Coherence and Alignment Among Science Curriculum, Instruction, and Assessment (CASCIA) Project

Grade 5 Unit 1: Matter and Its Interactions

Interpretive Guidance and Instructional Strategies for Educators

October 2023

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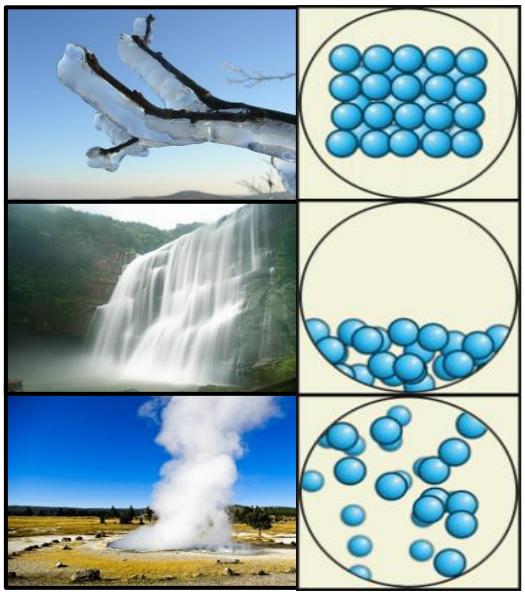
Purpose

The purpose of this document is to help educators understand their students' performance on the Grade 5 Unit 1 Science Assessment and to provide instructional strategies and resources for planning and adjusting instruction to help students learn, whether it involves reteaching previously addressed concepts and skills from the prior instructional unit or planning additional learning opportunities or interventions in the subsequent unit.



Unit Overview

By engaging in this unit, students deepen their knowledge of matter and its properties, physical and chemical changes, and how properties of matter can be investigated and used to describe substances, including the conservation of mass during changes. Students develop their experience and skills by developing models, making observations, and conducting investigations about matter and properties of matter.

Instructions for Educators

1. Based on your analysis of student work from the assessment, in combination with additional assessment evidence gathered over the course of the instructional unit, consider themes or trends in your students' performance. Refer to your students' scores on the Classroom Roster Report to determine the degree to which students in your classroom require additional instructional support based on their instructional needs levels—red, yellow, or green—for each performance category.
2. For each performance category, use the provided interpretive guidance (i.e., *What These Results Mean*, *Next Instructional Steps*, and *Example Scored and Annotated Student Work* located in the Grade 5 Unit 1 EOU Assessment Scoring Guide) to understand what your students likely know and are able to do and to consider next instructional steps based on their instructional needs levels. Scored and annotated student work samples are provided for each performance category to demonstrate the evidence students might demonstrate in response to each prompt for each possible score point. The student responses represent the full range of score points possible for each prompt based on the scoring rubric.
3. For each performance category, use the *Instructional Strategies and Resources* organized by Universal Design for Learning (UDL) principle to support the design and delivery of accessible instruction and learning opportunities for all students based on their performance on the Grade 5 Unit 1 Assessment and their recommended instructional needs. These instructional recommendations can be selected and used to intentionally plan instruction and learning opportunities for students across the range of instructional needs levels (i.e., red, yellow, green).

Universal Design For Learning

The instructional strategies and resources provided in this document are organized by the Universal Design for Learning (UDL) principles. UDL is a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn." (CAST, 2022). Taking time to reflect on prior instruction when planning for accessible, differentiated, and culturally responsive instruction for diverse learners and culturally diverse classrooms serves to identify ways to improve future instructional practices. The UDL Guidelines provide a framework for this reflection. The guidelines include three principles, Multiple Means of Engagement, Multiple Means of Representation, and Multiple Means of Action & Expression as ways to focus on variety and flexibility in instructional practices.

Multiple Means of Engagement	*The WHY of Learning* - provide options for recruiting student interest, sustaining effort, and promoting motivation
Multiple Means of Representation	*The WHAT of Learning* - provide options for displaying information, including alternatives for auditory and visual information, use multi-media, clarify vocabulary and symbols, support comprehending text, and guide information processing and visualization
Multiple Means of Action & Expression	*The HOW of Learning* – vary the methods for student responses and collection of evidence of their learning, optimize access to tools and technologies, use multiple tools for construction and composing responses, facilitate managing information and resources, and enhance student capacity for monitoring progress

By examining instruction and instructional materials through the lens of each of these principles, we can identify and thus reduce or remove barriers to diverse learners to promote accessible and equitable teaching and learning opportunities. Application of UDL guidelines and principles allows all students to engage with and be provided with multiple means of representing instructional content and expressing what they know and can do which is similarly the purpose of the use of accommodations for students receiving special education, students who have a 504 plan, and emerging Bilinguals.

Performance Category 1: Model the Structure of Matter

Interpretive Guidance for Performance Category 1: Model the Structure of Matter *Task 1, Prompt 1, (5 points); Task 2 Prompt 1 (5 points)*		
Red (0-4 score points earned) ➢ Extensive additional instruction and reteaching of these skills is recommended. ➢ The student needs significant opportunities to reinforce and apply these skills in future learning.	**Yellow (5-7 score points earned)** ➢ Moderate additional instruction on these skills is recommended. ➢ The student needs additional opportunities to strengthen these skills in future learning.	**Green (8-10 score points earned)** ➢ **Minimal to no** additional instruction on these skills is recommended. ➢ The student is ready to extend these skills in future learning.
What These Results Mean		
This student is likely able to: • Present **incomplete and/or inaccurate** representations of molecules in various phases including relative particle arrangement and spacing. • Use the model to develop i**ncomplete and largely inaccurate** explanations of macro-phenomena resulting from the bulk movement and rearrangement of particles too small to be seen. • Demonstrate **partial** understanding of the relationship between microscopic properties of materials such as particle size, arrangement, and spacing, and **show limited understanding** of how these affect macroscopic properties of the same materials such as visibility and the ability to hold shape.	**This student is likely able to:** • Present **clear and complete** representations **with minor errors or omissions** of molecules in various phases including relative particle arrangement and spacing. • Use the model to develop i**ncomplete** but **accurate** explanations of macro-phenomena resulting from the bulk movement and rearrangement of particles too small to be seen. • Demonstrate **partial** understanding of the relationship between microscopic properties of materials such as particle size, arrangement, and spacing, and **apply some of these concepts** to describe macroscopic properties of the same materials such as visibility and the ability to hold shape.	**This student is likely able to:** • Present **clear, complete**, and **accurate** representations of molecules in various phases including relative particle arrangement and spacing. • Use the model to develop **thorough** and **accurate** explanations of macro-phenomena resulting from the bulk movement and rearrangement of particles too small to be seen. • Demonstrate **complete and accurate** understanding of the relationship between microscopic properties of materials such as particle size, arrangement, and spacing, and macroscopic properties of the same materials such as visibility and the ability to hold shape.

