



Stackable Instructionally- embedded Portable Science (SIPS) Assessments Project

Grade 8 Science

Unit 1 Instructionally-embedded Assessment Task:

“Kinetic Energy vs. Mass/Speed Investigation”

Forces and Energy

May 2023

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SIPS Grade 8 Unit 1 Instructionally-embedded Assessment Task

Grade 8	Unit 1	Instructional Segment 3	Task Title: Kinetic Energy vs. Mass/Speed Investigation
NGSS Performance Expectations Code(s) and Description(s)			
Code	Description		
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.]		
Acquisition Goals Number(s) and Descriptions(s)			
Number	Description		
A13.	Apply the scientific idea of kinetic energy (energy of motion) to design an object, tool, process, or system.		
A16.	Plan an investigation to gather data that demonstrates the relationship between KE and mass and/or speed.		
Evidence Statements			
<ul style="list-style-type: none"> Identify the purpose of the investigation, which includes providing evidence to describe the relationship between kinetic energy and mass and/or speed. Identify dependent and independent variables, as well as what variables should be controlled to examine a problem involving the relationship between kinetic energy and mass and/or speed. Select and determine which instruments will provide accurate and precise data to carry out an investigation regarding how changing the speed and/or mass affect the motion and kinetic energy of an object. Describe the experimental procedure necessary to investigate how changing the speed and/or mass affect the motion and kinetic energy of an object. 			

Source Documentation and Information Resources References (e.g., publications, websites, citations, images, videos, etc.) Please include source name, description, citation, and a link to its original location below. Include additional rows as needed.	Licensing: Please mark an “X” under the appropriate licensing. If resource is not under a creative commons (CC) license, please attempt to find a source with CC licensing. If you are unable, please select other and provide additional information about the source in the source documentation section.							
	<i>CC0/ Public Domain</i>	<i>CC BY</i>	<i>CC BY-SA</i>	<i>CC BY-NC</i>	<i>CC BY-NC-SA</i>	<i>CC BY-ND</i>	<i>CC BY-NC-ND</i>	<i>Other</i>
Bowling ball and conservation of energy video in task scenario: <ul style="list-style-type: none"> • Bowling Ball - Conservation of Energy - YouTube [https://www.youtube.com/watch?v=8GLtFNaiMH8] 								X
Illustration of plastic cup used throughout task: <ul style="list-style-type: none"> • Cup Plastic Paper - Free vector graphic on Pixabay [https://pixabay.com/vectors/cup-plastic-paper-yellow-isolated-304195/] 	X							

Teacher Administration Guide

Introduction

- Educators developed the accompanying classroom task to align to one or more aspects of the NGSS Performance Expectation(s) (PEs) to determine where students are in their learning at a specific point in time during an instructional sequence. Educators will need to make intentional decisions about when and how to use this task based on their students' learning needs, the purpose of giving the task, and the intended use of the evidence gathered.
- This task is designed to measure students' ability to integrate the dimensions and demonstrate their knowledge, skills, and abilities as represented by NGSS Performance Expectation **MS-PS2-2**. By administering this task, educators can gather and evaluate evidence to make accurate and meaningful judgments about students' science learning and determine how instruction may need to be adjusted along an instructional sequence to best support students.
- The phenomenon addressed in the phenomenon-based scenario is that the kinetic energy of an object is the energy that it possesses due to its motion, and the kinetic energy of an object depends upon its mass (kinetic energy increases as mass increases) as evidenced by the release and movement of a bowling bowl without force being applied. This phenomenon is also addressed through two investigations that experiment with kinetic energy given different conditions and variables.
- In this task, students figure out aspects of an experimental procedure necessary to investigate how changing mass affects the motion and kinetic energy of objects.

Administration Guidelines

- One (1) class period
- Segment 3 Lessons: "Investigating How Speed and Mass Affect the Motion and Energy of an Object," "Moving Energy," and "Modeling Kinetic Energy."
- Students individually complete a series of prompts reflecting the following chain of sensemaking:
 - Students state the purpose of a described kinetic energy investigation.
 - Students are given a set of available lab materials to set up and conduct the investigation and identify the materials as an independent variable, a dependent variable, or a constant variable.
 - Students are provided with a list of available measuring tools and describe which measuring tools will provide accurate and precise data.
 - Students describe and explain data considerations when planning an investigation to ensure fair testing and accurate results.
 - Students are given conditions for a second kinetic energy investigation and from a given set of available lab materials to set up and conduct the investigation, identify each of the materials as an independent variable, a dependent variable, or a constant variable.
 - Students describe differences between what is being measured and demonstrated in the first investigation compared to the second investigation.

