Test Specifications

New Mexico Assessment of Science Readiness (NM-ASR)

Purpose of the NM-ASR

Part of a Balanced Assessment System

The NM-ASR is New Mexico's statewide summative assessment for Science, administered at the end of grades 5, 8, and 11. As the NM-ASR is a single measure at the end of a grade band, interpretations and uses of NM-ASR scores should be supplemented with additional measures, including information from classroom summative and formative assessments in science.

Formative assessment may include the use of STEM Gauge, which is a collection of formative assessment materials for grades K–8 being provided by Cognia during the term of their contract with the state to administer the NM-ASR. The materials are aligned to the NGSS and therefore to the New Mexico *STEM Ready! Science Standards*. The materials for STEM Gauge may be accessed at the following site: http://go.cognia.org/instructional-support-materials-for-new-mexico-science-educators.

Claims/Score Interpretation and Use Statements

The NM-ASR is designed to measure whether students are on track to be ready for college or career, as defined by the State, by showing they have mastered the New Mexico *STEM Ready! Science Standards*. The standards require integration of Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts to explain phenomena and solve problems.

In addition to overall scale score, student performance on three science subdomains is reported:

- Practices and Crosscutting Concepts in Physical Sciences
- Practices and Crosscutting Concepts in Life Sciences
- Practices and Crosscutting Concepts in Earth and Space Sciences

Test Specifications – Test Design

Assessable Standards

The NM-ASR assesses the New Mexico *STEM Ready! Science Standards* as follows:

- Grade 5 test: All standards in grades 3, 4, and 5, *except* 5-SS-1 NM.
- Grade 8 test: All standards in the middle school grade band (6-8), **including** MS-ESS3-3 NM.
- Grade 11 test: All standards in the high school grade band (9-12), *except* HS-LS2-7 NM and HS-SS-1 NM (but **including** HS-SS-2 NM).

Test Design

The NM-ASR test is administered in three sessions. The test is administered online as a computer-based test (CBT).

Online accommodations are available for the CBT. Paper, large-print, and Braille test forms, as well as computer- and print-based Spanish test forms, are also provided.

No calculator is provided for the NM-ASR, as no items require calculator use. A periodic table will be provided as a reference for high school (Grade 11).

The types of items on the NM-ASR are item clusters (CL), 2-point machine-scored standalone items (MS-2), and 4-point open-ended standalone items (OE). Additional item type descriptions and sample items can be found in the item specifications section on page 11.

Both core operational items (which count for a student's score) and matrix field test items (which are try-out items that do not count for a student's score) are included on the NM-ASR test.

The total number of test items, points, and estimated testing time for the NM-ASR are shown in the following tables.

Student Testing Experience							
Grade 5	Cluster/Passage Items			Standalone Items		Total	Total
	Stim/Psg	MS-1	MS-2	MS-2	OE	Items	Points
Core Operational Items	6	12	12	8	3	35	64
Matrix Field Test Items	2	4	4	4	1	13	24
Total Student Experience	8	16	16	12	4	48	88
				Estimated Testing Time (min)			**150**

Student Testing Experience							
Grade 8	Cluster/Passage Items			Standalone Items		Total	Total
	Stim/Psg	MS-1	MS-2	MS-2	OE	Items	Points
Core Operational Items	6	12	12	8	3	35	64
Matrix Field Test Items	2	4	4	4	1	13	24
Total Student Experience	8	16	16	12	4	48	88
				Estimated Testing Time (min)			**150**

Student Testing Experience							
Grade 11	Cluster/Passage Items			Standalone Items		Total	Total
	Stim/Psg	MS-1	MS-2	MS-2	OE	Items	Points
Core Operational Items	6	12	12	10	3	37	68
Matrix Field Test Items	2	4	4	5	1	14	26
Total Student Experience	8	16	16	15	4	51	94
				Estimated Testing Time (min)			**165**

Practice Test

A full-length practice test mirroring the operational test design is available beginning in the 2020-2021 school year. The practice tests and supporting materials can be accessed at https://newmexico.onlinehelp.cognia.org/practice-tests-nm-asr/.