Interpretive Guidance for Performance Category 1: Model the Structure of Matter *Task 1, Prompt 1, (5 points); Task 2 Prompt 1 (5 points)*		
Red (0-4 score points earned) ➢ Extensive additional instruction and reteaching of these skills is recommended. ➢ The student needs significant opportunities to reinforce and apply these skills in future learning.	**Yellow (5-7 score points earned)** ➢ Moderate additional instruction on these skills is recommended. ➢ The student needs additional opportunities to strengthen these skills in future learning.	**Green (8-10 score points earned)** ➢ **Minimal to no** additional instruction on these skills is recommended. ➢ The student is ready to extend these skills in future learning.
Next Instructional Steps		
Provide opportunities for the student to: • Select the most accurate and complete particle model of a macrophenomenon from a range of models. • Select the most accurate and complete explanation of a macrophenomenon from a range of explanations. • Collaboratively critique and revise incomplete or inaccurate models and/or explanations of particle movement and rearrangement that leads to a macrophenomenon.	**Provide opportunities for the student to:** • From a given model, develop a complete and accurate explanation of a macrophenomenon resulting from the bulk movement and rearrangement of particles too small to be seen. • Complete a partial model to support an explanation. • Identify and use multiple representations of particles too small to be seen. • Evaluate the strength of a provided model and/or explanation based on the relationship between the microscopic properties of particles and the macroscopic properties of the same materials.	**Provide opportunities for the student to:** • Compare and refine models of a wide range of macro-phenomena due to various influences on particle spacing, movement, and rearrangement. • With and without using models, compare and refine explanations of a wide range of macro-phenomena focusing on the generalizability of various influences on particle spacing, movement, and rearrangement.

Instructional Strategies and Resources for Performance Category 1: Model the Structure of Matter *Task 1, Prompt 1, (5 points); Task 2 Prompt 1 (5 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	***Modeling through Discourse*** Provide varied opportunities (stations, small groups, partners, whole class) for students to engage in interactive discourse where they build on others' ideas to optimize the use of a range of models to show relationships among variables or represent analogies and/or abstract concepts to describe a scientific principle or design solution. Opportunities for scientific discourse should be situated in authentic, interest-driven science investigations. ***Culturally Responsive Modeling*** Foster model-development practices that are culturally responsive, drawing from and respecting students' cultural resources, backgrounds, and personal experiences. Provide a range of ways for students to engage in cooperative learning (e.g., think-pair-share, jigsaw, round robin) with diverse groupings of students.	• Talk Activities Flowchart – This flowchart can help structure activities so that students' talk is more equitable, scientific, and focused on sensemaking in support of a classroom culture based on curiosity and learning. [https://stemteachingtools.org/sp/talk-flowchart] • Lifting with Air Video – This video can be used to support students' observations and discussions of evidence that supports the idea that air is matter. [https://nebraskapublicmedia.pbslearningmedia.org/resource/phy03.sci.phys.matter.zlift/lifting-with-air/] • Matter and Change – The various videos (accompanied by text) and simulations encourage discourse about matter and how it changes. [https://www.labxchange.org/library/pathway/lx-pathway:14fc26bf-b721-4902-bf62-1286021a0afc?source=/library/clusters/lx-cluster:ChemistryResources] • STEM Teaching Tools – Practice Brief 55 – This article explains why it is crucial to make cultural diversity visible in STEM education. [https://stemteachingtools.org/brief/55] • STEM Teaching Tools – Practice Brief 48 – This article discusses how teachers can use tools to scaffold student science talk and includes Talk Resource Tools to foster shifts in science classroom talk. [https://stemteachingtools.org/brief/48]

Instructional Strategies and Resources for Performance Category 1: Model the Structure of Matter *Task 1, Prompt 1, (5 points); Task 2 Prompt 1 (5 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	***Modeling and Critiquing Scientific Models*** Use spoken and written examples to model how to evaluate and refine models comparing predictions with the real world and encourage students to adjust and refine the model by identifying strengths and weaknesses in the model to explain that natural objects exist from the very small to the immensely large.	• Molecules of Water in Different States Simulation – This simulation can be viewed and discussed by students to explain how the particles of water change as the states of matter change. [https://nebraskapublicmedia.pbslearningmedia.org/resource/arct15-sci-meltingboiling/melting-and-boiling-simulation/] • Matter Compilation: Crash Course Kids – This YouTube video addresses the states of matter and the principles of each state. [https://www.youtube.com/watch?v=wyRy8kowyM8] • How to Teach Scientific Models – These strategies offer guidance about how to explicitly teach and critique scientific models. [https://edu.rsc.org/feature/how-to-teach-scientific-models/3010560.article]
	***Promoting Engagement through Interactive, Collaborative Games*** Use interactive games and collaborative formats to reinforce disciplinary core ideas related to science ideas about a phenomenon demonstrating that matter of any type can be subdivided into particles that are too small to see.	• Properties of Matter: Matter's Physical Properties PBS Science – These science video games related to the properties of matter can be shared via Google Classroom. [https://alaskapublic.pbslearningmedia.org/resource/52c952e6-d70c-44b2-915d-c2a11dd0190f/properties-of-matter-matters-physical-properties-unctv-science/] • States of Matter Basics – This interactive video can help students learn and describe characteristics of three states of matter: solid, liquid, and gas. Students can predict how varying the temperature or pressure would change the behavior of particles by watching the videos. [https://phet.colorado.edu/sims/html/states-of-matter-basics/latest/states-of-matter-basics_en.html]

