NATIONAL GEOGRAPHIC

RESOURCE LIBRARY
ACTIVITY : 50 MINS

Build a Solar Eclipse Viewer

Students use everyday items to build a solar eclipse viewer. They use it to examine the sun's corona and storms from the sun, such as solar flares and Coronal Mass Ejections (CMEs).

GRADES

3 - 8

SUBJECTS

Earth Science, Astronomy, Experiential Learning

CONTENTS

1 Image, 1 Link, 2 PDFs, 1 Video

OVERVIEW

Students use everyday items to build a solar eclipse viewer. They use it to examine the sun's corona and storms from the sun, such as solar flares and Coronal Mass Ejections (CMEs).

For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/build-a-solar-eclipse-viewer/

Program

WILDEST WEATHER IN THE SOLAR SYSTEM

DIRECTIONS

1. Introduce solar eclipses and related vocabulary.
Display the diagram of a solar eclipse. Ask students to analyze the diagram and describe what happens during a solar eclipse in their own words. Explain that a solar eclipse occurs when the

moon is in a position directly between the Earth and the sun. On Earth, we see the moon's shadow (the umbra), which fully blocks the sun. The sun's corona, or halo, is visible during those few minutes that the sun's bright light is totally obscured by the moon. When the sun is only partially blocked by the moon's shadow (the penumbra), a portion of the sun's disk is visible. We are able to view the heliosphere, the outer layer of the sun.

2. Show students the video clip from National Geographic Channel's "Staring at the Sun."
Watch the video clip. Then check students' comprehension. Ask:

- *Why is Earth the only planet in the solar system that experiences total solar eclipses?* (The ratio of size and distance between the sun and Earth creates a perfect situation where the moon completely blocks out the solar surface.)
- *What is totality? What's the maximum amount of time totality lasts?* (Totality is the period when the sun, moon, and Earth come into perfect alignment. It never lasts for more than 8 minutes.)
- *What is the sun's corona?* (the sun's outer atmosphere)
- *What is the sun's photosphere?* (the bright, everyday surface of the sun)

3. Introduce the hands-on activity and discuss safety precautions.
Draw an image of the sun that is 40 centimeters (15.7 inches) in diameter on the board. Have students cover or close one eye and hold up their thumbs very close to their faces as they look toward the sun image. Have them move their thumbs slightly left or right to try to block the image. Explain that this demonstrates an eclipse if their heads were the Earth and their thumbs were our moon. Tell students that they are going to investigate solar activity and build a viewer to allow them to observe a solar eclipse. One safe way of viewing the sun during a partial eclipse, or anytime, is a pinhole camera, which allows users to view a projected image of the sun. Remind students to never look directly at the sun, even during a total solar eclipse. Partial eclipses, annular eclipses, and the partial phases of total eclipses are never safe to watch without taking special precautions. Even when 99% of the sun's surface is obscured during the partial phases of a total eclipse, the remaining crescent is intensely bright and cannot be viewed safely without eye protection. Looking directly at the sun can quickly result in permanent eye damage or blindness.

4. Have students assemble their solar eclipse viewers.
Divide students into small groups. Distribute one copy of the handout Build a Solar Eclipse Viewer to each group. Allow groups enough time to assemble their viewers.

5. Have students go outdoors and use their viewers.
Check to make sure groups built their viewers correctly. Distribute a copy of the worksheet Observe the Sun Using a Solar Viewer. Take students outside and remind them of the safety precautions they must take. If you are planning to view an actual solar eclipse, ask students to look for the following: As the moon begins to move in front of the sun and the eclipse begins, students will be able to see the penumbra (or a shadowing on Earth and a partial solar eclipse). If you are in the correct location on Earth and the moon totally blocks the sun, you will be in the umbra. Students should be able to observe the eclipse as it happens through their viewers. Have students sketch what they observe in Part 2 of the worksheet. If a solar eclipse is not impending, students can still use their pinhole cameras to look at the sun's projection and identify sunspots or possibly even observe a solar flare.

