



Stackable Instructionally- embedded Portable Science (SIPS) Assessments Project

Grade 5 Science

Unit 4 Instructionally-embedded Assessment Task Specification Tool:

“Star Light, Star Bright”

Earth and Its Gravitational Force and Motion

September 2023

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Grade 5	Unit 4	Instructional Segment 1	Task Title: Star Light, Star Bright
Unit 4 Title: Earth and Its Gravitational Force and Motion			
Anchor Phenomenon		Problematization/Investigative Strategy for the Unit	
<p>In this unit, the anchor phenomenon is centered around observations of what is in the sky. As an example, the unit engages students with the astronomical studies of Indigenous cultures from around the world to encourage students to consider how different cultures engage with astronomy and the stars. The teacher can find a variety of resources online; one example of Indigenous astronomy can be found at Native Skywatchers. The teacher may also want to consider contacting local tribal agencies, tribal cultural departments, or intertribal agencies for localized information. Links to additional resources are also included in the materials at the end of the instructional framework.</p> <p>Alternative anchoring phenomena can be selected by the teacher, such as having students "look up" outside to start their thinking and generate observations about that day's sun, moon, and/or their evening's stars, moon, and satellites/space station.</p>		<p>Using constellations from diverse backgrounds as inspiration, students develop their own constellations and stories from their own local night sky. (Students may use a digital planetarium if they cannot go out after dark.) Students generate questions about their constellations, the sun, and the stars' apparent movements across the sky.</p>	
Segment 1 Overview			
<p>By engaging in the practices of developing and using models, constructing explanations and designing solutions, analyzing and interpreting data, and engaging in argument from evidence, students learn about the size, brightness, and distance of stars in the sky about the sun. Students begin the unit by exploring an anchoring phenomenon based on their observations of what is in the sky as seen in media, stories they have heard, or their actual surroundings. Possible driving questions include, "Why doesn't the moon fall to the Earth?," "Why is everyone's sky different?," etc. This investigation is revisited in the segment as students learn more about stories about constellations from an Indigenous community.</p> <p>Assessments for this segment focus on Big Idea 2 which has students develop models, construct explanations, analyze and interpret data, and engage in arguments from evidence to understand more about patterns that they observe in the sky. Students are informally assessed on their understanding of patterns in what they observe and learn about objects in the sky. Students are formally assessed on their ability to generate graphical representations and models and use those to support arguments related to the idea that the apparent brightness of the sun and stars is due to their relative distances from the Earth and that even though stars may be a great distance they can emit light.</p>			

Lesson Title(s)	Lesson Description(s)
The Sun and Stars	<p>In the lesson, "The Sun and Stars," students explore a variety of resources, gather information, and record their learning in their science notebooks or other organizers. To support students' research and focus, the teacher may want to provide curated resources grouped by topic or by sub-questions. Potential topics/sub-questions include:</p> <ul style="list-style-type: none"> • What is a star made of? • Why are some stars brighter than others? • Which star is closest? Is it the brightest? • How far away are the stars? • How can we see the stars? • What kinds of telescopes do we use to see the stars? • Why are telescopes bigger or smaller? • What is the sun? • How is the sun different from other stars? How is it alike? • How far away is the sun? How does that compare to other stars? <p>Next, students prepare a presentation that includes an explanation and their understanding of the distance of the sun from Earth relative to other stars. After students gather their information, they meet with other groups to share and collaborate on what they found and why they think their information is important.</p> <p><u>What Students Figure Out</u></p> <p>After students have finished their collaboration, the teacher shares with them an article on the topic of light pollution from satellites, such as Astronomy The Guardian or Elon Musk's Starlink satellites are interfering with astronomy. It's just the beginning. - Vox. The 2nd article has a number of simulations embedded in it to view as well. The class discusses the article and the impacts of satellites on the night sky.</p>
Big, Small, it is all Relative	<p>Students watch the video Forced Perspective. The teacher pauses the video at 7 seconds. Students are asked to rank objects from tallest to shortest: painting, man, ball, cup 1, cup 2, and a chair. Students watch the remainder of the video to see that, because of the relationship between apparent size and the actual size of an object, things are not always as they appear.</p> <p>To see this quantitatively, students gather data that includes graphical displays about the apparent size of a basketball, a baseball, or some other objects. After placing the students in small groups, the teacher provides them with a ruler and a measuring tape. The teacher places the two balls next to each other and students stand at different distances away from the balls and record measurements of how</p>

large the ball appears to be using the ruler. Students examine their data to see what patterns they notice, noticing that the closer they are to the objects the larger they appear to be. (It is well above grade level for students to find the mathematical relationship between apparent size and distance. The focus instead is on the idea that as they get closer the object appears larger.) The teacher encourages them to consider how they would arrange the two objects so that they were the same size and how to make the smaller object appear larger.