Instructional Strategies and Resources for Performance Category 1: Model the Structure of Matter *Task 1, Prompt 1, (5 points); Task 2 Prompt 1 (5 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		• States of Matter Games – This website includes interactive games on the states of matter [https://www.sciencekids.co.nz/gamesactivities/gases.html]

	*Vocabulary*
	Provide varied opportunities for students to learn and apply vocabulary in diverse situations and contexts. Vocabulary retention improves when academic terminology is layered on conceptual understanding. To maximize vocabulary building, support students in building conceptual understanding and then apply the academic terminology using the strategies outlined below.
	• Build understanding of domain-specific vocabulary using a multi-sensory approach or having students participate in simulations.
	• Make connections between vocabulary and real-life or future opportunities.
	  ○ Explain, describe, give real-world examples, or provide concrete representations of vocabulary words rather than formal definitions. Vocabulary.com (see Resources) provides explanations of words using real-world examples. Once signed in, an educator can create word lists for students.
	  ○ Build a vocabulary word wall that students can add to and reference during instruction and self-guided activities or tasks.
		• STEM Teaching Tools – Practice Brief 66 – This article discusses how to support emerging multilingual learners as they develop language that interprets and explains phenomena. [https://stemteachingtools.org/brief/66]
		• Vocabulary.com – This site provides explanations of words using real-world examples. Once signed in, an educator can create word lists for students. [https://www.vocabulary.com/]
		• Text Project – Word Pictures – This site provides Word Pictures that are free for educators to use. Their site includes word pictures for core vocabulary and various content areas including science and social studies. [https://textproject.org/archive/textproject-word-pictures/]
		• The Science Penguin – This website provides ideas to teach science vocabulary. The vocabulary demonstration activity uses real objects to teach vocabulary terms. [http://thesciencepenguin.com/2013/12/science-solutions-vocabulary.html]
		• Interactive Word Walls Enliven Vocab Learning – This article with teaching strategies supports students' use of a word wall to build understanding of key vocabulary.

Instructional Strategies and Resources for Performance Category 1: Model the Structure of Matter *Task 1, Prompt 1, (5 points); Task 2 Prompt 1 (5 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	○ Have students restate the vocabulary word in their own words. Take this opportunity to help students connect new vocabulary, especially general vocabulary, to prior knowledge. • Read books or watch video related to vocabulary words and concepts. • Sort words, photographs, or concrete representations into categories. Text Project (see Resources) provides Word Pictures that are free for educators to use. It includes Word Pictures for core vocabulary and various content areas, including science and social studies. • Pre-teach vocabulary and symbols, especially in ways that promote connection to the learners' experience and prior knowledge. • Define domain-specific vocabulary using both domain-specific and common terms. • Embedded visual, non-linguistic supports for vocabulary clarification (pictures, videos, etc.). • Have students create their own glossary of terms.	[https://www.middleweb.com/37209/interactive-word-walls-enliven-vocab-learning/]

Instructional Strategies and Resources for Performance Category 1: Model the Structure of Matter *Task 1, Prompt 1, (5 points); Task 2 Prompt 1 (5 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	*Presenting Information in Different Modalities* Provide information using a variety of multimedia (e.g., videos, interactives, simulations), informational texts, and formats to teach and reinforce disciplinary core ideas related to a phenomenon demonstrating that matter of any type can be subdivided into particles that are too small to see.	• Matter and Its States – This video addressing the states of matter can be shared with students to support their understanding of the concept of matter. [https://www.youtube.com/watch?v=SYB2MPJ2Il4] • American Chemical Society – Matter is Made of Tiny Particles – In this lesson, students develop a model to describe that matter is made up of tiny particles too small to be seen. Students use their model to describe the differences in attraction among the particles of a solid, liquid, and gas. [https://www.acs.org/education/resources/k-8/inquiryinaction/fifth-grade/chapter-1-investigating-matter-at-the-particle-level/matter-is-made-of-tiny-particles.html#:~:text=Solids%2C%20liquids%2C%20and%20gases%20are%20made%20of%20tiny,as%20much%20as%20they%20are%20in%20a%20solid.]
	*Scaffolds for Communicating through Models* Provide scaffolds for developing models to provide evidence to explain a phenomenon or support a design solution (e.g., sentence frames, graphic organizers, norms for whole class discussion, roles for students during small group activities) to support communicating in science-specific ways that may seem unnatural for students.	• National Science Foundation – Tools for Ambitious Science Teaching – This site discusses a tool that provides scaffolds for writing that support learners in constructing explanations with evidence. These take the form of sentence frames, guides for how to help English learners practice final explanations, norms for whole class discussion that are developed by students, roles that students can take in small group activities, and others. [https://ambitiousscienceteaching.org/scaffolding-students-written-explanations/]

Instructional Strategies and Resources for Performance Category 1: Model the Structure of Matter *Task 1, Prompt 1, (5 points); Task 2 Prompt 1 (5 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		• Model Teaching – CER Checklist and Graphic Organizer – This site provides an introduction to Claim-Evidence-Reasoning (CER) and downloadable resources and writing templates. [https://www.modelteaching.com/education-articles/writing-instruction/claim-evidence-reasoning-cer]
	*Expressing Learning in Multiple Modalities* Provide multiple, flexible options for students to communicate their models and learning in class. • Use technologies that facilitate student participation and communication, such as discussion boards, podcasts, or blogs. • Allow students to choose a multi-modal project they would like to complete to demonstrate their learning, such as a poster presentation, debate, short film, lab report, blog, infographic, drawing, poetry, writing and performing a song, creating a game, etc. • Provide a variety of ways in which students can "write" to respond to questions (e.g., traditional form of writing, with sentence starters, using pictures, etc.)	• Properties of Matter – This website provides information about how to teach states of matter with inquiry. Each unit contains media resources, activities, questions, special features, and teacher resources for use in the classroom. [https://manoa.hawaii.edu/exploringourfluidearth/chemical/matter/properties-matter] • STEM Teaching Tools – Multiple Means of Action and Expression – This article provides considerations for engaging students through multiple means of action and expression. [https://stemteachingtools.org/sp/multiple-means-of-action-and-expression]

