Stackable Instructionally-embedded Portable Science (SIPS) Assessments Project

Grade 5 Science
Unit 4 End of Unit Assessment Design Patterns
Earth and Its Gravitational Force and Motion
September 2023

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SIPS Grade 5 Unit 4 End of Unit Assessment Design Patterns (5-PS2-1, 5-ESS1-1, 5-ESS1-2)

Grade 5 SIPS Design Pattern for 5-PS2-1

Element	Description
Knowledge and Practices (DCI, SEP, CCC)	In this task, students: • demonstrate an understanding that the gravitational force of Earth acting on an object pulls that object toward the planet's center. • support an argument with evidence, data, or a model to demonstrate understanding of the disciplinary core ideas. The crosscutting concept of identifying cause-and-effect relationships and using them to explain change is the organizing concept for these DCIs.
Performance Expectation	**5-PS2-1.** Support an argument that the gravitational force exerted by Earth on objects is directed down. [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] *[Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]*
Knowledge, Skills, & Abilities (KSAs)	**KSA1:** Support an argument that the gravitational force exerted by Earth on objects is directed down. **KSA2:** Determine and use relevant evidence to describe the interactions that occur between objects and Earth. **KSA3:** Support a provided argument related to gravitational attraction. **KSA4**: Identify and describe the given evidence, data, and/or models that support a claim that includes the idea that the gravitational force exerted by Earth on objects is directed down toward the center of Earth. **KSA5**: Identify cause-and-effect relationships in order to explain change in an object's motion (i.e., object that is initially stationary when held moves downward when it is released) due to gravitational interactions.
Student Demonstration of Learning	• Develops a model that provides evidence to support a claim about how gravity affects objects. • Develops a model to show how gravitational forces act to pull objects toward the center of the Earth. • Creates and/or supports an argument of gravitational force. • Supports or constructs an argument, using evidence/data or a model, that gravity always acts to pull objects toward the Earth's center.

	• Evaluates evidence/data to determine whether it is sufficient and relevant to show that gravitational forces act to pull objects toward the center of Earth. • Makes an accurate prediction or a model about how an object behaves when influenced by gravity. • Selects the evidence that best supports the claim about a phenomenon illustrating the downward gravitational force of Earth acting on an object or objects.
Work Product	• Draw a model to describe phenomena. • Written argument with supporting evidence. • Constructed response. • Selected 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 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. • 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. • The task requires students to develop a model to apply scientific concepts (e.g., the gravitational force) to support the claim. • The task requires students to use data to be used as evidence to support the idea that the gravitational force exerted by the Earth

	on objects is directed “down” (towards the center of the Earth), no matter the height or location from which an object is released.

Variable Features (Aspects of an assessment task that <u>can be varied</u> to shift complexity or focus.)	• Complexity of scientific concept(s) to be modeled.
	• Domain-specific vocabulary and definitions.
	• Phenomenon addressed in the scenario, including but not limited to:
	  ○ Released objects in a particular location falling downward.
	  ○ An object falling downward at widely separated locations on Earth.
	  ○ Objects of varying mass, but the same shape and volume, falling at the same acceleration.
	• Format of "real-world" phenomenon under investigation: image, data, text, combination.
	• Function of the model:
	  ○ To explain a mechanism underlying a phenomenon.
	  ○ To predict future outcomes.
	  ○ To describe a phenomenon to generate data to inform how the world works.
	• Degree to which components of the model are provided.
	• Model may be student-created or provided for revision or creation.
	• Representation of model.
	• Use or purpose of the model.
	• Type of evidence/data that supports a claim.
	• Use of cause-and-effect relationships to explain changes.

