Stackable Instructionally-embedded Portable Science (SIPS) Assessments Project

Grade 8 Science

Unit 4 Task 2 Specification Tool & Verification of Alignment

Providing Solutions to Problems Using Simple Wave Properties

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SIPS Grade 8 Unit 4 Task 2 Specification & Verification of Alignment

Grade: 8	Unit: 4	Task Number: 2	Task Title: Color My World

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]

Phenomena or Phenomena-rooted Design Problem

- The task focuses on color, the frequency-dependent bending of light at a surface between media, and the production of rainbows in the sky.

Scenario/Context/Situation/Boundaries

- The scenario introduces the appearance of rainbows in the sky.
- The task then transitions to the properties of light waves which include the frequency-dependent bending of light at a surface between media.
- This is followed up with students tracing the path that light travels between different transparent materials (e.g., air and water).
- The task then moves to the effects of shining a light through a prism and the relationship between the speed of light and wavelength to determine the reason the colors of light spread out.
- The task closes with students making the connection between the properties of light waves and the production of rainbows in the sky.

Variable Features to Shift Complexity or Focus

- Complexity of scientific concept(s) to be represented.
- Type of representation (e.g., mathematical/picture).
- Type of wave presented (e.g., sound, electromagnetic, mechanical, light).
- 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.

- Core idea targeted in a model (e.g., light sources, the materials, polarization of light, ray diagrams).
- Use or purpose of the representation.

General Description of Task/Chain of Sensemaking

- Students interpret a scenario of a light wave that experiences a change in properties after experiencing a change in medium. **[Prompt 1, Part A: MS-PS4-2, KSA3]**
- Students complete a model to show the path that light travels at surfaces between different transparent materials (e.g., air and water) where the light path bends. **[Prompt 1, Part B: MS-PS4-2, KSA1]**
- Students apply their model to describe the bending of light and the frequency-dependent bending of light at a surface between media. **[Prompt 1, Part C: MS-PS4-2, KSA2]**
- Students explain the effect of shining light through a prism in terms of the visible spectrum, wavelength, and speed, in terms of the bending of light using patterns in a data set. **[Prompt 2, Part A: MS-PS4-1, KSA3]**
- Students use the data and the scenario to explain the phenomenon that has occurred, the production of a rainbow in the sky. [**MS-PS4-1, KSA2]**

Targeted PE-related KSAs

MS-PS4-2, KSA3: Identify characteristics of the wave after it has interacted with a material (e.g., frequency, amplitude, wavelength).

MS-PS4-2, KSA1: Develop a model to describe the transmission of waves.

MS-PS4-2, KSA2: Use a model to make sense of given phenomena involving reflection, absorption, or transmission properties of light and matter waves.

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

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

Cross-performance Expectations Related KSAs to Target

NA

Student Demonstrations of Learning

- Model accurately represents the observable phenomena.
- Model 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.
- Shows patterns in waves that accurately interpret the relationship between frequency and wavelength.

Work Products
• Complete a model. • 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 Part A		**X**		**X**				**X**			**X**	
1 Part B		**X**			**X**			**X**				**X**
1 Part C		**X**		**X**				**X**		**X**		
2 Part A		**X**			**X**			**X**			**X**	
2 Part B		**X**		**X**					**X**		**X**	

Rubric Considerations

- Accuracy of the model.
- Sophistication of the explanations.
- Completeness and accuracy of response.

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.

Possible Technical Terms for Task

- wavelength, frequency, visible light, infrared, ultraviolet, gamma radiation, refraction, absorption, transmission, electromagnetic spectrum

Common Core State Standards for Literacy

NA

Common Core State Standards for Mathematics

Mathematical Practices

- **MP.2** Reason abstractly and quantitatively. **(MS-PS4-1)**
- **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.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