Test Specifications – Reporting Categories

The reporting categories for NM-ASR are based on the three content domains. Percentages for the distribution of operational (core) test points for each of the reporting categories reflect the distribution in the standards, so as not to over- or underrepresent content.

Based on this representativeness, the fourth content domain of Engineering, Technology, and Applications of Science as well as the NM-specific content domain of Science and Society are not reported as a subscore (as there are very few standards out of the total in each grade band). Items coded to these standards do count toward total test score.

Reporting Categories, Grade 5 NM-ASR

Reporting Category	Typical Number of Clusters	Typical Number of Standalone MS-2	Typical Number of Standalone OE	Number of Core Points	Percent of Core Points (+/- 4%)
Practices and Crosscutting Concepts in Physical Sciences	*2*	*4-6*	*1*	*24-28*	40%
Practices and Crosscutting Concepts in Life Sciences	*2*	*1-3*	*1*	*18-22*	30%
Practices and Crosscutting Concepts in Earth and Space Sciences	*2*	*1-3*	*1*	*18-22*	30%

Reporting Categories, Grade 8 NM-ASR

Reporting Category	Typical Number of Clusters	Typical Number of Standalone MS-2	Typical Number of Standalone OE	Number of Core Points	Percent of Core Points (+/- 4%)
Practices and Crosscutting Concepts in Physical Sciences	*2*	*2-4*	*1*	*20-24*	35%
Practices and Crosscutting Concepts in Life Sciences	*2*	*2-4*	*1*	*20-24*	35%
Practices and Crosscutting Concepts in Earth and Space Sciences	*2*	*1-3*	*1*	*18-22*	30%

Reporting Categories, Grade 11 NM-ASR

Reporting Category	Typical Number of Clusters	Typical Number of Standalone MS-2	Typical Number of Standalone OE	Number of Core Points	Percent of Core Points (+/- 4%)
Practices and Crosscutting Concepts in Physical Sciences	*2*	*3-5*	*1*	*22-26*	35%
Practices and Crosscutting Concepts in Life Sciences	*2*	*3-5*	*1*	*22-26*	35%
Practices and Crosscutting Concepts in Earth and Space Sciences	*2*	*1-3*	*1*	*18-22*	30%

Test Specifications – Cognitive Complexity

Because the *New Mexico STEM Ready! Science Standards* are NGSS-aligned, the cognitive complexity of items on the NM-ASR is evaluated with a different framework than Depth of Knowledge.

For the items on the NM-ASR, four indicators are used to classify the cognitive complexity of each item: stimulus, science and engineering practice, disciplinary core idea, and crosscutting concept. For each indicator, the classification in terms of high, medium, or low complexity is based on how the students are using the indicator to respond to the item – specifically, to what degree does students' engagement with the indicator contribute to the level of sense-making required by the item.

On the NM-ASR, after summing the operational (core) test points at each cognitive complexity level across all four indicators, **at least 10% of the points should be high cognitive complexity** and **no more than 35% of the points should be low cognitive complexity**.

The descriptors for each indicator at the three complexity levels (high, medium, low) are presented in the following tables.

STIMULUS	
High	- Phenomenon is novel, complex, and/or unfamiliar to students - Students must synthesize multiple pieces of information and do a significant amount of "figuring out" to make sense of the phenomenon
Medium	- Phenomenon is somewhat novel, but may be analogous to what many students are familiar with - Students must use multiple pieces of information and do an intermediate amount of "figuring out" to make sense of the phenomenon
Low	- Phenomenon is familiar and/or more straightforward for students - Students only need to use simple/straightforward information, and/or a single piece of information, and do a minimal amount of "figuring out" to answer the question or contribute to making sense of the phenomenon