Performance Category 2: Use Observations and Measurements of Properties of Matter

Interpretive Guidance for Performance Category 2: Use Observations and Measurements of Properties of Matter *Task 1, Prompts 2 & 3, (6 points); Task 2, Prompts 2 & 3 (5 points)*		
Red (0-3 score points earned) ➢ Extensive additional instruction and reteaching of these skills is recommended. ➢ The student needs significant opportunities to reinforce and apply these skills in future learning.	**Yellow (4-7 score points earned)** ➢ Moderate additional instruction on these skills is recommended. ➢ The student needs additional opportunities to strengthen these skills in future learning.	**Green (8-11 score points earned)** ➢ **Minimal to no** additional instruction on these skills is recommended. ➢ The student is ready to extend these skills in future learning.
What These Results Mean		
This student is likely able to: • Determine **few relevant** observations of the properties of a given substance needed to determine its identity. • Suggest experimental conditions that **demonstrate a limited understanding** of how observations of properties can determine the identity of unknown substances. • **Inaccurately or inconsistently** determine the identity of an unknown substance. • Present **partial, irrelevant, or inaccurate** evidence to support the identification of a particular substance.	**This student is likely able to:** • Determine **some relevant** observations of the properties of a given substance needed to determine its identity. • Suggest **appropriate** experimental conditions to elicit data needed to determine the identity of an unknown substance **about half of the time**. • Utilize data from observations to determine the identity of an unknown substance **about half of the time**. • Present **some relevant** evidence to support the identification of a particular substance.	**This student is likely able to:** • Determine **convincing, valid, and reliable** observations of the properties of a given substance needed to determine its identity. • Design **appropriate and systematic** experimental conditions to elicit data needed to determine the identity of an unknown substance. • Utilize data from observations to **consistently and accurately** determine the identity of an unknown substance. • **Consistently** present **convincing, valid, and reliable** evidence to support the identification of a particular substance.

Interpretive Guidance for Performance Category 2: Use Observations and Measurements of Properties of Matter *Task 1, Prompts 2 & 3, (6 points); Task 2, Prompts 2 & 3 (5 points)*		
Red (0-3 score points earned) ➢ Extensive additional instruction and reteaching of these skills is recommended. ➢ The student needs significant opportunities to reinforce and apply these skills in future learning.	**Yellow (4-7 score points earned)** ➢ Moderate additional instruction on these skills is recommended. ➢ The student needs additional opportunities to strengthen these skills in future learning.	**Green (8-11 score points earned)** ➢ **Minimal to no** additional instruction on these skills is recommended. ➢ The student is ready to extend these skills in future learning.
Next Instructional Steps		
Provide opportunities for the student to: • Match a list of observations with the type of evidence each elicits. • Identify an investigation that will produce relevant data it is designed to elicit. • Describe general evidence to be used to support the identification of an unknown substance. • Identify data collection procedures that will produce relevant data and/or evidence to answer a question related to the properties of matter.	**Provide opportunities for the student to:** • Evaluate the strength of a claim about the identity of an unknown substance based on relevant observations and the appropriateness of experimental conditions for data collection. • Evaluate the relevance of evidence in identifying an unknown substance based on what is needed to determine its identity. • Collaboratively critique and revise an inappropriate or incomplete experimental procedure to elicit the evidence needed to identify an unknown substance. • Design an investigation and explain the variables (dependent, independent, and control) in an investigation related to the properties of matter.	**Provide opportunities for the student to:** • Expand the type of data utilized to determine the identity of an unknown substance (color, odor, density, melting temperature, boiling temperature, and solubility). • Justify the selection of the tools/instruments and types of measurements that will produce relevant data to answer a question about properties of matter. • Compare results across experiments with different data for the same substance.

Instructional Strategies and Resources for Performance Category 2: Use Observations and Measurements of Properties of Matter *Task 1, Prompts 2 & 3 (6 points); Task 2, Prompts 2 & 3 (5 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	*Data Analysis Through Discourse* Provide varied opportunities (stations, small groups, partners, whole class) for students to engage in interactive discourse where they build on each other's' ideas to optimize the use of a range of tools for tabulation, graphical representation, visualization, and statistical analysis to analyze and interpret data. Opportunities for scientific discourse should be situated in authentic, interest-driven science investigations. *Culturally Responsive Use of Data* Foster data interpretation and informed design decisions that are culturally responsive, drawing from and respecting students' cultural resources, backgrounds, and personal experiences. Provide a range of ways for students to engage in cooperative learning (e.g., think-pair-share, jigsaw, round robin) with diverse groupings of students.	• Talk Activities Flowchart – This flowchart can help structure activities so that students' talk is more equitable, scientific, and focused on sensemaking in support a classroom culture focused on curiosity and learning. [https://stemteachingtools.org/sp/talk-flowchart] • Teacher and Student Discourse Tool – The first page of this tool helps teachers guide student discourse in the classroom. The second page of this tool helps students engage in discourse with each other in the classroom. [https://ngss.nsta.org/Resource.aspx?ResourceID=686] • STEM Teaching Tools – Practice Brief 55 – This article explains why it is crucial to make cultural diversity visible in STEM education. [https://stemteachingtools.org/brief/55] • STEM Teaching Tools – Practice Brief 48 – Teachers can use tools to scaffold student science talk. This Practice Brief includes Talk Resource Tools to foster shifts in science classroom talk. [https://stemteachingtools.org/brief/48]
	*Modeling and Critiquing Scientific Investigations* Use spoken and written examples to model scientific investigations and encourage students to evaluate and refine data collection strategies and mathematical analyses by identifying strengths and weaknesses in the investigation design and the data to be generated.	• Classroom Text Read Aloud – Read the text, What's the Matter in Mr. Whisker's Room?, by Michael Elsohn Ross and ask students to discuss in small groups the investigations presented in the text and determine how the data collection techniques could be refined. [https://ngss.nsta.org/Resource.aspx?ResourceID=363] • Student Investigation – from the American Chemical Society. Students plan and carry out an investigation to identify a liquid