Assessment Boundaries	• Assessment does not include mathematical representation of gravitational force. • Assessment does not include relative strength on gravity.
Technical Terms	• Gravity, horizon, spherical, Earth, force

Grade 5 SIPS Design Pattern for 5-ESS1-1

Element	Description
Knowledge and Practices (DCI, SEP, CCC)	In this task, students: • demonstrate an understanding that the sun is a star that appears larger and brighter than other stars because it is closer. • demonstrate an understanding that stars range greatly in their distance from Earth. • support an argument with evidence, data, or a model to demonstrate understanding of the disciplinary core ideas. The crosscutting concept that natural objects exist from the very small to the immensely large is the organizing concept for these DCIs.
Performance Expectation	**5-ESS1-1.** Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth. *[Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]*
Knowledge, Skills, & Abilities (KSAs)	**KSA1**: Describe and/or compare the brightness of the Sun and other stars. **KSA2**: Compare different stars' relative distance from Earth given information about their relative size and brightness. **KSA3**: Support an argument that differences in the apparent brightness of the sun compared to other stars are due to their relative distances from Earth. **KSA4:** Students develop a model showing the relationship between distance and apparent brightness of stars and use this to support their claim.
Student Demonstration of Learning	• Recognizes that the sun, which is a star, is much, much closer to the Earth than any other star in the universe. • Recognizes that stars vary in size and range greatly in their distance from the Earth. • Accurately describes the brightness of the sun and/or other stars. • Appropriately compares the brightness of the sun and/or other stars. • Accurately compares distances of multiple stars to Earth. • Identifies and/or describes evidence that supports an argument that differences in the brightness of the sun and/or stars are due to relative distances from Earth. • Develops a model that accurately reflects the relationship between distance and brightness of stars. • Accurately uses reasoning to explain how relevant evidence/data supports or refutes the claim which includes the idea that the

	apparent brightness of the sun and stars is due to their relative distances from Earth. • Accurately describes how a model supports an argument that differences in apparent brightness of stars are due to their relative distances from Earth.
Work Product	• Draw a model to describe phenomena. • Complete a model. • Selected response. • 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 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. • 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. • The task requires students to develop a model to apply scientific concepts (e.g., the gravitational force) to support the claim. • The task requires students to use data to be used as evidence to support the idea that the gravitational force exerted by the Earth on objects is directed "down" (towards the center of the Earth), no matter the height or location from which an object is released.

Variable Features (Aspects of an assessment task that <u>can be varied</u> to shift complexity or focus.)	• Complexity of scientific concept(s) to be modeled.
	• Domain-specific vocabulary and definitions.
	• Phenomenon addressed in the scenario, including but not limited to:
	  ○ Photometer measurements of luminosity can be used at varying distances from a light source.
	  ○ A comparison of the apparent brightness of two identical light sources at two different distances from an observer can be made.
	  ○ The sun appears brighter than other more distant stars.
	  ○ Distant stars appear dimmer than similar stars that are closer to Earth.
	  ○ Light from the sun can make it difficult to see distant objects in space.
	  ○ The sun is much brighter than other objects in the solar system.
	  ○ The apparent brightness of the sun is greater on Venus than on Saturn.
	• Function of the model:
	  ○ To explain a mechanism underlying a phenomenon.
	  ○ To predict future outcomes.
	  ○ To describe a phenomenon.
	  ○ To generate data to inform how the world works.
	• Degree to which components of the model are provided.
	• Model may be student-created or provided for revision or creation.
	• Representation of model.
	• Use or purpose of the model.
	• Type of evidence/data that supports a claim.
	• Use of cause-and-effect relationships to explain changes.
	• Number of stars and their distances from the Earth.
	• Representation of distance from Earth.
	• Representation of brightness of stars.

Assessment Boundaries	• Assessment is limited to relative distances, not sizes, of stars. • Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, and stage).
Technical Terms	• Relative distance, star, the sun, luminous, solar system, universe, Earth, apparent brightness

