensional learning.			X	
	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				X

(Column group header: Evidence of Quality?)

Category III Rating: **3**

At least adequate evidence for all criteria in the category; extensive evidence for at least one criterion

Criterion A.

Specific evidence from materials and review team consensus reasoning:

Each investigation engages students in three-dimensional sense-making. The construction of models and /or CERs allows for monitoring thinking and progress in each investigation. Teacher Preparation sections for each activity include a chart of the three dimensions, the elements, and an NGSS performance expectation reference.

Suggestions for improvement:

Criterion B.

Specific evidence from materials and review team consensus reasoning:

Formative assessment in the form of discussions, model sharing, probing questions, and model refinement occur regularly. Games are used to reinforce learning at key points.

Student response boxes describe to teachers the possible answers to formative assessment questions. The boxes also give additional lines of questioning based on student responses.

Activity 3.1, page 12: Students read several statements and decide which statement with which they agree. In the teacher support box, teachers are provided with questions to ask the student dependent on their response to further their thinking.

Suggestions for improvement:

	Be explicit about key assessment items. This unit provides a wealth of opportunities for assessment, but it should also identify what learning is critical to make sure students understand before moving on. Consider adding strategies for teachers if, based on the assessments, students would need additional support or re-teaching.
Criterion C.	**Specific evidence from materials and review team consensus reasoning:** **The unit outlines clearly what students should learn and what each model should include. It advises where to give general feedback and avoid evaluation and also includes examples of probing questions designed to illicit the learning in which students are engaged.** • Investigation Overview: Target Model is described as "what should the student's conceptual model include?" • Student Response boxes are provided for each student activity. Boxes provide possible answers from students and suggested teacher responses to those answers, whether correct or incorrect answers.
	Suggestions for improvement: This category would be rated extensive if three-dimensional rubrics for the models and the CER writing pieces were included.
Criterion D.	**Specific evidence from materials and review team consensus reasoning:** **Overall, this unit is unbiased. However, if you work with students who may not have a dryer in their home, the unit phenomena may not provide the same ability for sense-making.**
	Suggestions for improvement: Address the possibility that students may not have experience with the overarching phenomena. Give alternative ideas to teachers to make the phenomena as first-hand as possible.
Criterion E.	**Specific evidence from materials and review team consensus reasoning:** **Opportunities for formative and summative assessment in this unit are pervasive. There are a few examples of pre-assessments and limited examples of self-assessment.** • Pre-Assessment, Activity 3.1, page 6: "The purpose of Activity 3.1 is to encourage students to generate and discuss their initial ideas about the nature of matter."

	• Pre-Assessment, Activity 3.3, page 38: "Draw a model of what you think air would look like if you could zoom in and see its structure and composition, just like you did for the liquids." • Pre-Assessment, Activity 4.1, page 11: "How does your model explain your observations of substances?... The point of this question is to gauge students' current understanding, as well as to foster discussion about how we might learn about atoms and their internal structure."
	Suggestions for improvement: Add a formal pre-assessment for each investigation or for the entire unit. Consider clearly defining assessment items as formative or summative.
Criterion F.	**Specific evidence from materials and review team consensus reasoning:** **Students create models and revisit and revise them extensively. Students are given some peer feedback as well as teacher feedback. Class consensus is called for often and the results of consensus or consensus models are added to the DQ board. Students apply each chunk of learning to the unit driving phenomena often. This provides multiple opportunities for students to demonstrate their three-dimensional learning.** • Activity 1.3: Students create a model of their tape experiment and then build a consensus model as a class. • Activity 1.4: Students design and carry out their own investigation in order to make a claim about the charges of their tape strips. • Activity 1.5: Students improve their models of the pie pan demonstration and participate in a class discussion about why some things stick together and other things do not. • Investigation 2: Students experience several demonstrations and computer simulations and continue to refine and revise their model. Class discussions occur frequently to uncover misconceptions and solidify new learning. • Investigation 3: Students write a claim statement with evidence and reasoning to explain whether or not gas is matter. • Investigation 4: Students study a timeline of the history of the atom, run a computer simulation of the plum pudding model and perform a simple experiment to model the probable location of electrons in an atom.
	Suggestions for improvement:

Summary Comments

Overall, this is an exemplary model of three-dimensional science as evidenced by the rating of extensive in many categories. The strengths of this unit are its coherence due to the selection of an anchoring phenomena and the use of a DQ board and the wealth of information it provides to the instructor in order to carry out lessons that are three-dimensional. The lessons are engaging and are structured in a way that allows learning progression in a way that ultimately helps students make sense of content that is often difficult to master. The reviewers of this unit commend the writers for the obvious time, effort, and attention to NGSS science instruction that went into this unit.

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