

**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**

**September 2023**

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

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| **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. [**Prompt 2, Part B: MS-PS4-1, KSA2]**
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| **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/**](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”.
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| **SIPS Assessments Complexity Framework Components** |
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| **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** |  |

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| **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
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| **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)**
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| **Task Notes** |

 SIPS Assessments Complexity Framework

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| --- | --- |
| **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
 |