SEP (SCIENCE AND ENGINEERING PRACTICE)	
High	- Students must apply the SEP, or multiple SEPs, in a sophisticated way to make sense of the phenomenon (e.g., synthesis to perform more connections, steps, combination of SEP elements, such as having to combine data, produce a new graph or model as evidence, etc.) - Often little to no scaffolding that helps students apply the SEP
Medium	- Students must apply the SEP to make sense of the phenomenon - Typically some scaffolding that helps students apply the SEP
Low	- Students only need to use the SEP in a simple, mechanical way to answer the question or contribute to making sense of the phenomenon - Often a large amount of scaffolding that helps students apply the SEP

DCI (DISCIPLINARY CORE IDEA)	
High	- Students must apply and connect DCIs in a sophisticated way to make sense of the phenomenon, i.e., ○ application of science ideas (often multiple, grade-band appropriate ideas) in unique ways or new combinations ○ knowledge transfer to construct new understanding, make sense of novel phenomena - Often little to no scaffolding that helps students apply the DCI
Medium	- Students must apply or reason with the DCI(s) to make sense of the phenomenon - Typically some scaffolding that helps students apply the DCI
Low	- Students use the DCI in a simple, straightforward way (i.e., little to no application or reasoning) to answer the question or contribute to making sense of the phenomenon - Often a large amount of scaffolding that helps students apply the DCI

CCC (CROSSCUTTING CONCEPT)	
High	- Students must apply the CCC in an in-depth way to expand thinking and make non-typical connections to make sense of the phenomenon
Medium	- Students must use the CCC as specified by the CCC sub-bullet detail to make sense of the phenomenon
Low	- Students only use the CCC in a general way to answer the question or contribute to making sense of the phenomenon

Test Specifications – Fairness

Fairness is defined as the extent to which the test scores are valid for different groups of test takers. Consideration of universal design, bias, and sensitivity guidelines support the construction of fair, valid assessments.

Universal Design for Assessments

The concept of Universal Design for Assessments focuses on developing content and assessments that reach the widest population of students possible. Stimuli and items on the NM-ASR are designed to simply and clearly present tasks and to provide maximum readability, comprehensibility, and legibility. The seven elements of Universal Design for Assessments are based on the original UDL guiding principles:

Universal Design for Assessments

Principle	Explanation
Inclusive Assessment Population	Tests designed for state, district, or school accountability must include every student except those in the alternate assessment, and this is reflected in assessment design and field-testing procedures.
Precisely Defined Constructs	The specific constructs tested must be clearly defined so that all construct-irrelevant cognitive, sensory, emotional, and physical barriers are removed.
Accessible, Non-Biased Items	Accessibility is built into items from the beginning, and bias review procedures ensure that quality is retained in all items.
Amenable to Accommodations	Test design facilitates the use of needed accommodations (e.g., all items can be brailled).
Simple, Clear, and Intuitive Instructions and Procedures	All instructions and procedures are simple, clear, and presented in understandable language.
Maximum Readability and Comprehensibility	A variety of readability and plain language guidelines are followed (e.g., sentence length and number of difficult words kept to a minimum) for readable and comprehensible text.
Maximum Legibility	Characteristics that ensure easy decipherability are applied to text, tables, figures, and illustrations, and to response formats.

Bias

The concept of Bias is defined as the presence of some characteristic of an item that results in differential performance for two individuals of the same ability but from different ethnic, sex, cultural, or religious groups.

Bias can occur whenever content offends or disadvantages a student or group of students due to gender, race, regional background, socioeconomic status, or any other such classification.

Test developers take care to craft content in a way that does not misrepresent specific groups or rest on assumptions made about specific groups, that in turn could negatively impact how students interpret content.

- Stimulus and item content on the NM-ASR must not present stereotypes or unfair representations of gender, race, ethnicity, disability, culture, or religion.
- Stimulus and item content on the NM-ASR should not depend on overly-experiential information such as knowledge of technology, consumer goods, pop culture, geographic locations, or sports and extracurricular activities. While these topics are not completely excluded from use, care must be taken to ensure that the items are presented in a way that does not require a level of knowledge that would not be held by all students.

Sensitivity

Sensitivity refers to the presence of content that is contrary to the acceptable norms of the students, educators, parents, or other members of the community that may interact with the assessment. Sensitive subject matter can impact student performance or attitudes toward testing, and hence, their test scores.