Accessibility Considerations

Providing a range of accessibility considerations in the task (e.g., multiple ways of representing information, multiple types of supports, multiple ways in which students respond) promotes equity and fairness across a wide range of students who may be at different points in their science learning. In turn, these considerations can promote student interest and engagement in the tasks resulting in a more complete and accurate collection of evidence of students' science learning.

Accommodations for students with a disability or Multilingual Learners that are part of their on-going instructional programs are to be provided during the administration of this task. Accommodations should be consistent with those provided in students' daily instructional strategies and assessment opportunities, including assistive technology devices if appropriate. These accessibility considerations and accommodations enable accurate inferences about student learning and inform meaningful adjustments to planning and instruction.

Ancillary Materials

- Computer for students to view a video individually or in small/large group(s), referenced in the scenario and viewed before answering Prompt 1.
- [Bowling Ball- Conservation of Energy - YouTube](https://www.youtube.com/watch?v=8GLtFNaiMH8) (Bowling Ball – Conservation of Energy)
[<https://www.youtube.com/watch?v=8GLtFNaiMH8>]

Instructions for Administering the Performance Task or Implementing the Research Task, Design Project, or Lab

- Preview the video, “Bowling Ball - Conservation of Energy,” and identify and pre-teach any general academic vocabulary words or domain-specific vocabulary words that will support student understanding of the content shown in the video. Students should have access to and document the meaning of the vocabulary words to support their interpretation and understanding of the video's content.
- Show **0:00/0:55** of the video which demonstrates potential and kinetic energy and the Law of Conservation of Energy. Be sure to enable Closed Captions [CC].
- Inform students that the lab materials shown in Tables 1 and 2 are NOT drawn to scale.

Scoring Guidance

- A prompt-specific scoring rubric indicates scoring criteria for each prompt or activity across a range of score points.
- Student exemplars represent high-quality responses that align to full-point rubric scores. The exemplar responses are intended to assist educators' understanding of the nature and expectations of each prompt when applying the scoring rubric. Note the exemplars serve as examples of high-quality responses, and students may respond with equally relevant, scientifically accurate responses and ideas that meet the expectations of a full-point rubric score. In general, the exemplar response associated with the highest score point in the rubric meets expectations and is scientifically accurate, complete, coherent, and consistent with the type of student evidence expected as described in the rubric.
- The approximate scoring time for each student per prompt is:
 - Prompt 1 will require approximately 30 seconds.

- Prompt 2 will require approximately 30 seconds.
- Prompt 3 will require approximately 30 seconds.
- Prompt 4 will require approximately one minute.
- Prompt 5 Part A & Part B will require approximately one minute.

Student Task

This task is about kinetic energy, forces, and motion.

Task Scenario

Physics explains how the universe works and why things work the way they do. Things are moving all around us. Kinetic energy is the energy of a moving object.

If you have heard someone say trust physics, this video *Bowling Ball – Conservation of Energy* (<https://www.youtube.com/watch?v=8GLtFNaiMH8>) gives you evidence as to why you **CAN** trust physics. Watch as Mr. Bergmann and his students trust physics when releasing a bowling ball into motion under certain conditions.

Prompt 1 - Purpose of the Scientific Investigation

You are going to conduct an investigation of kinetic energy. You will observe the results of three objects with different masses after each collides with an empty plastic container. Each object will be released from the top of a ramp, one at a time. At the bottom of the ramp, each object collides with the same plastic container.

Define the purpose of this scientific investigation by filling in the blanks in the statement below using words from the word bank.

