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

**Grade 8 Science**

**Unit** **1 Task 1 Specification Tool & Verification of Alignment**

**Forces and Energy**

**September 2023**

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SIPS Grade 8 Unit 1 Task 1 Specification & Verification of Alignment

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| **Grade: 8** | **Unit: 1** | **Task Number: 1** | **Task Title: Storing Grocery Carts** |
| **NGSS Performance Expectations** | | | |
| **MS-PS2-1.** Apply Newton’s third law to design a solution to a problem involving the motion of two colliding objects.[Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] *[Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension*.*]*  **MS-PS2-2.** Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.[Clarification Statement: Emphasis is on balanced (Newton’s first law) and unbalanced forces in a system, qualitative comparisons of forces, mass, and changes in motion (Newton’s second law), frame of reference, and specification of units.][*Assessment Boundary: Assessment is limited to forces and changes in motion in one dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.*] | | | |
| **Phenomena or Phenomena-rooted Design Problem** | | | |
| * Design a solution to a problem involving the motion of two colliding objects. | | | |
| **Scenario/Context/Situation/Boundaries** | | | |
| * The scenario includes a situation in which students plan an investigation in order to apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects. * Students are asked to make logical and conceptual connections between evidence and explanations. | | | |
| **Variable Features to Shift Complexity or Focus** | | | |
| * Phenomenon addressed. * Complexity of scientific concept(s) to be modeled. * Format of "real-world" phenomenon under investigation: image, data, text, combination. * Domain-specific vocabulary. * Use or purpose of the model. | | | |

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| **General Description of Task/Chain of Sensemaking** | | |
| * Students develop a model to identify action-reaction pairs of forces and the objects/components involved in a physical situation involving a collision between two objects. **[Prompt 1, Part A: MS-PS2-1, KSA1]** * Students are asked to apply scientific concepts, principles, theories, and big ideas to construct an explanation of a real-world collision between two objects. **[Prompt 1, Part B: MS-PS2-2, KSA2]** * Students are asked to evaluate designs for collisions and provide an explanation using the provided criteria and constraints of the solution. **[Prompt 2, Parts A & B: MS-PS2-1, KSA2]** * Students identify the scientific principle (e.g., action-reaction forces) that supports the effectiveness of the design**. [Prompt 2, Part C: MS-PS2-1, KSA6]** * Students describe the relative magnitude and direction of the forces exerted onto a system and whether or not they balance each other. **[Prompt 2, Part D: MS-PS2-2, KSA4]** | | |
| **Targeted PE-related KSAs** | | |
| **MS-PS2-1, KSA1:** Develop a model to represent the motion of objects in colliding systems and their interactions (e.g., inputs, processes, and outputs, as well as energy and matter flows within systems).  **MS-PS2-2, KSA2:** Explain how the change in motion of an object (i.e., changes over time and forces at different scales) is due to balanced or unbalanced forces acting on the object.  **MS-PS2-1, KSA2:** Describe a design approach as a possible solution to a problem involving the motion of two colliding objects.  **MS-PS2-1, KSA6:** Apply Newton’s third law to identify the scientific principle (e.g., action-reaction forces) that supports the effectiveness of the design.  **MS-PS2-4, KSA4:** Make logical and conceptual connections between evidence and explanations of stability and change in an object’s motion. | | |
| **Cross-performance Expectations Related KSAs to Target** | | |
| NA | | |
| **Student Demonstrations of Learning** | | |
| * Model accurately represents the observable phenomena. * Develops and/or uses a model to determine a design solution to a problem. * Identifies a solution that is most likely to be successful. * Determines how well the design solution meets the criteria and constraints, based upon an understanding of Newton’s third law. * Analyzes and interprets data to determine how a design best minimizes collision force. | | |
| **Work Products** | | |
| * Complete a model. * Interpretation of models. * Constructed response. | | |
| **Application of Universal Design for Learning-based Guidelines to Promote Accessibility (**[**https://udlguidelines.cast.org/**](https://udlguidelines.cast.org/) **)** | | |
| **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. * Activating relevant prior knowledge. * Bridge concepts with relevant analogies and metaphors. * 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** |  |  | | **2 Part A** |  | **X** |  |  | | **X** |  |  | | **X** |  |  | **X** |  | | **2 Part B** |  | **X** |  |  | | **X** |  |  | | **X** |  |  | **X** |  | | **2 Parts C & D** |  | **X** |  |  | | **X** |  |  | |  | **X** |  |  | **X** | |
| **Rubric Considerations** |
| * Accuracy of the model. * Sophistication of the explanations. |
| **Assessment Boundaries** |
| * Assessment is limited to vertical or horizontal interactions in one dimension. * Assessment is limited to forces and changes in motion in one dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry. |
| **Common Alternate Conceptions** |
| * **MS-PS2-1**   + Action-reaction forces cancel each other. * **MS-PS2-2**   + Different types of motion—rest, constant velocity, and constant acceleration—are the same.   + If speed increases, then acceleration must be increasing as well.   + Contact/field forces and net forces are the same.   + Forces must be exerted on a system for the system to maintain motion.   + If the sum of all forces adds to zero, then the object must be at rest.   + If the sum of all forces adds to zero, then the object cannot move.   + Any force on an object must be in the direction of movement.   + Individual forces, not their sum, determine the motion of an object.   + If an object is moving, the sum of all forces cannot equal zero.   + Constant speed, not constant acceleration, results from constant force.   + An object can have a force within it that keeps it moving. |
| **Possible Technical Terms for Task** |
| * balanced force, unbalanced force, collision, Newton’s third law of motion, action-reaction force pairs, momentum |
| **Common Core State Standards for Literacy** |
| **ELA/Literacy**   * **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. **(MS-PS2-1)** * **RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. **(MS-PS2-1), (MS-PS2-2)**   **Writing History/Social Studies, Science and Technical Subjects**   * **WHST.6-8.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. **(MS-PS2-1), (MS-PS2-2)** |
| **Common Core State Standards for Mathematics** |
| **Mathematical Practices**   * **MP.2** Reason abstractly and quantitatively. **(MS-PS2-1)**   **Mathematics**   * **6.NS.C.5** Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. **(MS-PS2-1)** * **6.EE.A.2** Write, read, and evaluate expressions in which letters stand for numbers. **(MS-PS2-1), (MS-PS2-2)** * **7.EE.B.3** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. **(MS-PS2-1), (MS-PS2-2)** * **7.EE.B.4** Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities. **(MS-PS2-1), (MS-PS2-2)** |
| **Task Notes** |
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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 is presented concretely 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 | |