Consideration of bias and sensitivity issues is very important when developing content for an assessment. Test developers must ensure that stimuli and items are free of content that will negatively affect a student’s performance not because of what the student knows and can do but because the content evokes an emotional response from that student (or is in some other way distracting to the student).

Subjects/contexts that are likely to prompt emotional distress on the part of students cannot be used on the NM-ASR (e.g., war, violence, human death or debilitating disease, animal-based medical research). Careful judgment should be applied to PEs that cover topics that may be considered controversial by some groups (e.g., evolution examples, population dynamics including death/extinction, environmental impact). Those PEs represent content knowledge to be assessed, but the assessment must be done in a sensitive, unbiased way.

Stimulus Specifications

All items for the NM-ASR have a stimulus. For clusters, all items in the set are associated with a common stimulus that presents a science phenomenon or engineering design problem. For standalone items (MS-2, OE), the item includes a lead stimulus that provides a specific science phenomenon or engineering design problem, or context thereof. By phenomenon, we mean something observable that happens in the real world, whether natural or man-made. By engineering design problem, we mean a personal or societal need or want.

Specifications for Cluster Stimuli

1. The stimulus must present a single, rich science phenomenon or engineering design problem aligned to the PEs.
2. The stimulus may present any variety of elements to provide the necessary information to support sense-making (via the items) around the phenomenon or problem: text paragraphs, passages, graphs, data tables, models, drawings, etc.
3. The stimulus must be rich enough to support the development of enough items for the cluster, in the context of a storyline (sequence of sense-making) around the phenomenon or problem using the DCIs, SEPs, and CCCs of the targeted PEs.
4. All information in the stimulus should be necessary, but not conceptually sufficient, for students to respond (i.e., students must also use their own knowledge of the constructs in the PE(s) to answer the items, rather than simply identify given information).
5. The stimulus phenomenon or problem must be grade-appropriate, engaging, and relevant for students at that grade level.
6. The stimulus should adhere to the specifications in the following table regarding length, wording, and complexity.*

Stimulus characteristic	**Elementary School (Grades 3-5)**	**Middle School (Grades 6-8)**	**High School (Grades 9-12)**
Text word count**	100-300 words	100-400 words	100-400 words
*****Count should balance text and graphic load – in a stimulus with more and/or complex graphics, the word count should be lower; in a stimulus with few and/or very simple graphics, the word count could, if needed, be at the higher end of range.*			
Vocabulary level *(excluding science content vocabulary)*	Grade 3	Grade 5 maximum	Grade 8 maximum
Readability/Lexile maximum	820L (Gr 3)	1010L (Gr 5)	1185L (Gr 8)
Qualitative text characteristics	Simple sentence structures, clear/uncomplicated graphics, lower vocabulary demands, use of only essential science vocabulary.	Slight mix of simple and more complex phrasing and sentence structure, average to moderately complex graphics, average vocabulary demands.	Mix of simple and more complex phrasing and sentence structure, average to moderately complex graphics, average vocabulary demands.

*Items aligned to the NM-Specific Standards may sometimes exceed these specifications, especially word count, because of the detailed NM-specific contexts that must be provided.

Specifications for Standalone Item Stimuli

1. MS-2 items: The stimulus must present a hook or driving reason for the question being asked, and it must set a phenomenon- or problem-based context, aligned to the PE, for the item. The stimulus will typically not be as extensive as a stimulus for an item cluster.
2. OE items: The stimulus must present a hook or driving reason for the question being asked, and it must include a phenomena or problem, aligned to the PE, to drive the item. The stimulus for open-ended items will typically be more concise than for item clusters but more detailed than for MS-2 standalone items.

Item Specifications

Alignment

The items on the NM-ASR are aligned to the New Mexico *STEM Ready! Science Standards*, including both the NGSS and the NM-Specific Standards.

Each item is aligned to a performance expectation (PE) as well as dimensions of the performance expectation. All items must have either 2-dimensional or 3-dimensional alignment.

