Stackable Instructionally-embedded Portable Science (SIPS) Assessments Project

Grade 8 Science

Unit 4 Task 3 Specification Tool & Verification of Alignment

Providing Solutions to Problems Using Simple Wave Properties

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SIPS Grade 8 Unit 4 Task 3 Specification & Verification of Alignment

Grade: 8	Unit: 4	Task Number: 3	Task Title: Sounds of Silence

NGSS Performance Expectations

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. [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.]

MS-PS4-2. Develop and use a model to describe how waves are reflected, absorbed, or transmitted through various materials. [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions]

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on the people and the natural environment that may limit possible solutions.

Phenomena or Phenomena-rooted Design Problem

- The task focuses on sound and noise as the basis for a design problem related to improving a recording studio.

Scenario/Context/Situation/Boundaries

- The scenario introduces a description of what a recording studio is used for and the design problem of how to minimize unwanted noise in a local recording studio.
- The task then asks students to interpret complete a position vs. time graph related to the sound waves produced by playing different music notes on a guitar.
- The task then asks students to describe and mathematically support an explanation that relates to the concept that an increase in energy results in an increase in the amplitude of the wave.
- The task then moves to the description of sources of unwanted noise in a recording studio given a description of the setting.
- The task closes with students developing a design solution, including identifying the scientific knowledge related to the problem and solution, identifying how the solution solves the problem, and identifying considerations for testing the solution.

Variable Features to Shift Complexity or Focus

- Complexity of scientific concept(s) to be represented.
- Domain-specific vocabulary and definitions.
- Type of wave presented (e.g., sound, electromagnetic, mechanical, light).
- Format of "real-world" phenomenon under investigation: image, data, text, combination.
- Standard units used (e.g., grams, liters).
- Function of the model:
  - To explain a mechanism underlying a phenomenon.
  - To predict future outcomes.
  - To describe a phenomenon.
  - To generate data to inform how the world works.
- Use or purpose of the model.
- Type of model (e.g., physical/virtual).
- Core idea targeted in a model (e.g., light sources, the materials, polarization of light, ray diagrams).

General Description of Task/Chain of Sensemaking

- Students interpret a position vs. time graph and use it to demonstrate their understanding of loudness and amplitude. **[MS-PS4-1, KSA1]**
- Students use the mathematical relationship between amplitude and energy (energy is proportional to the square of the amplitude) to complete a data table. **[Prompt 2, Part A: MS-PS4-1, KSA2]**
- Students use mathematical representations to describe the relationship between amplitude and energy (energy is proportional to the square of the amplitude). **[Prompt 2, Part B: MS-PS4-1, KSA4]**
- Students are then asked to provide a written description, model, or graph to show a comparison of a high-pitch note to a low-pitch note. **[Prompt 2, Part C: MS-PS4-1, KSA3]**
- Students explain why certain materials are good for certain functions, such as sound absorbers. **[Prompt 3, Part A: MS-PS4-2, KSA4]**
- Students use a list of products available to improve the recording studio to determine constraints of a design problem (i.e., cost, materials, and noise reduction ratings). **[Prompt 3, Part B: MS-PS4-2 & MS-ETS1-1, KSA1]**
- Students are then asked to determine considerations for testing the solution. **[Prompt 3, Part C: MS-PS4-2 & MS-ETS1-1, KSA2]**

Targeted PE-related KSAs

MS-PS4-1, KSA1: Create a graphical representation of a simple wave that demonstrates a repeating pattern.

MS-PS4-1, KSA2: Use models and mathematical thinking to demonstrate understanding of wave properties.

MS-PS4-1, KSA4: Use a graph to describe how the amplitude of a wave is related to the energy in a wave.

MS-PS4-1, KSA3: Identify patterns as an organizing concept for understanding wave properties.

MS-PS4-2, KSA4: Use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Cross-performance Expectations Related KSAs to Target

MS-PS4-2 & MS-ETS1-1, KSA1: Use provided information to determine constraints of a design problem (time, materials, cost) as it relates to a specific phenomenon or scenario.

MS-PS4-2 & MS-ETS1-1, KSA2: Use a model to make sense of a given phenomenon or scenario to determine considerations for testing the solution.

Student Demonstrations of Learning

- Model and/or graph accurately represents the observable phenomena.
- Model and/or graph accurately shows relationships among wave properties.
- Model accurately captures all mechanistic features of the observable phenomena.
- Correctly applies a simple mathematical wave model to a physical system or phenomenon to identify how the wave model characteristics correspond with physical observations.
- Identifies relevant or meaningful patterns that address a scientific question.
- Identifies and describes relevant relationships between components of the model.

Work Products

- Complete a model.
- Organize data into tables/charts/graphs.
- Constructed response.
- Apply evidence.

Application of Universal Design for Learning-based Guidelines to Promote Accessibility (https://udlguidelines.cast.org/)		
Multiple Means of Engagement	**Multiple Means of Representation**	**Multiple Means of Action & Expression**
• Context or content. • Age appropriate. • Appropriate for different groups. • Makes sense of complex ideas in creative ways. • Vary the degree of challenge or complexity within prompts.	• Provide visual diagrams and charts. • Make explicit links between information provided in texts and any accompanying representation of that information in illustrations, equations, charts, or diagrams. • Activate relevant prior knowledge. • Highlight or emphasize key elements in text, graphics, diagrams, and formulas. • Use outlines, graphic organizers, unit organizer routines, concept organizer routines, and concept mastery routines to emphasize key ideas and relationships. • Give explicit prompts for each step in a sequential process.	• Solve problems using a variety of strategies. • Sentence starters. • Embed prompts to “show and explain your work”.