Grade 5 SIPS Design Pattern for 5-ESS1-2

Element	Description
Knowledge and Practices (DCI, SEP, CCC)	In this task, students: • demonstrate an understanding that the orbits of Earth around the sun and the orbits of the moon around the Earth, together with the rotation of Earth about an axis cause observable patterns. • demonstrate an understanding that there are observable patterns related to daily changes in length and direction of shadows, day and night, the seasonal appearance of some stars in the night sky, and the position of the sun, moon, and stars at different times of the day and year. • represent data in graphical displays to reveal patterns to demonstrate understanding of the disciplinary core ideas. The crosscutting concept of identifying patterns in data and using similarities and differences in patterns to sort, classify, communicate, and analyze changes in natural phenomena are the organizing concepts for these DCIs.
Performance Expectation	**5-ESS1-2.** Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] *[Assessment Boundary: Assessment does not include causes of seasons.]*
Knowledge, Skills, & Abilities (KSAs)	**KSA1:** Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows. **KSA2:** Represent data in graphical displays to reveal patterns of daily changes in the length of day and night. **KSA3:** Represent data in graphical displays to reveal patterns of the seasonal appearance of some stars in the night sky. **KSA4:** Use organized data to find and describe relationships between the datasets (i.e., orbits of Earth around the sun and of the moon around Earth, the rotation of Earth about an axis between its North and South poles). **KSA5**: Identify similarities and differences in the timing of observable changes in shadows, daylight, and the appearance of stars to describe how events occur at different rates (e.g., Earth rotates on its axis once a day, while its orbit around the sun takes a full year). **KSA6**: Organizes data in a way to reveal patterns or relationships related to the orbits of Earth around the sun, of the moon around Earth, and/or the rotation of Earth about its axis, which makes predictions possible.

Student Demonstration of Learning	• Uses graphical displays to organize data pertaining to daily and seasonal changes caused by Earth's rotation and orbit around the sun. • Uses organized data to find and describe relationships/patterns within the datasets (e.g., the length of the day gradually changes throughout the year as Earth orbits the sun, with more daylight hours in the summer and fewer daylight hours in the winter; similarities and differences in the timing of observable changes in shadows; and the appearance of stars show that events occur at different rates). • Sorts, classifies, communicates, and analyzes simple rates of change for natural phenomena using similarities and differences in patterns.
Work Product	• Organize data in a table and/or graphical display (e.g., chart, graph). • Summarize data to identify relationships between datasets. • Interpretation of data. • Graph quantities. • Constructed response. • Selected 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 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. • 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. • The task requires students to organize data in a way to reveal patterns or relationships that make predictions possible. • The task requires students to use data to be used as evidence to support the idea that the gravitational force exerted by the Earth on objects is directed "down" (towards the center of the Earth), no matter the height or location from which an object is released.

Variable Features (Aspects of an assessment task that <u>can be varied</u> to shift complexity or focus.)	• Complexity of scientific concept(s) to be modeled.
	• Domain-specific vocabulary and definitions.
	• Phenomenon addressed in the scenario, including but not limited to:
	  ○ The length of shadow at noontime over the course of the year.
	  ○ The pattern of daylight (i.e., length of daylight) during regular intervals over the course of a year.
	  ○ The path of the sun and stars across the sky as they rise and set.
	  ○ Stars in the sky that are viewable during some times of the year but not others.
	  ○ The movement, length, or both, of shadows cast by an object and the movement of the Sun throughout the day.
	• Data sets addressed in the scenario, including but not limited to:
	  ○ Hours of daylight.
	  ○ Length and/or direction of shadows.
	  ○ Presence or absence of stars and/or constellations.
	  ○ Phases of the moon.
	  ○ Seasonal patterns in duration of daylight.
	  ○ Daily patterns of change in the length and/or direction of shadows.
	  ○ Patterns of sunrise and/or sunset.
	  ○ Patterns of appearance for stars and/or constellations.
	• Graphic organizers presented may be diagrams, graphs, data tables, and/or drawings.
	• Patterns of change addressed in the scenario, including but not limited to:
	  ○ The day/night cycle.
	  ○ The change in length and direction of shadows during the day.
	  ○ The apparent motion of the sun across the daytime sky and the moon across the nighttime sky
	  ○ The changes in the appearance of the moon over a period of four weeks.

	○ The seasonal changes in the position of the stars in the night sky.
Assessment Boundaries	• Assessment does not include causes of seasons.
Technical Terms	• Earth's axis, Earth's poles, constellations, orbit, rotation, sunrise, sunset, shadows, winter, summer, fall, spring, cyclical pattern, sun, moon, day, year

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