Item Types

The types of items on the NM-ASR are item clusters, 2-point machine-scored standalone items (MS-2), and 4-point open-ended standalone items (OE):

- An item cluster is a set of items all associated with a common stimulus. Clusters contain four items. These items may be multiple choice, multiple select, or technology-enhanced, with two of the items being worth 1 point and two of the items being worth 2 points. The clusters typically align to two PEs, and all clusters measure all three dimensions of the PEs being assessed.
- Standalone MS-2 items are worth 2 points. These items have two parts (Part a and Part b) for students to answer, and 0, 1, or 2 points total can be earned across Part a and Part b. These items may be multiple choice, multiple select, or technology-enhanced (e.g., drag-and-drop, hot spot, drop-down selections).
- Open-ended items are worth 4 points. These items require students to write an extended response to a prompt. The prompt may be a single prompt, or more typically, the items are written with multiple, scaffolded parts for students to respond to. These items are hand-scored, with scorers using a rubric and scoring notes to evaluate responses on a scale from 0–4.

Samples of each of these item types are included on the following pages.

Clusters: Clusters are a set of 4 items all associated with an introductory passage, or "stimulus."

- The stimulus typically contains both text and graphics such as diagrams, tables, or graphs. An example stimulus from the *grade 5 practice test* is on the next page. The items associated with the cluster assess two Physical Sciences PEs:
  - 5-PS1-3: Make observations and measurements to identify materials based on their properties.
    SEP: Planning and Carrying Out Investigations
    DCI: PS1.A: Structure and Properties of Matter
    CCC: Scale, Proportion, and Quantity
  - 5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances.
    SEP: Planning and Carrying Out Investigations
    DCI: PS1.B: Chemical Reactions
    CCC: Cause and Effect

Read the information. Then answer the questions that follow.

Investigating Gas Production

In class, a teacher demonstrates a chemical reaction by mixing vinegar and baking soda to produce bubbles of gas. Eliana wonders whether mixing other substances could also produce a gas. She decides to test different combinations of sugar, water, vinegar, and baking soda.

Some properties of these substances are shown in the table.

Properties of Substances

Substance	Color	Solid or Liquid	Attracted to a Magnet	Conducts Electricity
Sugar	White	Solid	No	No
Water	Clear	Liquid	No	Yes
Vinegar	Clear	Liquid	No	Yes
Baking soda	White	Solid	No	No

Investigation 1

Eliana mixes a small amount of each liquid and solid in a bowl and observes whether bubbles of gas are produced. Her observations are shown in the table.

Investigation 1 Observations

Liquid Used	Solid Used	Gas Produced
Water	Sugar	No
Water	Baking soda	No
Vinegar	Sugar	No
Vinegar	Baking soda	Yes

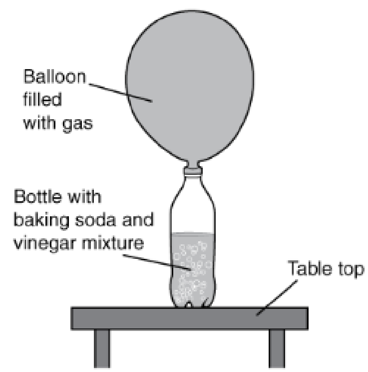
Investigation 2

Next, Eliana wonders whether changing the amount of baking soda would change the amount of gas produced. To investigate, she follows these steps:

1. Record the mass of a balloon.
2. Pour 50 milliliters of vinegar into a bottle.
3. Put 5 milliliters of baking soda inside the balloon. Hold the balloon so that the baking soda stays inside the balloon and attach the open end of the balloon to the top of the bottle.
4. Lift the balloon so that the baking soda falls into the bottle with vinegar.
5. Wait one minute.
6. Carefully remove the balloon from the bottle without allowing any gas to escape.
7. Measure the mass of the balloon filled with gas.
8. Calculate the mass of gas produced by subtracting the mass of the balloon from the mass of the balloon filled with gas.
9. Repeat steps 1–8 until three trials have been completed.
10. Repeat steps 1–9 with 10 milliliters and 15 milliliters of baking soda.

