



Stackable Instructionally- embedded Portable Science (SIPS) Assessments Project

Grade 8 Science

Unit 4 Task 1 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 1 Specification & Verification of Alignment

Grade: 8	Unit: 4	Task Number: 1	Task Title: Now You See It
NGSS Performance Expectations			
<p>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.]</p> <p>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]</p>			
Phenomena or Phenomena-rooted Design Problem			
<ul style="list-style-type: none">• The task focuses on light waves, the evolution of sight, and how some species can see what humans cannot.			
Scenario/Context/Situation/Boundaries			
<ul style="list-style-type: none">• The scenario introduces a topic related to physiological adaptations related to vision in living organisms.• The task presents an analogy of how a human eye receives light and processes light like a light sensor.• The task then transitions to wave properties and how light can be described and measured as energy.• This is followed up with mathematical representations that students create and subsequently use as evidence to support scientific conclusions about how the amplitude of a wave is related to the energy in a wave.• The task closes with students completing a model of the electromagnetic spectrum to make connections between the light humans cannot see as opposed to what is seen by a species of snake.			
Variable Features to Shift Complexity or Focus			
<ul style="list-style-type: none">• Complexity of scientific concept(s) to be represented.• Domain-specific vocabulary and definitions.• Graphic organizers presented may be diagrams, graphs, data tables, and/or drawings.• Type of wave presented (e.g., sound, electromagnetic, mechanical, light).• Phenomenon addressed in the scenario, including but not limited to:<ul style="list-style-type: none">○ Light waves created by a lightbulb, a laser, the sun, or some other source and interpreted by humans as visible light if they are within a certain frequency range.			

- Range and complexity of data provided.
- Representation of data.
- Types of mathematical representations to describe and/or support scientific conclusions about how the amplitude of a wave is related to the energy in a wave.
- Function of the representation:
 - To explain a mechanism underlying a phenomenon.
 - To predict future outcomes.
 - To describe a phenomenon.
 - To generate data to inform how the world works.
- The degree to which components of the model are provided.
- Type of wave presented (e.g., sound, electromagnetic, mechanical, light).
- Core idea targeted in model (e.g., light sources, the materials, polarization of light, ray diagrams).
- Type of evidence/data that supports a claim.

General Description of Task/Chain of Sensemaking

- Students describe the law of reflection using a model and mathematical thinking to demonstrate understanding of wave properties. **[Prompt 1: MS-PS4-1, KSA2]**
- Students graph data and use their results to describe the mathematical relationship between amplitude and energy (energy is proportional to the square of the amplitude). **[Prompt 2: MS-PS4-1, KSA4]**
- Students complete a wave model that describes the relationship between wavelength and frequency in the electromagnetic spectrum and use the model to explain the properties of light that some species perceive that humans cannot. **[Prompt 3: MS-PS4-2, KSA2]**

Targeted PE-related KSAs

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

Cross-performance Expectations Related KSAs to Target

NA

Student Demonstrations of Learning

- Model accurately represents the observable phenomena.
- 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 and describes relevant relationships between components of the model.
- Accurately describes how waves transmit energy.
- Shows patterns in waves that accurately interpret the relationship between frequency and wavelength.

Work Products

- 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
<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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		X			X			X				X
3			X		X				X		X	

Rubric Considerations

- Accuracy of the graph.
- 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

- amplitude, wavelength, frequency, resting position, crest, trough, transverse wave, visible light, infrared, ultraviolet, gamma radiation, reflection, 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	<p>A.1 Degree and nature of sense-making about phenomena or problems</p> <ul style="list-style-type: none"> Requires one or two dimensions One dimension may have a greater degree of emphasis than another Requires previously learned ideas or concepts 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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	<p>B.1 Complexity of the presentation</p> <ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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
	<p>B.2 Cognitive demand of response development</p> <ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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