Instructional Strategies and Resources for Performance Category 2: Use Observations and Measurements of Properties of Matter *Task 1, Prompts 2 & 3 (6 points); Task 2, Prompts 2 & 3 (5 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		based on how it interacts on different paper surfaces. Students collect qualitative data and use their observations to identify an unknown liquid. [https://www.acs.org/education/resources/k-8/inquiryinaction/fifth-grade/substances-have-characteristic-properties/lesson2-2--identifying-an-unknown-liquid.html] • NSTA Article – What Makes A Great Science Investigation? – An article for teacher background. Includes higher-level thinking questions to guide evaluation and discussion of investigations. [https://www.nsta.org/science-and-children/science-and-children-mayjune-2022/q-what-makes-great-science-investigation#:~:text=A%3A%20A%20great%20science%20investigation,the%20concept%20to%20new%20situations]
	***Promoting Engagement through Interactive, Collaborative Games*** Use interactive games and collaborative formats to reinforce disciplinary core ideas related to science ideas about using the structure and properties of matter to identify unknown materials.	• Crime Scene Soil Investigation – An investigation in which students use properties of matter to solve the mystery of Billy's stolen bike. *This resource is free for NSTA members. [https://ngss.nsta.org/Resource.aspx?ResourceID=732] • Properties of Matter Interactive Game - This interactive game could be engaging for students who need extra support with identifying properties and how properties relate to uses of materials. [https://www.sciencekids.co.nz/gamesactivities/materialproperties.html] • Building Collaboration – This article introduces 10 strategies for encouraging the success of collaborative learning.

Instructional Strategies and Resources for Performance Category 2: Use Observations and Measurements of Properties of Matter *Task 1, Prompts 2 & 3 (6 points); Task 2, Prompts 2 & 3 (5 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		[https://gsehd.gwu.edu/articles/10-strategies-build-student-collaboration-classroom]

	*Vocabulary*
	Provide varied opportunities for students to learn and apply vocabulary in diverse situations and contexts. Vocabulary retention improves when academic terminology is layered on conceptual understanding. To maximize vocabulary building, support students in building conceptual understanding and then apply the academic terminology using the strategies outlined below.
	• Build understanding of domain specific vocabulary using a multi-sensory approach or having students participate in simulations.
	• Make connections between vocabulary and real-life or future opportunities.
	  ○ Explain, describe, give real-world examples, or provide concrete representations of vocabulary words rather than formal definitions. Vocabulary.com (see Resources) provides explanations of words using real-world examples. Once signed in, an educator can create word lists for students.
	  ○ Build a vocabulary word wall that students can add to and reference during instruction and self-guided activities or tasks.
		• STEM Teaching Tools – Practice Brief 66 – This article relates to supporting emerging multilingual learners as they develop language that interprets and explains phenomena. [https://stemteachingtools.org/brief/66]
		• STEM Teaching Tools – Word Catchers – Word Catchers are designed to help students, especially multilingual learners, develop and use science- and phenomena-related words and phrases that support their sensemaking. [https://stemteachingtools.org/assets/landscapes/WordCatchers.pdf]
		• Vocabulary.com – This site provides explanations of words using real-world examples. Once signed in, an educator can create word lists for students. [https://www.vocabulary.com/]
		• Text Project – Word Pictures – This site provides Word Pictures that are free for educators to use. Their site includes word pictures for core vocabulary and various content areas including science and social studies. This link will take you to the Word Pictures page where you can select the category of words you want to use. [http://textproject.org/classroom-materials/textproject-word-pictures/]

Instructional Strategies and Resources for Performance Category 2: Use Observations and Measurements of Properties of Matter *Task 1, Prompts 2 & 3 (6 points); Task 2, Prompts 2 & 3 (5 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	○ Have students restate the vocabulary word in their own words. Take this opportunity to help students connect new vocabulary, especially general vocabulary, to prior knowledge. • Read books or watch video related to vocabulary words and concepts. • Sort words, photographs, or concrete representations into categories. Text Project (see Resources) provides Word Pictures that are free for educators to use. It includes Word Pictures for core vocabulary and various content areas, including science and social studies. • Pre-teach vocabulary and symbols, especially in ways that promote connection to the learners' experience and prior knowledge. • Define domain-specific vocabulary using both domain-specific and common terms. • Embedded visual, non-linguistic supports for vocabulary clarification (pictures, videos, etc.). • Have students create their own glossary of terms.	• The Science Penguin – The Science Penguin site provides ideas to teach science vocabulary. The vocabulary demonstration activity uses real objects to teach vocabulary terms. [http://thesciencepenguin.com/2013/12/science-solutions-vocabulary.html] • Interactive Word Walls Enliven Vocab Learning – This article has teaching strategies to support students' use of a word wall to build understanding of key vocabulary. [https://www.middleweb.com/37209/interactive-word-walls-enliven-vocab-learning/]

Instructional Strategies and Resources for Performance Category 2: Use Observations and Measurements of Properties of Matter *Task 1, Prompts 2 & 3 (6 points); Task 2, Prompts 2 & 3 (5 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	***Presenting Information in Different Modalities*** Provide information using a variety of multimedia (e.g., videos, interactives, simulations), informational texts, and formats to teach and reinforce disciplinary core ideas related to using the structure and properties of matter to identify unknown materials.	• Wonder of Science – This video has interactive "Thinking Slides". Students identify systems, components, and physical quantities to reinforce data collection and analysis of properties of a material or system that can be measured. [https://docs.google.com/presentation/d/1z6CHxzVlezSr8tEVdAnx9usUnmAGMzqS7oViJLl28Xo/template/preview] • Mystery Powder Lab Video Investigation Part 1 and Part 2 – Part 1 shows an investigation to determine properties of white substances when mixed with different liquids and heated. Part 2 shows an investigation to identify two mystery substances using the properties identified in the Part 1 investigation. [https://www.youtube.com/watch?v=Qc3ypSs00Ks] [https://www.youtube.com/watch?v=s9xcuSZrNAg] • Materials and Their Properties, Choosing the Right Material For the Job – This YouTube video shows how properties of materials are used to select the best material for a specific purpose. [https://www.youtube.com/watch?v=FMFlksv25GA]
	***Scaffolds for Communicating Using Observations and Measurements*** Provide scaffolds for designing investigations to provide evidence to explain a phenomenon or support a design solution (e.g., sentence frames, graphic organizers, norms for whole class discussion, roles for students during small group activities) to support communicating in science-specific ways that may seem unnatural for students.	• National Science Foundation – Tools for Ambitious Science Teaching – This site discusses a tool that provides scaffolds for writing that support learners in constructing explanations with evidence. These take the form of sentence frames, guides for how to help English learners practice final explanations, norms for whole class discussion that are developed by students, roles that students can take in small group activities, and others.