The results of one trial are shown in the diagram.

Gas in a Balloon



Eliana's data are shown in the table.

Investigation 2 Data

Amount of Baking Soda (milliliters)	Mass of Gas Produced (grams)			Average Mass of Gas Produced (grams)
	Trial 1	Trial 2	Trial 3	
5	1.0	0.8	1.2	1.0
10	1.5	1.9	1.4	1.6
15	2.4	1.9	2.6	2.3

- Two of the items in the cluster are machine-scored items worth 1 point each. These items may be multiple-choice, multi-select, or technology-enhanced items (e.g., drag-and-drop, hot spot, drop-down selections).

Which evidence from the investigations supports the claim that mixing vinegar and baking soda produces a new substance?

Hide All

(A) A gas is produced when a liquid and a solid are mixed.

(B) When a liquid and solid are mixed, the mass does not change.

(C) The properties of substances stay the same when the substances are mixed.

(D) Different amounts of baking soda can be mixed with the same amount of vinegar.

MS-1 cluster item, grade 5 practice test, aligned to PE 5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances. The dimensions for the PE are SEP: Planning and Carrying Out Investigations; DCI: PS1.B: Chemical Reactions; CCC: Cause and Effect. This particular MS-1 item in the cluster assesses the DCI and CCC dimensions.

- The other two items in the cluster are machine-scored items worth 2 points each. These items have two parts, with Part a worth 1 point and Part b also worth 1 point. Each part of the item may be presented as multiple-choice, multi-select, or technology-enhanced (e.g., drag-and-drop, hot spot, drop-down selections).

This question has two parts. Be sure to answer both parts of the question.

Part a
Eliana claims that when baking soda and vinegar are mixed, a new substance forms.

Select the phrase that describes an observation from investigation 2 that supports her claim.

After baking soda and vinegar are mixed, [-Select an Answer-] .

Part b
Which observation is evidence that the new substance inside the balloon is a gas?

Hide All

(A) The new substance filled the balloon.

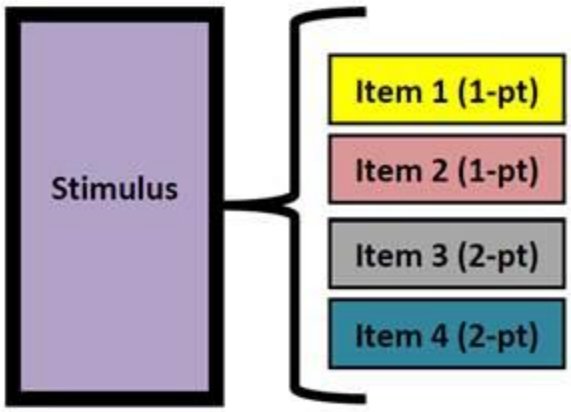
(B) The new substance has more mass than the baking soda.

(C) The new substance takes up less space than the vinegar.

(D) The new substance increases as the baking soda increases.

MS-2 cluster item, grade 5 practice test, aligned to PE 5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances. The dimensions for the PE are SEP: Planning and Carrying Out Investigations; DCI: PS1.B: Chemical Reactions; CCC: Cause and Effect. This particular MS-2 item in the cluster assesses the DCI and CCC dimensions.

- The entire cluster is worth a total of 6 points. The diagram below summarizes the structure of a cluster.

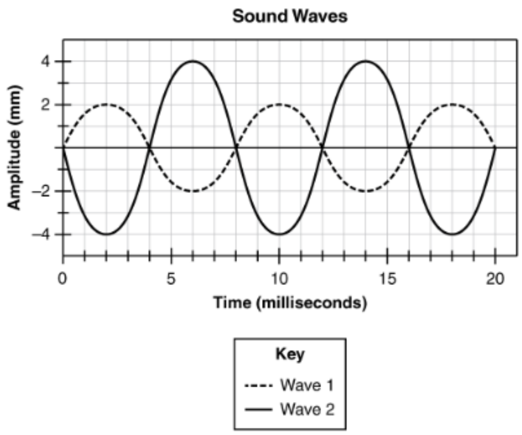


MS-2 Items: MS-2 items are standalone, or individual, machine-scored items.