SIPS Assessments Complexity Framework Components

Prompt	**A.1** Degree and nature of sense-making about phenomena or problems			**B.1** Complexity of the presentation			**B.2** Cognitive demand of response development			**B.3** Cognitive demand of response production		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
1		**X**			**X**			**X**			**X**	
2 Parts A & B	**X**				**X**			**X**			**X**	
2 Part C		**X**		**X**					**X**			**X**
3 Part A	**X**			**X**			**X**				**X**	
3 Part B		**X**			**X**			**X**			**X**	
3 Part C		**X**		**X**					**X**		**X**	

Rubric Considerations

- Accuracy of the model.
- Accuracy of the graph.
- Sophistication of the explanations.

Assessment Boundaries

- Assessment should be limited to qualitative applications pertaining to light and mechanical waves.
- Assessment is limited to qualitative applications pertaining to mechanical waves.
- Assessment is limited to standard repeating waves and should not include electromagnetic waves.
- Assessment should be limited to qualitative applications pertaining to light and mechanical waves.

Common Alternate Conceptions

- **MS-PS4-1**
  - Period, frequency, and wavelength are interchangeable.
  - Amplitude affects wavelength and/or frequency.
- **MS-PS4-2**

- The brightness of light is dependent on the color (frequency) as well as amplitude.
- A sound wave is the movement of air particles.
- A physical wave is able to move matter permanently to a new location along the wave's direction of propagation.

- **MS-ETS1-1**
  - A problem only has one true solution.
  - Some problems cannot be solved.
  - A solution can be perfect, with no limitations or drawbacks.
  - Everyone will benefit from the best solution.

Possible Technical Terms for Task

- amplitude, wave, pitch, resting position, Noise Reduction Coefficients (NRC), decibel

Common Core State Standards for Literacy

Reading Informational

- **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. **(MS-ETS-1)**

Writing

- **WHST.6.8** Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. **(MS-ETS1-1)**

Common Core State Standards for Mathematics

Mathematical Practices

- **MP.2** Reason abstractly and quantitatively. **(MS-PS4-1), (MS-ETS1-1)**
- **MP.4** Model with mathematics. **(MS-PS4-1)**

Mathematical Content

- **6.RP.A.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. **(MS-PS4-1)**
- **6.RP.A.3** Use ratio and rate reasoning to solve real-world and mathematical problems. **(MS-PS4-1)**
- **7.EE.3** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form, convert between forms as appropriate, and assess the reasonableness of answers using mental computation and estimation strategies. **(MS-ETS1-1)**
- **7.RP.A.2** Recognize and represent proportional relationships between quantities. **(MS-PS4-1)**

- **8.F.A.3** Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. **(MS-PS4-1)**

Task Notes

SIPS Assessments Complexity Framework

	Component	Complexity		
		Low	Moderate	High
Connections to Curriculum and Instruction	**A.1 Degree and nature of sense-making about phenomena or problems**	• Requires one or two dimensions • One dimension may have a greater degree of emphasis than another • Requires previously learned ideas or concepts	• Requires integration of two dimensions in the service of sense-making • Requires integration of same or different combinations of dimensions as represented in the PE bundle • Requires a combination of previously learned ideas or concepts and newly presented information	• Requires integration of three dimensions in the service of sense-making • Requires integration of same or different combinations of dimensions as represented in the PE bundle • Requires a combination of previously learned ideas or concepts and newly presented information
Characteristics of the Tasks	**B.1 Complexity of the presentation**	• The amount and type of information provided in the scenario supports limited simple connections among ideas or concepts • Provides few, simple graphics/data/models • Includes definitions or examples • Phenomenon or problem presented in a concrete way with high level of certainty	• The amount and type of information provided in the scenario supports multiple evident connections among ideas or concepts • Provides graphics/data/models • Limited use of definitions or examples • Phenomenon or problem presented with some level of uncertainty	• The amount and type of information provided in the scenario supports multiple and varied complex connections among ideas or concepts • Provides complex graphics/data/models • Phenomenon or problem presented with high-degree of uncertainty
	B.2 Cognitive demand of response development	• Requires well-defined set of actions or procedures • Requires a connection or retrieval of factual information • Response requires a low level of sophistication with routinely encountered well-practiced applications	• Requires application of ideas and practices given cues and guidance • Requires drawing relationships and connecting ideas and practices • Response requires a moderate level of sophistication with typical but relatively complex representation of ideas and application of skills	• Requires selection and application of multiple complex ideas and practices • Requires high degree of sense-making, reasoning, and/or transfer • Response requires a high level of sophistication with non-routine or abstract representation of ideas and application of skills

B.3 Cognitive demand of response production	• Responses include selection from a small set of options presented as text (e.g., word, short phrase) or other formats (e.g., a simple graphic or process)	• Responses include one or more sentences or a paragraph, a moderately complex graphic, or multiple steps in a simple or moderately complex process	• Responses include multiple paragraphs, multiple graphics of at least moderate complexity, or multiple steps in a complex process