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**Stackable Instructionally-embedded Portable Science (SIPS) Assessments Project**

**Grade 8 Science**

**Unit 4 End of Unit Assessment Design Patterns**

**Providing Solutions to Problems Using Simple Wave Properties**

**September 2023**

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Design Patterns (MS-PS4-1, MS-PS4-2)

**Grade 8 SIPS Design Pattern for** **MS-PS4-1**

|  |  |
| --- | --- |
| Element | Description |
| Knowledge and Practices (DCI, SEP, CCC) | In this task, students:   * understand that a simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. * use mathematical representations to describe and/or support scientific conclusions and design solutions. * apply logical and conceptual connections between evidence and explanations.   The crosscutting concept of applying graphs and charts to identify patterns in data is the organizing concept for these DCIs. |
| Performance Expectation | **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.] |
| Knowledge, Skills, & Abilities (KSAs) | **KSA1:** Create a graphical representation of a simple wave that demonstrates a repeating pattern.  **KSA2:** Use models and mathematical thinking to demonstrate understanding of wave properties.  **KSA3:** Identify patterns as an organizing concept for understanding wave properties.  **KSA4:** Use a graph to describe how the amplitude of a wave is related to the energy in a wave. |
| Student Demonstration of Learning | * Model accurately represents the observable phenomena. * Model accurately captures all mechanistic features of the observable phenomena. * Model accurately shows relationships among wave properties. * Correctly applies a simple mathematical wave model to a physical system or phenomenon to identify how the wave model characteristics correspond with physical observations. * Correctly predicts the change in the energy of the wave if any one of the parameters of the wave is changed. * Identiﬁes relevant or meaningful patterns that address a scientific question. * Identifies and describes relevant relationships between components of the model. * Shows patterns in waves that accurately interpret the relationship between frequency and wavelength. |
| Work Product | * Draw a model. * Complete a model. * Mathematical representations. * Constructed-response. |
| Task Features | * The task focuses on performances for which students’ opportunity to learn has prepared them. * The task is based on the assessed KSA(s) and driven by a high-quality scenario that focuses on a phenomenon or design problem. * The task scenario is grounded in the phenomena and problems being addressed. * The task prompts students to make connections between observed phenomena or evidence and reasoning underlying the observation/evidence. * The task provides ways for students to make connections of meaningful local, global, or universal relevance. * The task scenario is sufficient, engaging, relevant, and accessible to a wide range of students. * The task is accessible, appropriate, and cognitively demanding for all learners, including students with disabilities, students who are English learners, or those who are working below or above grade level. * All prompts within a task are fair and equitable and include a range of presentation and response modes. * The task requires students to use scientific reasoning and process skills to produce evidence that can be used by educators to make inferences about student learning. * The task requires students to use reasoning and integrate multiple dimensions (i.e., SEP, DCI, CCC) to support sense-making about phenomena or problems. * All tasks elicit core ideas as defined in the PE. * The task uses information that is scientifically accurate. * The task elicits core ideas as defined in the PE. * The task uses active voice and present tense. * The task is written at or below grade level. |
| Variable Features - Aspects of an assessment task that can be varied to shift complexity or focus | * Complexity of scientific concept(s) to be represented. * 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 representation may be provided for revision or one that is created from scratch. * What type of wave is being modeled? * Use or purpose of the representation. * Type of representation (e.g., mathematical/picture). * Core idea targeted (e.g., sound sources, the medium, deformation, and vibration of an instrument’s string). |
| Assessment Boundaries | * Assessment does not include electromagnetic waves and is limited to standard repeating waves. * Assessment should be limited to qualitative applications pertaining to light and mechanical waves. |
| Technical Terms | * Waves, amplitude, frequency, absorb, medium, trough, crest, nodal line/rest line, interface |

**Grade 8 SIPS Design Pattern for MS-****PS4-2**

|  |  |
| --- | --- |
| Element | Description |
| Knowledge and Practices (DCI, SEP, CCC) | In this task, students:   * + understand that a sound wave needs a medium through which it is transmitted.   + understand that when light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object’s material and the frequency (color) of the light.   + understand that the path light travels can be traced as straight lines, except at surfaces between different transparent materials where the light path bends.   + understand that a wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.   + understand that because light can travel through space, it cannot be a matter wave, like sound or water waves. * develop and use a model to describe phenomena.   The crosscutting concept of applying the knowledge that structures can be designed to serve particular functions is the organizing concept for these DCIs. |
| Performance Expectation | **MS-PS4-2** Develop and use a model to describe that 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] |
| Knowledge, Skills, & Abilities (KSAs) | **KSA1:** Develop a model to describe the transmission of waves.  **KSA2:** Use a model to make sense of given phenomena involving reflection, absorption, or transmission properties of light and matter waves.  **KSA3:** Identify characteristics of the wave after it has interacted with a material (e.g., frequency, amplitude, wavelength).  **KSA4:** Use a model to describe that waves are reflected, absorbed, or transmitted through various materials.  **KSA5:** Develop a model to describe that waves are reflected or absorbed. |
| Student Demonstration of Learning | * Model accurately represents the observable phenomena. * Model accurately captures all mechanistic features of the observable phenomena. * Model accurately shows the transmission of waves. * Accurately describes how waves transmit energy. * Accurately describes that vibrations in materials set up wavelike disturbances that spread away from the source, such as sound waves. * Correctly describes whether the model shows how waves are reflected, absorbed, or transmitted through a material. |
| Work Product | * Draw a model. * Complete a model. * Constructed-response. * Short-response. |
| Task Features | * The task focuses on performances for which students’ opportunity to learn has prepared them. * The task is based on the assessed KSA(s) and driven by a high-quality scenario that focuses on a phenomenon or design problem. * The task scenario is grounded in the phenomena and problems being addressed. * The task prompts students to make connections between observed phenomena or evidence and reasoning underlying the observation/evidence. * The task provides ways for students to make connections of meaningful local, global, or universal relevance. * The task scenario is sufficient, engaging, relevant, and accessible to a wide range of students. * The task is accessible, appropriate, and cognitively demanding for all learners, including students with disabilities, students who are English learners, or those who are working below or above grade level. * All prompts within a task are fair and equitable and include a range of presentation and response modes. * The task requires students to use scientific reasoning and process skills to produce evidence that can be used by educators to make inferences about student learning. * The task requires students to use reasoning and integrate multiple dimensions (i.e., SEP, DCI, CCC) to support sense-making about phenomena or problems. * All tasks elicit core ideas as defined in the PE. * The task uses information that is scientifically accurate. * The task elicits core ideas as defined in the PE. * The task uses active voice and present tense. * The task is written at or below grade level. |
| Variable Features - Aspects of an assessment task that can be varied to shift complexity or focus | * Type of wave presented (e.g., sound, electromagnetic, mechanical, light). * Format of "real-world" phenomenon under investigation: image, data, text, combination. * Standard units used (e.g., grams, liters). * Use or purpose of the model. * Type of model (e.g., physical/virtual). * Core idea targeted in a model (e.g., light sources, the materials, polarization of light, ray diagrams). |
| Assessment Boundaries | * 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. |
| Technical Terms | * Mechanical waves, electromagnetic waves, wavelength, transverse wave, longitudinal wave, wave speed, visible light, spectrum, vacuum, refraction, reflection, transmit, transparent |

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