

**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.
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| **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.
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| **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]**
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| **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.
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| **Work Products** |
| * Complete a model.
* Interpretation of models.
* Constructed response.
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| **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** |
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| **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** |

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| **Rubric Considerations** |
| * Accuracy of the model.
* Sophistication of the explanations.
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| **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.
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| **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.
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| **Possible Technical Terms for Task**  |
| * balanced force, unbalanced force, collision, Newton’s third law of motion, action-reaction force pairs, momentum
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| **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)**
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| **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)**
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| **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
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| **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
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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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