Word Bank

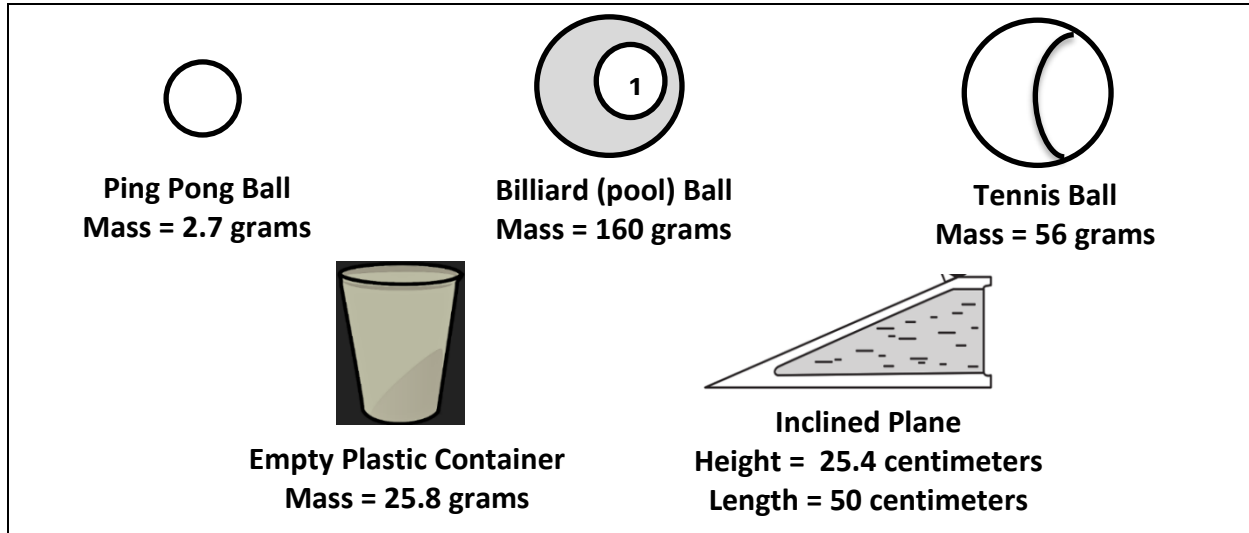
change	speed	mass
height	gravity	density
collision	length	force

The investigation will provide evidence to describe that the _____
in the plastic container's motion is due to the _____ of an object and the
_____ acting on an object.

Prompt 2 - Identification of Variables

Figure 1 shows the materials to be used to set up this investigation. Note the materials are not drawn to scale.

Figure 1. Investigation Lab Materials



The variables related to the investigation are listed in **Table 1**. Use an “X” to show which are Independent Variables, Dependent Variables, or Constant Variables in **Table 1**.

Table 1. Identification of Variables

Variable	Independent Variable	Dependent Variable	Constant Variable
Mass of the plastic container			
Mass of the ball			
Length of the ramp			
Distance plastic container moves			
Height of the inclined plane			

Prompt 3 - Selection of Measuring Tools

Several measuring tools are available to measure the effects of each object’s collision with the plastic container.

Circle the measuring tool you would use to obtain accurate and precise data.

Meterstick marked in centimeters	Ruler marked in inches	Ruler marked in millimeters	Measurement tape marked in quarter inches
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Support your answer by describing why a level of accuracy and precision in the collection of data is required.

I would select this measuring tool for accuracy because _____

To obtain precise data, I would need to _____

Prompt 4 - Data Collection and Experimental Procedure

When planning an investigation, multiple points about the data must be considered to ensure fair testing and accurate results.

Describe and explain the data considerations for this investigation by completing in **Table 2**.

Table 2. Data Considerations

Data Considerations	Description	Justification
Data to be Collected	I will collect	This information is needed to show
Number of Trials to Ensure Fair Testing	The number of trials I need is	This ensures fair testing because
How the Data will be Analyzed	I will analyze the data by	I would analyze the data this way because

