



# **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

Grade: 8	Unit: 4	Task Number: 2	Task Title: Color My World
<b>NGSS Performance Expectations</b>			
<p><b>MS-PS4-1.</b> 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.]</p> <p><b>MS-PS4-2.</b> 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]</p>			
<b>Phenomena or Phenomena-rooted Design Problem</b>			
<ul style="list-style-type: none"><li>• The task focuses on color, the frequency-dependent bending of light at a surface between media, and the production of rainbows in the sky.</li></ul>			
<b>Scenario/Context/Situation/Boundaries</b>			
<ul style="list-style-type: none"><li>• The scenario introduces the appearance of rainbows in the sky.</li><li>• The task then transitions to the properties of light waves which include the frequency-dependent bending of light at a surface between media.</li><li>• This is followed up with students tracing the path that light travels between different transparent materials (e.g., air and water).</li><li>• 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.</li><li>• The task closes with students making the connection between the properties of light waves and the production of rainbows in the sky.</li></ul>			
<b>Variable Features to Shift Complexity or Focus</b>			
<ul style="list-style-type: none"><li>• Complexity of scientific concept(s) to be represented.</li><li>• Type of representation (e.g., mathematical/picture).</li><li>• Type of wave presented (e.g., sound, electromagnetic, mechanical, light).</li><li>• Function of the model:<ul style="list-style-type: none"><li>○ To explain a mechanism underlying a phenomenon.</li><li>○ To predict future outcomes.</li><li>○ To describe a phenomenon.</li><li>○ To generate data to inform how the world works.</li></ul></li></ul>			

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- Core idea targeted in a model (e.g., light sources, the materials, polarization of light, ray diagrams).
  - Use or purpose of the representation.
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### General Description of Task/Chain of Sensemaking

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- 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

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**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.

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### Cross-performance Expectations Related KSAs to Target

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NA

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### Student Demonstrations of Learning

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- 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.
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## 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

- 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.

### Multiple Means of Representation

- 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.

### Multiple Means of Action & Expression

- 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.

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**Possible Technical Terms for Task**

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

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**Common Core State Standards for Literacy**

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NA

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**Common Core State Standards for Mathematics**

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**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**

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## SIPS Assessments Complexity Framework

Component	Complexity		
	Low	Moderate	High
<b>Connections to Curriculum and Instruction</b>	<p><b>A.1 Degree and nature of sense-making about phenomena or problems</b></p> <ul style="list-style-type: none"> <li>Requires one or two dimensions</li> <li>One dimension may have a greater degree of emphasis than another</li> <li>Requires previously learned ideas or concepts</li> </ul>	<ul style="list-style-type: none"> <li>Requires integration of two dimensions in the service of sense-making</li> <li>Requires integration of same or different combinations of dimensions as represented in the PE bundle</li> <li>Requires a combination of previously learned ideas or concepts and newly presented information</li> </ul>	<ul style="list-style-type: none"> <li>Requires integration of three dimensions in the service of sense-making</li> <li>Requires integration of same or different combinations of dimensions as represented in the PE bundle</li> <li>Requires a combination of previously learned ideas or concepts and newly presented information</li> </ul>
<b>Characteristics of the Tasks</b>	<p><b>B.1 Complexity of the presentation</b></p> <ul style="list-style-type: none"> <li>The amount and type of information provided in the scenario supports limited simple connections among ideas or concepts</li> <li>Provides few, simple graphics/data/models</li> <li>Includes definitions or examples</li> <li>Phenomenon or problem presented in a concrete way with high level of certainty</li> </ul>	<ul style="list-style-type: none"> <li>The amount and type of information provided in the scenario supports multiple evident connections among ideas or concepts</li> <li>Provides graphics/data/models</li> <li>Limited use of definitions or examples</li> <li>Phenomenon or problem presented with some level of uncertainty</li> </ul>	<ul style="list-style-type: none"> <li>The amount and type of information provided in the scenario supports multiple and varied complex connections among ideas or concepts</li> <li>Provides complex graphics/data/models</li> <li>Phenomenon or problem presented with high-degree of uncertainty</li> </ul>
	<p><b>B.2 Cognitive demand of response development</b></p> <ul style="list-style-type: none"> <li>Requires well-defined set of actions or procedures</li> <li>Requires a connection or retrieval of factual information</li> <li>Response requires a low level of sophistication with routinely encountered well-practiced applications</li> </ul>	<ul style="list-style-type: none"> <li>Requires application of ideas and practices given cues and guidance</li> <li>Requires drawing relationships and connecting ideas and practices</li> <li>Response requires a moderate level of sophistication with typical but relatively complex representation of ideas and application of skills</li> </ul>	<ul style="list-style-type: none"> <li>Requires selection and application of multiple complex ideas and practices</li> <li>Requires high degree of sense-making, reasoning, and/or transfer</li> <li>Response requires a high level of sophistication with non-routine or abstract representation of ideas and application of skills</li> </ul>

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**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

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