Instructional Strategies and Resources for Performance Category 2: Use Observations and Measurements of Properties of Matter *Task 1, Prompts 2 & 3 (6 points); Task 2, Prompts 2 & 3 (5 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		[https://ambitiousscienceteaching.org/scaffolding-students-written-explanations/] • Model Teaching – CER Checklist and Graphic Organizer – This site provides an introduction to Claim-Evidence-Reasoning (CER) and downloadable resources and writing templates. [https://www.modelteaching.com/education-articles/writing-instruction/claim-evidence-reasoning-cer] • Wonder of Science "Patterns of Material Properties" – This is a graphic organizer. Provide a scaffold for recording observational data and then could be used to identify patterns and analyze data. [https://static1.squarespace.com/static/59c3bad759cc68f757a465a3/t/5e18aa7e766381076cfa2d52/1578674814985/5-PS1-3+Material+Properties++%28Student+Version%29.pdf] • Sentence Starters vs Sentence Frames – This YouTube video for teachers describes the difference between sentence frames and starters with guidance on when to use them, based on the goal of the writing/speaking task. [https://www.youtube.com/watch?app=desktop&v=6LI6V8jxbXc]
	*Expressing Learning in Multiple Modalities* Provide multiple, flexible options for students to communicate their investigation designs and quantitative measurement methods and learning in class.	• Presenting findings of Student Investigation from the American Chemical Society – Students collect qualitative data and will use their observations to identify an unknown liquid. [https://www.acs.org/education/resources/k-

Instructional Strategies and Resources for Performance Category 2: Use Observations and Measurements of Properties of Matter *Task 1, Prompts 2 & 3 (6 points); Task 2, Prompts 2 & 3 (5 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	• Use technologies that facilitate student participation and communication, such as discussion boards, podcasts, or blogs. • Allow students to choose a multi-modal project they would like to complete to demonstrate their learning, such as a poster presentation, debate, short film, lab report, blog, infographic, drawing, poetry, writing and performing a song, creating a game, etc. • Provide a variety of ways in which students can "write" to respond to questions (e.g., traditional form of writing, with sentence starters, using pictures, etc.)	8/inquiryinaction/fifth-grade/substances-have-characteristic-properties/lesson2-2--identifying-an-unknown-liquid.html] • STEM Teaching Tools - Article - Considerations for engaging students through multiple means of action and expression. [https://stemteachingtools.org/sp/multiple-means-of-action-and-expression] • Lab Report Templates – These templates can be downloaded as is or can provide ideas for creating your own. Students could use this as a structure for communicating their findings. [https://www.science-sparks.com/science-experiment-templates/]

Performance Category 3: Use Observations and Measurements of Chemical Reactions

Interpretive Guidance for Performance Category 3: Use Observations and Measurements of Chemical Reactions *Task 3, Prompt 1 (3 points); Task 3, Prompt 2 (4 points)*		
Red (0-3 score points earned) ➢ Extensive additional instruction and reteaching of these skills is recommended. ➢ The student needs significant opportunities to reinforce and apply these skills in future learning.	**Yellow (4-5 score points earned)** ➢ Moderate additional instruction on these skills is recommended. ➢ The student needs additional opportunities to strengthen these skills in future learning.	**Green (6-7 score points earned)** ➢ **Minimal to no** additional instruction on these skills is recommended. ➢ The student is ready to extend these skills in future learning.
What These Results Mean		
This student is likely able to: • Attempt to determine if a new substance has been formed, with **varying results**. • Present **partial, inaccurate, or irrelevant** qualitative evidence to make a conclusion about the formation of a new substance. • **Attempt to represent** provided data in a graph. • Provide **little relevant** quantitative data to support an **incomplete or inaccurate** explanation of the conservation of mass before and after mixing substances, no matter the change in properties.	**This student is likely able to:** • Utilize data to determine if a new substance has been formed, with **varying results**. • Present **valid and reliable** qualitative evidence to make a conclusion about the formation of a new substance. • **Attempt to represent** provided data in a graph. • Provide **some relevant** quantitative data to support a **reasonable** explanation of the conservation of mass before and after mixing substances, no matter the change in properties.	**This student is likely able to:** • Utilize data to **accurately** determine if a new substance has been formed. • Present **convincing, valid, and reliable** qualitative evidence to **support an accurate** conclusion about the formation of a new substance. • **Accurately represent** provided data in a graph, using **simple computational thinking** as necessary. • Provide quantitative data to support a **complete and accurate** explanation of the conservation of mass before and after mixing substances, no matter the change in properties.

Interpretive Guidance for Performance Category 3:
Use Observations and Measurements of Chemical Reactions

Task 3, Prompt 1 (3 points); Task 3, Prompt 2 (4 points)

Red (0-3 score points earned)	Yellow (4-5 score points earned)	Green (6-7 score points earned)
➢ Extensive additional instruction and reteaching of these skills is recommended. ➢ The student needs significant opportunities to reinforce and apply these skills in future learning.	➢ Moderate additional instruction on these skills is recommended. ➢ The student needs additional opportunities to strengthen these skills in future learning.	➢ **Minimal to no** additional instruction on these skills is recommended. ➢ The student is ready to extend these skills in future learning.
Next Instructional Steps		
Provide opportunities for the student to: • Match conclusions about the formation of a new substance with qualitative data gathered while mixing two substances. • Identify qualitative evidence to make a conclusion about the formation of a new substance. • Represent provided data in a mostly completed graph. • Identify inaccurate or irrelevant evidence (e.g., data) to support an explanation about the formation of a new substance or the conservation of mass.	**Provide opportunities for the student to:** • From a list of conclusions, identify the most accurate statements using qualitative data related to the formation of a new substance to justify their selection. • From a list of qualitative data with varying degrees of relevance, identify the most relevant pieces of data to support an explanation about the formation of a new substance or the conservation of mass. • Represent provided data in a graph that has been started.	**Provide opportunities for the student to:** • Evaluate the limitations of the data analysis (e.g., measurement error) and identify implications for the findings related to the conservation of mass before and after mixing substances. • Use detailed and multiple sources of evidence (e.g., data) to make well-supported scientific claims about the formation of a new substance or the conservation of mass. • Accurately represent self-collected data in a graph using simple computational thinking as necessary. • Design an experiment to determine if a new substance is formed, focusing on gathering quantitative data to illustrate the conservation of mass.

