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**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]** | | | | | |
| **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** |
| |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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

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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 | |