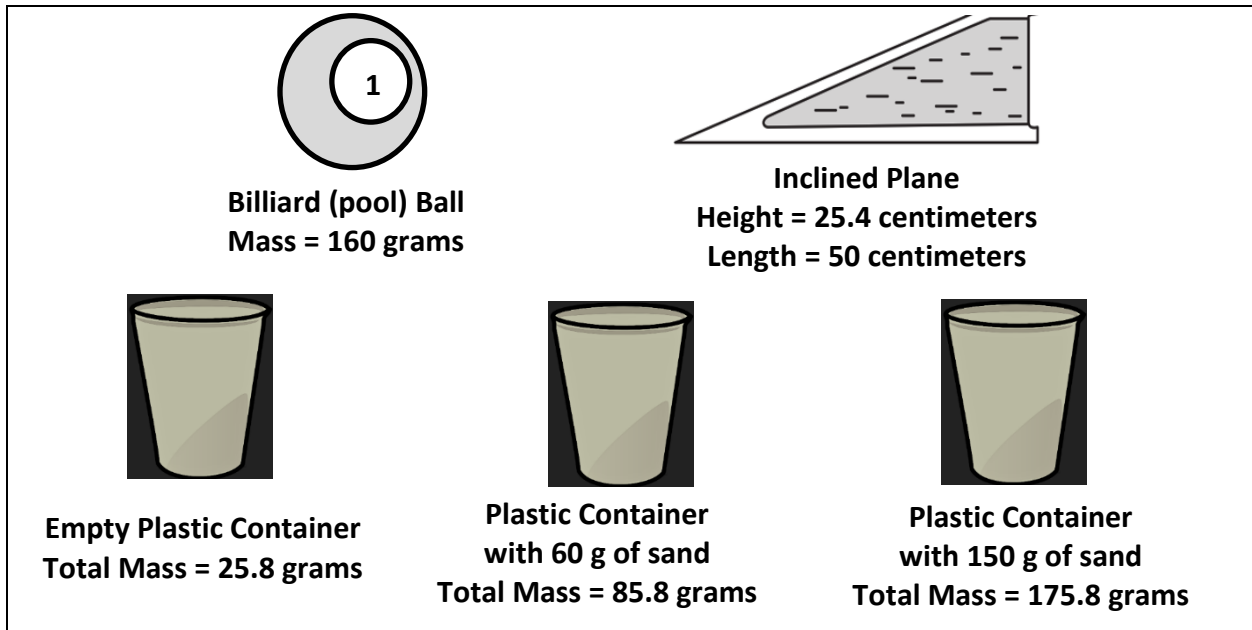
Prompt 5 - Identification of Variables for Second Investigation and Comparison

Part A.

You are going to conduct a second investigation of kinetic energy. You will observe the results of one object after it collides with three different plastic containers with different masses.

Figure 2 shows the available lab materials for this second investigation. Note the materials are not drawn to scale.

Figure 2. Second Investigation Lab Materials



The lab materials from Figure 2 are listed in Table 3. Use an “X” to show which are Independent Variables, Dependent Variables, or Constant Variables in **Table 3** for the **second** investigation.

Table 3. Second Investigation Identification of Variables

Variable	Independent Variable	Dependent Variable	Constant Variable
Height of the inclined plane			
Mass of the plastic container			
Mass of the billiard ball			
Length of the ramp			
Distance plastic containers move			

Part B.

Describe the difference between what is being measured and shown in the first investigation compared to the second investigation.

The first investigation measures _____

and shows _____

The second investigation measures _____

and shows _____

Task Rubric to Evaluate Student Evidence

Task	Score Point 0	Score Point 1	Score Point 2	Score Point 3	Score Point 4
Prompt 1	No aspect of the response is correct	Response completes the purpose statement with the words “change”, “mass,” and “force” in this order	NA	NA	NA
Prompt 2	No aspect of the response is correct	Response correctly identifies one (1) or two (2) of the five (5) variables	Response correctly identifies three (3) or four (4) of the five (5) variables	Response correctly identifies five (5) of the five (5) variables	NA
Prompt 3	No aspect of the response is correct	Response correctly identifies one (1) of the three (3) aspects	Response correctly identifies two (2) of the three (3) aspects	Response includes the following aspects: <ul style="list-style-type: none"> • Identifies ruler marked in millimeters • Provides a statement about why this tool provides the most accurate data • Provides a statement about why multiple measures with this tool provides precise data 	NA