Instructional Strategies and Resources for Performance Category 3: Use Observations and Measurements of Chemical Reactions

Task 3, Prompt 1 (3 points); Task 3, Prompt 2 (4 points)

Instructional Strategies and Resources

	Teaching Strategies	***Resources***
	*Data Analysis Through Discourse* Provide varied opportunities (stations, small groups, partners, whole class) for students to engage in interactive discourse where they build on others' ideas in the use of a range of tools for tabulation, graphical representation, visualization, and statistical analysis to analyze and interpret data. Opportunities for scientific discourse should be situated in authentic, interest-driven science investigations. *Culturally Responsive Use of Data* Foster data interpretation and informed design decisions that are culturally responsive, drawing from and respecting students' cultural resources, backgrounds, and personal experiences. Provide a range of ways for students to engage in cooperative learning (e.g., think-pair-share, jigsaw, round robin) with diverse groupings of students.	• Talk Activities Flowchart – This flowchart can help structure activities so that students' talk is more equitable, scientific, and focused on sensemaking in support a classroom culture based on curiosity and learning. [https://stemteachingtools.org/sp/talk-flowchart] • STEM Teaching Tools – Practice Brief 55 – This article explains why it is crucial to make cultural diversity visible in STEM education. [https://stemteachingtools.org/brief/55] • Teacher and Student Discourse Tool – The first page of this tool helps teachers guide student discourse in the classroom. The second page of this tool helps students engage in discourse with each other in the classroom. [https://ngss.nsta.org/Resource.aspx?ResourceID=686] • Barfing Pumpkin Video – This video supports students' discussions about whether they think a chemical reaction occurred and the evidence that they have to support their conclusion. [https://nebraskapublicmedia.pbslearningmedia.org/resource/odc08.scitech.matter-energy.barfingpumpkin/barfing-pumpkin/] • STEM Teaching Tools – Practice Brief 48 – This article discusses how teachers can use tools to scaffold student science talk and includes Talk Resource Tools to foster shifts in science classroom talk. [https://stemteachingtools.org/brief/48]

Instructional Strategies and Resources for Performance Category 3: Use Observations and Measurements of Chemical Reactions *Task 3, Prompt 1 (3 points); Task 3, Prompt 2 (4 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		• Sponge Candy: Chemistry Video – This video is about the role of baking soda in candy making and supports students' observations and discussions of chemical reactions. [https://nebraskapublicmedia.pbslearningmedia.org/resource/fe3c3f0f-fa71-4f02-aeea-de2693f2c564/sponge-candy-chemistry-video-compact-science/]
	***Modeling Scientific Investigations*** Use spoken and written examples to model scientific investigations and encourage students to evaluate and refine data collection strategies and mathematical analyses by identifying strengths and weaknesses in the investigation design and the data to be generated.	• American Chemical Society – Conservation of Mass – This lesson engages students in an investigation to take measurements showing that whether the process involves a change of state, dissolving, or a chemical reaction, the total mass of the substances does not change. [https://www.acs.org/education/resources/k-8/inquiryinaction/fifth-grade/chapter-4/conservation-of-mass.html] • NSTA Article – What Makes A Great Science Investigation? - This article offers educators information about how to use higher-level thinking questions to guide evaluation and discussion of investigations. [https://www.nsta.org/science-and-children/science-and-children-mayjune-2022/q-what-makes-great-science-investigation#:~:text=A%3A%20A%20great%20science%20investigation,the%20concept%20to%20new%20situations.]

Instructional Strategies and Resources for Performance Category 3: Use Observations and Measurements of Chemical Reactions *Task 3, Prompt 1 (3 points); Task 3, Prompt 2 (4 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	***Promoting Engagement through Interactive, Collaborative Games*** Use interactive games and collaborative formats to reinforce disciplinary core ideas related to science ideas about the structure and properties of matter and chemical reactions.	• Cookie Creation Game – In this game, students must use trial and error to determine the right ratio of cookie ingredients. [https://nebraskapublicmedia.pbslearningmedia.org/resource/ruffruffman-sci-cookiecreator/ruffs-cookie-creator/] • Chemical Reaction Race Cars – This game encourages students to use their knowledge of chemical reactions to design and propel a race car that will go the furthest distance. *Resource is free for NSTA members. [https://ngss.nsta.org/Resource.aspx?ResourceID=970]
	***Vocabulary*** Provide varied opportunities for students to learn and apply vocabulary in diverse situations and contexts. Vocabulary retention improves when academic terminology is layered on conceptual understanding. To maximize vocabulary building, support students in building conceptual understanding and then apply the academic terminology using the strategies outlined below. • Build understanding of domain specific vocabulary using a multi-sensory approach or having students participate in simulations. • Make connections between vocabulary and real-life or future opportunities. ○ Explain, describe, give real-world examples, or provide concrete representations of vocabulary words rather than formal definitions. Vocabulary.com (see	• STEM Teaching Tools – Practice Brief 66 - Article related to supporting emerging multilingual learners as they develop language that interprets and explains phenomena. [https://stemteachingtools.org/brief/66] • Vocabulary.com – This site provides explanations of words using real-world examples. Once signed in, an educator can create word lists for students. [https://www.vocabulary.com/] • STEM Teaching Tools – Practice Brief 66 – This article discusses how to support emerging multilingual learners as they develop language that interprets and explains phenomena. [https://stemteachingtools.org/brief/66] • Vocabulary.com – This site provides explanations of words using real-world examples. Once signed in, an educator can create word lists for students. [https://www.vocabulary.com/]