- As in the cluster, the standalone MS-2 items are worth 2 points and have two parts, with Part a worth 1 point and Part b also worth 1 point. Each part of the item may be presented as multiple-choice, multi-select, or technology-enhanced (e.g., drag-and-drop, hot spot, drop-down selections).

This question has two parts. Be sure to answer both parts of the question.

Elaine is researching the characteristics of sound waves as she listens to music. She finds a diagram that shows two sound waves.



Part a
Select the number that describes the sound waves in the diagram.

Wave 1 has [-Select an Answer-] the energy of Wave 2.

Part b
Elaine predicts that the energy in each sound wave would double if the frequency of the wave doubled.

Which statement describes her prediction?

Hide All

(A) Her prediction is correct because the energy of a wave is proportional to the wave's frequency.

(B) Her prediction is incorrect because the energy of a wave is proportional to the square of the wave's frequency.

(C) Her prediction is correct because the energy of a wave is proportional to speed and a wave with twice the frequency has twice the speed.

(D) Her prediction is incorrect because the energy of a wave is proportional to the wavelength and a wave with twice the frequency has half the wavelength.

MS-2 item, grade 8 practice test, aligned to PE MS-PS4-1: Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. The dimensions for the PE are SEP: Using Mathematics and Computational Thinking; DCI: PS4.A: Wave Properties; CCC: Patterns. This particular MS-2 standalone item assesses the SEP, DCI, and CCC dimensions.

OE Items: OE, or open-ended, items are standalone items that require students to provide a written response to a prompt or question.

- The prompt or question may be a single prompt, or more typically, the item will be written with multiple, scaffolded parts for students to answer.
- The items are worth 4 points each and are hand-scored for 4, 3, 2, 1, or 0 points by trained scorers using a rubric and scoring notes.

This question has two parts. Be sure to answer both parts of the question.

Some students work at a local aquarium. One of their tasks is to care for mollusks and corals in ocean water in a tank at the aquarium. The students need to make sure that the ocean water has the right balance of calcium ions (Ca^{2+}) and carbonate ions (CO_3^{2-}) that the mollusks and corals need to build their shells and skeletons.

To do this, the students need to ensure that calcium and carbonate ions are continuously added to the ocean water in the tank. The students know that ocean water contains calcium carbonate, which naturally breaks down into calcium and carbonate ions. The equilibrium relationship between the components in the water is shown in the equation.

Equilibrium Equation

$$CO_2 + H_2O + CaCO_3 \rightleftarrows Ca^{2+} + 2\ H^+ + 2\ CO_3^{-2}$$

The students decide to test the equilibrium relationships in the equation. With ocean water as an input, the students remove calcium ions (Ca^{2+}) as the ions form in the water in the tank. The students observe that as they remove calcium ions, more calcium ions form in the tank. They realize that this is an example of Le Chatelier's principle that describes the equilibrium relationships in the water.

The people who work at the aquarium tell the students that ocean water contains carbon dioxide (CO_2) and that increasing amounts of CO_2 in ocean water can cause some of the calcium carbonate ($CaCO_3$) in the shells and skeletons of ocean organisms to dissolve.

The students want to solve this problem by decreasing the amount of carbon dioxide in ocean water.

a. Describe one way students could decrease the amount of CO_2 in ocean water by applying Le Chatelier's principle.

b. Describe one constraint on implementing the change described in Part (a).

OE item, grade 11 practice test, aligned to PE HS-PS1-6: Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. The dimensions for the PE are SEP: Constructing Explanations and Designing Solutions; DCI: PS1.B: Chemical Reactions and ETS1.C: Optimizing the Design Solution; CCC: Stability and Change. This particular OE item assesses the SEP, DCI, and CCC dimensions.