The Vanishing Sun

Knowledge Set Teaching Guide

This Knowledge Set is designed to promote scientific inquiry as students learn about how ordinary people and scientists across the U.S. are planning to study the total solar eclipse that will take place on August 21, 2017. The initial text in this set introduces ancient beliefs about the cause of solar eclipses. Students then read texts that provide modern scientific explanations for solar eclipses. As students progress through this set they will develop their own questions about solar eclipses and formulate ideas for other eclipse-related investigations.

Target Grades & Subject(s): Grades 6-12; Physical/Earth & Space Science

Learning Objectives

- Students will describe the different types of solar eclipses and use models to demonstrate and explain their causes. (NGSS MS/HS-ESS1-1)
- Students will use textual and scientific evidence to support claims about solar eclipses. (CCSS RST.1, RST.2)

Before Teaching this Series

- Create a large K-W-L chart (3-column chart labeled: Know, Want to know, and Learned) and ask students to share ideas about what they already know and want to find out about solar eclipses. At the end of this set, review the chart and add student responses to the "Learned" column.
- Review key vocabulary and concepts related to the Sun-Moon-Earth system (e.g., Earth and Moon orbits, Earth's rotation, gravity, lunar vs. solar eclipse, etc.)

Texts in this Set (download texts here)

Text 1: Daughter of the Sun (3 pages)	
The first text in this set is a myth told by the Cherokee people to explain the reasons for the first solar eclipse. This myth helps introduce ideas and questions that people have had about eclipses for thousands of years and prompts students to begin generate their own questions about the universe. As students read, they will examine different perspectives and consider how different ideas about the universe came about.	Discussion Questions: - Based on the story, what were some things that the Cherokee people seemed to understand or recognize about the universe? - If you lived during ancient times, how might you go about investigating solar eclipses?
Text 2: Explainer: what is a solar eclipse? (4 pages)	
Next, students will read an article that explains what modern scientists now know about the motion of celestial bodies and the cause of eclipses. The instruction in this text guides students to summarize main ideas and to describe the different types of solar eclipses. [Note: This text may be somewhat challenging for 6-7 grade students. If necessary, consider assigning selected sections of this text or the CK-12 textbook section from our catalog instead (1-8: Solar Eclipses).]	Extension Activity: Working in pairs, give students a small foam ball impaled on a pencil or stick. With only a single light source in the room, have students move around the light source to observe how much of it is lit from different positions. Draw or post a diagram showing the phases of the moon and discuss the location of the sun, moon, and earth during each phase.
Text 3: When the sun goes dark: 5 questions answered about the solar eclipse (2 pages)	
This text provides a model for inquiry while also deepening students' understanding of eclipse events as the author answers some common questions about solar eclipses. As students read this text they will also learn more specifically about the "Great American Eclipse" (occurring on August 21, 2017). After reading, students will synthesize details from this text and the previous article to explain the causes and significance of a total eclipse.	Extension Activity: Have student groups explore the size of the moon and its distance from Earth by creating scale diagrams (see "Investigation: How Big and Far is the Moon?" attached). Throughout the investigation provide opportunities to compare their models and share their thinking with other groups.
Text 4: Northwest citizen scientists among the many helping track solar eclipse across US (3 pages)	
The final text in this set focuses on how "citizen scientists" are helping scientists collect data during the "Great American Eclipse." It also describes what scientists are hoping to learn from this event and how ordinary people can get involved. Encourage students to view the eclipse and share their observations.	Extension Activity: Have students explore why eclipses happen using models (see "Investigation: Why do Eclipses Happen?" attached). Before the activity show students images of a variety of solar eclipses and ask them to summarize what they see.

Actively Learn

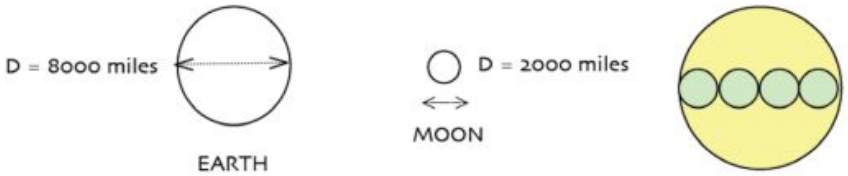
Investigation: How Big and How Far is the Moon?*

Materials: 3 balls of miscellaneous sizes for each group (one of the balls should have a diameter four times that of one of the other balls in the set), Measuring tools (ruler, measuring tape)

Part 1: Investigate the size difference between the Earth and Moon

With students working in pairs:

- Tell students you would like to make a scale model of the Earth and Moon using balls, but you are unsure which ones to use. Ask each pair to select the two balls they recommend you use. As a whole group, have each pair show the pair of balls they selected and explain their reasoning. Discuss the similarities and differences between each pair's choices.
- Give the students the following information and ask them to reevaluate their selections:
    - Earth Diameter: 8,000 miles (12,800 km)
    - Moon Diameter: 2,000 miles (3,200 km)

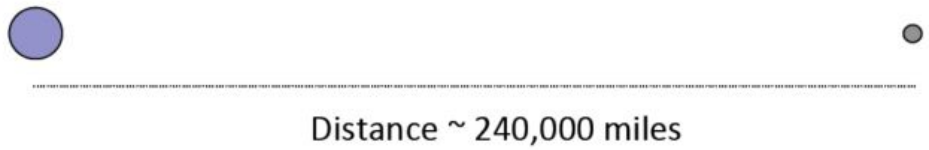


- Have each pair of students select the two balls that most closely matches with the provided data. They should use the measuring devices to check the ratio of the diameter of the Earth and Moon (4:1). Encourage them to use whatever technique and materials are available to measure.
- As a whole group, discuss and explain how their models changed when given the actual data.

Part 2: Investigate the distance between the Earth and Moon

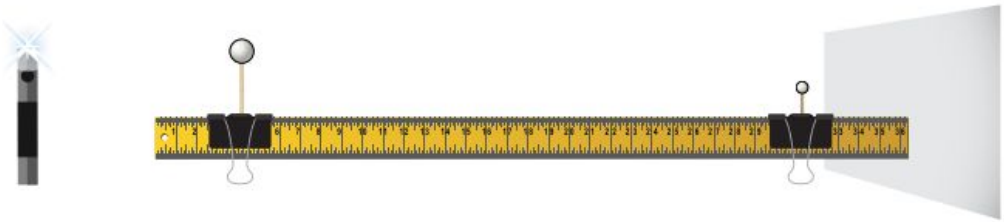
With students working in their same pairs and with the same balls they determined represented the Earth and Moon:

- Ask the pairs of students to place the balls they selected before at the distance apart they think the model Earth and Moon should be on this scale.
- As a whole group, ask each pair to explain their thinking and why they chose the distances they did. Ask another pair of students if they agree or disagree with their estimate, and to explain their thinking.
- Give the students the following information:
    - Distance from Earth to the Moon: 240,000 miles (385,000 km)



- Using this information, and the information provided in the previous section, ask students to use any technique they want to determine the scale distance between the pair of balls representing the Earth and Moon.
- As a whole group, have students explain how they determined the scale distance between the Earth and Moon.
    - With a variety of different sizes of balls, the distances will vary, however, if students have accurately portrayed the scale distance, they will form similar ratios when comparing individual models.

Actively Learn

Investigation: Why Do Eclipses Happen?*
Materials (for each group): Yardstick , 1" foam ball, ¼" round plastic bead, two toothpicks, two medium-sized binder clips, flashlight (or a lamp without a shade), all-purpose glue, index card
Part 1: Create a scale model for Earth and Moon Working in groups: ● Ask students to construct a model for the Earth and Moon to scale using the yardstick, foam ball, plastic bead, toothpicks, and binder clips. (see image below). ● Remind students of the distance between the Earth and Moon -- Earth is about 8,000 miles in diameter and is 240,000 miles away from the Moon. Since the Earth ball is one inch in diameter in our model 1 inch = 8,000 miles. Earth should be attached to the yardstick 30 inches away from the moon.   

Part 2: Model creating a solar eclipse
 	
Working with their models:
● Ask groups to use their models and the flashlight to try to reproduce the phenomena they observed in the solar eclipse images and sequences.
  ○ Prompt groups to re-create a partial, annular, and total solar eclipse.
● If students find it difficult to align their model to produce an eclipse, encourage them to use the index card to align the shadows of both objects to form their eclipses.
● Encourage students to make connections between a solar eclipse and lunar phases.
● During a whole group discussion, have students demonstrate and defend how they used their model to re-create a solar eclipse.
  ○ Ask groups to describe how they had to move their model and/or flashlight to re-create each type of solar eclipse. What were the limitations of their model?
  ○ Discuss why eclipses happen and how the findings of their investigation relate to the information they learned in the readings.

* Investigations adapted from The Universe in the Classroom: Getting Ready for the All American Eclipse! by Brian Kruse (Astronomical Society of the Pacific); NSTA's Science Scope: Exploring Lunar and Solar Eclipses via a 3-D Modeling Design Task; and Eclipse Activity Guide: Our Place in the Solar System — Sun, Earth, Moon and Eclipses