Instructional Strategies and Resources for Performance Category 3: Use Observations and Measurements of Chemical Reactions *Task 3, Prompt 1 (3 points); Task 3, Prompt 2 (4 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	Resources) provides explanations of words using real-world examples. Once signed in, an educator can create word lists for students. ○ Build a vocabulary word wall that students can add to and reference during instruction and self-guided activities or tasks. ○ Have students restate the vocabulary word in their own words. Take this opportunity to help students connect new vocabulary, especially general vocabulary, to prior knowledge. • Read books or watch video related to vocabulary words and concepts. • Sort words, photographs, or concrete representations into categories. Text Project (see Resources) provides Word Pictures that are free for educators to use. It includes Word Pictures for core vocabulary and various content areas, including science and social studies. • Pre-teach vocabulary and symbols, especially in ways that promote connection to the learners' experience and prior knowledge. • Define domain-specific vocabulary using both domain-specific and common terms. • Embedded visual, non-linguistic supports for vocabulary clarification (pictures, videos, etc.). • Have students create their own glossary of terms.	• Text Project – Word Pictures – This site provides Word Pictures that are free for educators to use. Their site includes word pictures for core vocabulary and various content areas including science and social studies. [https://textproject.org/archive/textproject-word-pictures/] • The Science Penguin – This website provides ideas to teach science vocabulary. The vocabulary demonstration activity uses real objects to teach vocabulary terms. [http://thesciencepenguin.com/2013/12/science-solutions-vocabulary.html] • Interactive Word Walls Enliven Vocab Learning – This article with teaching strategies supports students' use of a word wall to build understanding of key vocabulary. [https://www.middleweb.com/37209/interactive-word-walls-enliven-vocab-learning/]

Instructional Strategies and Resources for Performance Category 3: Use Observations and Measurements of Chemical Reactions *Task 3, Prompt 1 (3 points); Task 3, Prompt 2 (4 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	***Presenting Information in Different Modalities*** Provide information using a variety of multimedia (e.g., videos, interactives, simulations), informational texts, and formats to teach and reinforce disciplinary core ideas related to the structure and properties of matter and chemical reactions.	• Wonder of Science – This video includes interactive "Thinking Slides." Students identify systems, components, and physical quantities to reinforce data collection and analysis of properties of a material or system that can be measured. [https://thewonderofscience.com/mlccc32] • Can Acidic Drinks Cause Teeth to Decay Lab – In this lab investigation, students explore how the structure of the tooth fragment or eggshell changed as a result of the chemical reaction in the experiment. [https://science-u.org/experiments/dental-decay.html]
	***Scaffolds for Communicating Using Observations and Measurements*** Provide scaffolds for designing investigations to provide evidence to explain a phenomenon or support a design solution (e.g., sentence frames, graphic organizers, norms for whole class discussion, roles for students during small group activities) to support communicating in science-specific ways that may seem unnatural for students.	• National Science Foundation – Tools for Ambitious Science Teaching – This site discusses a tool that provides scaffolds for writing that support learners in constructing explanations with evidence. These take the form of sentence frames, guides for how to help English learners practice final explanations, norms for whole class discussion that are developed by students, roles that students can take in small group activities, and others. [https://ambitiousscienceteaching.org/scaffolding-students-written-explanations/] • Model Teaching – CER Checklist and Graphic Organizer – This site provides an introduction to Claim-Evidence-Reasoning (CER) and downloadable resources and writing templates. [https://www.modelteaching.com/education-articles/writing-instruction/claim-evidence-reasoning-cer]

Instructional Strategies and Resources for Performance Category 3: Use Observations and Measurements of Chemical Reactions *Task 3, Prompt 1 (3 points); Task 3, Prompt 2 (4 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		• Sentence Starters vs Sentence Frames – This YouTube video for teachers describes the difference between sentence frames and starters with guidance on when to use them based on the goal of the writing/speaking task. [https://www.youtube.com/watch?app=desktop&v=6LI6V8jxbXc]
	*Expressing Learning in Multiple Modalities* Provide multiple, flexible options for students to communicate their investigation designs and quantitative measurement methods and learning in class. • Use technologies that facilitate student participation and communication, such as discussion boards, podcasts, or blogs. • Allow students to choose a multi-modal project they would like to complete to demonstrate their learning, such as a poster presentation, debate, short film, lab report, blog, infographic, drawing, poetry, writing and performing a song, creating a game, etc. • Provide a variety of ways in which students can "write" to respond to questions (e.g., traditional form of writing, with sentence starters, using pictures, etc.)	• STEM Teaching Tools – Multiple Means of Action and Expression – This article provides considerations for engaging students through multiple means of action and expression. [https://stemteachingtools.org/sp/multiple-means-of-action-and-expression] • Focusing on Science in Elementary Classrooms – This article addresses the importance of using multiple modalities in teaching science in elementary classrooms. [https://www.edutopia.org/article/focusing-science-elementary-students-year/] • Student Success in Science – This article discusses how to differentiate success through various ways for students to respond. [https://blog.savvas.com/how-to-differentiate-for-success-in-the-science-classroom/] • Investigation demonstration and student activities from American Chemical Society. After students complete the activity, have small groups of students present the results of one of the activities or demonstrations through a poster, drawing, or infographic.

Instructional Strategies and Resources for Performance Category 3: Use Observations and Measurements of Chemical Reactions *Task 3, Prompt 1 (3 points); Task 3, Prompt 2 (4 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		[https://www.acs.org/education/resources/k-8/inquiryinaction/fifth-grade/chapter-4/conservation-of-mass.html] • American Chemical Society – Conservation of Mass – This lesson engages students in an investigation to take measurements showing that whether the process involves a change of state, dissolving, or a chemical reaction, the total mass of the substances does not change. After students complete the activity, they can present the results of one of the activities or demonstrations through a poster, drawing, or infographic. [https://www.acs.org/education/resources/k-8/inquiryinaction/fifth-grade/chapter-4/conservation-of-mass.html]