<p>Prompt 4</p>	<p>No aspect of the response is correct</p>	<p>Response correctly identifies one (1) of the six (6) aspects</p>	<p>Response correctly identifies two (2) or three (3) of the six (6) aspects</p>	<p>Response correctly identifies four (4) of the six (6) aspects</p>	<p>Response includes the following aspects:</p> <ul style="list-style-type: none"> • Accurate description of data to be collected • Reasonable justification for the corresponding description • Accurate description of number of trials to ensure fair testing • Reasonable justification for the corresponding description (e.g., check for mistakes, improve precision, etc.) • Accurate description of data to be collected • Reasonable justification for the corresponding description
<p>Prompt 5 Part A.</p>	<p>No aspect of the response is correct</p>	<p>Response correctly identifies one (1) or two (2) of the five (5) variables</p>	<p>Response correctly identifies three (3) or four (4) of the five (5) variables</p>	<p>Response correctly identifies five (5) of the five (5) variables</p>	<p>NA</p>

<p>Prompt 5 Part B.</p>	<p>No aspect of the response is correct</p>	<p>Response correctly identifies one (1) of the four (4) aspects</p>	<p>Response correctly identifies two (2) of the four (4) aspects</p>	<p>Response correctly identifies three (3) of the four (4) aspects</p>	<p>Response includes the following aspects:</p> <ul style="list-style-type: none"> • Describe what is measured in the first investigation • Describe what is shown in the first investigation • Describe what is measured in the second investigation • Describe what is shown in the second investigation
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Exemplar Responses

Prompt 1 - Purpose of the Scientific Investigation

Define the purpose of this scientific investigation by filling in the blanks in the statement below using words from the word bank.

The investigation will provide evidence to describe that the **change** in the plastic container's motion is due to the **mass** of an object and the **force** acting on an object.

Prompt 2 - Identification of Variables

The variables related to the investigation are listed in **Table 1**. Use an "X" to show which are Independent Variables, Dependent Variables, or Constant Variables in **Table 1**.

Table 1. Identification of Variables

Variable	Independent Variable	Dependent Variable	Constant Variable
Mass of the plastic container			X
Mass of the ball	X		
Length of the ramp			X
Distance plastic container moves		X	
Height of the inclined plane			X

Prompt 3 - Selection of Measuring Tools

Circle the measuring tool you would use to obtain accurate and precise data.

Meterstick marked in centimeters	Ruler marked in inches	Ruler marked in millimeters	Measurement tape marked in quarter inches
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I would select this measuring tool for accuracy because it will give me the most accurate data because measuring to the nearest millimeter is more accurate than measuring to the nearest inch.

To obtain precise data, I would need to measure the distance the plastic container moves more than once.

Prompt 4 - Data Collection and Experimental Procedure

Describe and explain the data considerations for this investigation in **Table 2**.

Table 2. Data Considerations

Data Considerations	Description	Justification
Data to be Collected	I will collect data to show the distance the plastic container moves.	This information is needed to show the effect of the forces acting on the plastic container.
Number of Trials to Ensure Fair Testing	The number of trials I need is more than one trial for each ball.	This ensures fair testing because by repeating trials more than once, I can be sure to check if I make a mistake when measuring and that now my data is more precise.
How the Data will be Analyzed	I will analyze the data by first averaging the results for each ball after the trials. Then, I would compare the results of the three balls.	I would analyze the data this way because it will provide evidence about how far the container moves due to the mass of the ball that hits it.

Prompt 5 - Identification of Variables for Second Investigation and Comparison

Part A.

The lab materials from Figure 2 are listed in Table 3. Use an “X” to show which are Independent Variables, Dependent Variables, or Constant Variables in **Table 3** for the **second** investigation.

Table 3. Second Investigation Identification of Variables

Variable	Independent Variable	Dependent Variable	Constant Variable
Height of the inclined plane			X
Mass of the plastic container	X		
Mass of the billiard ball			X
Length of the ramp			X
Distance plastic containers move		X	

Part B.

Describe the difference between what is being measured and shown in the first investigation compared to the second investigation.

The first investigation measures the distance an object moves when other objects with different masses hit it and shows the relationship between forces and the object's motion.

The second investigation measures the distance three objects of different masses move when they are each hit by another object that has the same mass and shows the relationship between the mass of an object and how much force it takes to move it.

Task Notes

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