6. Have students reflect on their experience.
Prompt them with the following questions:

- *Describe what you observed. What, if anything, surprised you?*
- *What activity were you able to see in the sun's corona?*
- *How much time did the solar eclipse take? How quickly did it change from umbra to penumbra?*
- *What would you do differently? Why?*

Modification

Make a simpler version of the solar eclipse viewer with two thin but stiff pieces of white cardboard. Punch a small, clean pinhole in one piece of cardboard and let the sunlight fall through that hole onto the second piece of cardboard, which serves as a screen, held below it. An inverted image of the sun is formed. To make the image larger, move the screen farther from the pinhole. To make the image brighter, move the screen closer to the pinhole. Do not make the pinhole wide or you will only have a shaft of sunlight rather than an image of the crescent sun. Remember, this instrument is used with your back to the sun. The sunlight passes over your shoulder, through the pinhole, and forms an image on the cardboard screen beneath it. Do not look through the pinhole at the sun.

Informal Assessment

Have students answer the following questions, either orally or in writing:

- *What happens during a solar eclipse?*

- *What are the umbra and penumbra?*
- *Why is a solar eclipse an ideal time to observe activity in the sun's corona?*

Extending the Learning

Have students watch the NASA video "What are solar flares and coronal mass ejections?" and summarize, orally or in writing, what the two phenomena are and how they affect Earth.

OBJECTIVES

Subjects & Disciplines

Earth Science
- Astronomy

- Experiential Learning

Learning Objectives

Students will:

- explain what happens during a solar eclipse
- observe and describe the sun's corona and solar activity

Teaching Approach

- Learning-for-use

Teaching Methods

- Discussions
- Hands-on learning
- Multimedia instruction

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Learning and Innovation Skills
    - Communication and Collaboration
- Critical Thinking Skills
  - Analyzing
  - Creating
  - Understanding

National Standards, Principles, and Practices

NATIONAL SCIENCE EDUCATION STANDARDS

• **(5-8) Standard D-3:**
Earth in the solar system
• **(K-4) Standard D-3:**
Changes in earth and sky

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- 2 pieces of stiff, white cardboard
- Aluminum foil
- Colored construction paper
- Duct tape or other strong tape
- Hole puncher
- Paper towel or wrapping paper tubes
- Pencils
- Push pins
- Scissors
- White card stock or construction paper

REQUIRED TECHNOLOGY

- Internet Access: Required

- Tech Setup: 1 computer per classroom, Projector, Speakers
- Plug-Ins: Flash

PHYSICAL SPACE

- Classroom
- Outdoor natural environment

GROUPING

- Large-group instruction
- Small-group instruction

OTHER NOTES

Although this activity is best used with a solar eclipse, you can also use this activity anytime to reinforce concepts related to the sun's activity.

BACKGROUND & VOCABULARY

Background Information

The best part of a solar eclipse is the dramatic view of the sun's corona, or outer atmosphere, which we can see only when the brilliant solar disk is blocked by the moon. The corona is not just light shining from around the disk: it is actually the outermost layer of the solar atmosphere. Although the gas is very sparse, it is extraordinarily hot (800,000 to 3,000,000 Kelvin); even hotter than the surface of the sun. The corona shows up as pearly white streamers, whose shape is dependent on the sun's current magnetic fields. Because of this, every eclipse is unique. A solar eclipse is only visible from a small area of Earth and happens infrequently.

Prior Knowledge

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Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
atmosphere	*noun*	layers of gases surrounding a planet or other celestial body.
corona	*noun*	outermost part of the sun or another star's atmosphere.
coronal mass ejection	*noun*	huge burst of solar wind and other charged particles.
diameter	*noun*	width of a circle.
heliosphere	*noun*	large region around the sun affected by the sun's magnetic field and the solar wind.
Kelvin scale	*noun*	scale for measuring temperature where zero Kelvin is absolute zero, the absence of all energy.
penumbra	*noun*	partial shadow between the full shadow (umbra) and full illumination on an eclipsed body during an eclipse.
photosphere	*noun*	lowest visible layer of a star and the boundary from which the star's diameter is measured.
solar eclipse	*noun*	event when the sun is blocked by the moon passing between it and the Earth.
solar flare	*noun*	explosion in the sun's atmosphere, which releases a burst of energy and charged particles into the solar system.
sunspot	*noun*	dark, cooler area on the surface of the sun that can move, change, and disappear over time.
totality	*noun*	period during an eclipse when light from the eclipsed body is completely blocked.
umbra	*noun*	moon's shadow that covers the sun during a solar eclipse.

For Further Exploration

Websites

- NASA: Eclipse Web Site—Solar Eclipse Page
- NASA: Scientific Visualization Studio
- National Geographic News: What If the Biggest Solar Storm on Record Happened Today?

- Nat Geo Movies: Wildest Weather in the Solar System
- National Geographic Science: Space

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