To understand how brightness is impacted by distance, students collect data using a light meter and measure the change in brightness at different distances from a light source, similar to the science project [Star light, Star bright: How Does Light Intensity Change with Distance?](#). In this activity, students use a light meter or light meter app on a smartphone/tablet to measure how bright a light source is at different distances. Students create graphs of their data and find that brightness drops off significantly as they move away from the source (Inverse Square Law, note: the mathematical relationship is above grade level but could be an opportunity for advanced students.) After students have created their graphs, the class discusses what the graph means for brightness. The teacher uses questioning strategies to support students in recognizing that brightness decreases rapidly as we move away from an object before slowing down.

What Students Figure Out

The teacher shows the initial video again to students, pausing at 7 seconds again. Students create an annotated drawing that uses evidence, logic, and reasoning to explain the apparent sizes of the different objects which includes drawings, labels, explanatory text, and other representations that they feel are appropriate.

Formal Assessment Title	Assessment Description
Star Light, Star Bright	In this task, students explore why stars appear brighter or dimmer in the sky. They work with data related to two ways in which a star's brightness can be measured, the actual brightness (brightness from a fixed distance) and apparent brightness (brightness from Earth). Students use data to support the claim that a star's brightness as observed from Earth is a function of both distance and actual brightness.
NGSS PE(s) Code(s) & Description(s)	
5-ESS1-1. Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth. <i>[Clarification Statement: Absolute brightness of stars is the result of a variety of factors. Relative distance from Earth is one factor that affects apparent brightness and is the one selected to be addressed by the performance expectation.] [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).]</i>	

AG(s) Code(s) & Description(s)

A1. Develop and/or use a model to describe that light from stars reaches Earth even when those stars' distances vary greatly.

A2. Support an argument that stars range greatly in their distance from Earth and they emit light that can reach Earth, using evidence, data, or a model.

A3. Represent data in graphical displays to reveal that the sun is closer than other stars and that the sun appears larger and brighter than other stars.

Evidence Statement(s)

- Identify evidence that supports an explanation about the relationship between distance and apparent size and/or brightness of the sun versus all other stars.
 - Identify what evidence or data supports an argument that stars range greatly in their distance from Earth and/or that stars emit light that can reach Earth.
 - Describe how data shows that the sun is closer than other stars and/or that the sun appears larger and brighter than other stars.
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Phenomenon or Phenomenon-rooted Design Problem

- Students explore how different from one another individual stars can be. They learn that the apparent visual brightness of a star is not a good indicator of its distance.
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General Scenario Description

Students compare absolute brightness and apparent brightness to the distance of stars from Earth.

Chain of Sensemaking

- Compare data of apparent brightness vs. absolute brightness for two stars to explain which star is further away.
 - Compare data of absolute brightness vs. distance of two stars to predict which will appear brighter from Earth.
 - Represent the distance of three stars from Earth in a graphic to support a claim related to a star's apparent brightness and distance from Earth to show distance vs. apparent brightness of stars.
 - Plot data related to the scenario of students' investigation of apparent brightness using a flashlight and changes in the diameter of the beam when the flashlight is moved away from the wall.
 - Make a claim and develop an argument with evidence about why the Earth's sun appears brighter and larger than other similar stars.
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Work Products

- Short Answer
 - Constructed response
 - Complete a model
 - Graph data
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- Graphic Organizer: Claim, Evidence, Reasoning

Application of Universal Design for Learning-based Guidelines to Promote Accessibility (<https://udlguidelines.cast.org/>)

Multiple Means of Engagement	Multiple Means of Representation	Multiple Means of Action & Expression
<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Context or content <input checked="" type="checkbox"/> Age appropriate <input checked="" type="checkbox"/> Appropriate for different groups <input checked="" type="checkbox"/> Makes sense of complex ideas in creative ways <input checked="" type="checkbox"/> Vary the degree of challenge or complexity within prompts 	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Provide visual diagrams and charts <input type="checkbox"/> Make explicit links between information provided in texts and any accompanying representation of that information in illustrations, equations, charts, or diagrams <input checked="" type="checkbox"/> Activate relevant prior knowledge <input type="checkbox"/> Bridge concepts with relevant and simple analogies and limited use of metaphors <input type="checkbox"/> Highlight or emphasize key elements in text, graphics, diagrams, formulas <input checked="" type="checkbox"/> Use outlines, graphic organizers, unit organizer routines, concept organizer routines, and concept mastery routines to emphasize key ideas and relationships <input checked="" type="checkbox"/> Give explicit prompts for each step in a sequential process 	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Solve problems using a variety of strategies <input checked="" type="checkbox"/> Sentence starters <input checked="" type="checkbox"/> Embed prompts to “show and explain your work”

Targeted PE(s) Code(s) and Alternate Conception(s)

- **NGSS PE: 5-ESS1-1** Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.
 - **Common Alternate Conceptions**
 - The sun is bigger and brighter than some other stars.
 - All stars are the same size.

Vocabulary

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|--|---|
| <ul style="list-style-type: none"> • Absolute brightness • Apparent brightness • Light year | <ul style="list-style-type: none"> • Star • Constellation • Diameter |
|--|---|