NATIONAL GEOGRAPHIC

RESOURCE LIBRARY
ACTIVITY : 50 MINS

Our Active Sun

Students observe and plot sunspots, predict solar storms, and determine the rate of solar rotation.

GRADES

6 - 8

SUBJECTS

Earth Science, Astronomy, Experiential Learning, Mathematics

CONTENTS

3 PDFs, 1 Video, 2 Links

OVERVIEW

Students observe and plot sunspots, predict solar storms, and determine the rate of solar rotation.

For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/our-active-sun/

Program

WILDEST WEATHER IN THE SOLAR SYSTEM

DIRECTIONS

1. Activate students' prior knowledge about the sun and solar energy.
Project the KWL Chart on the board. Ask students to brainstorm a list of things they already know about the sun and solar energy. Students may brainstorm information such as: the sun is

a star, we receive energy that can be harnessed (solar panels), we shouldn't look directly at the sun, and plants need sunlight to grow. Have students list ideas in the "Know" column. Then, invite volunteers to add to the "Want to Know" column. Encourage students to generate questions such as: Does the sun rotate? How does the sun affect our seasons? and What are solar storms? Tell students that they will learn about the sun and solar storms in this activity, and they will return to the KWL chart later to complete column 3.

2. Establish a purpose and watch the video "Solar Storms."

Have students watch the National Geographic Channel video "Solar Storms." Ask: *What tools are scientists using to predict solar storms?* Elicit from students that scientists are creating computer models by mapping the sun's magnetic fields, or electrical currents. Explain to students that sunspots are regions of extremely strong magnetic field found on the sun's surface. The average lifetime of a medium-sized sunspot grouping is about one solar rotation, or 27 days. Then, ask students to think about how they use technology in their daily lives. Ask: *Why are solar storms a threat to our high-tech lives? What might some examples be?* Students should be able to infer that the electrical activity from the sun has the ability to interrupt electrical activity on Earth, and provide examples.

3. Have small groups complete the worksheet Sunspot Mapping Grid.

Divide students into small groups of three. Distribute one copy of the worksheet Sunspot Mapping Grid to each group. Go to the Solar and Heliospheric Observatory (SOHO) Movie Theater website. Select image type: MDI Continuum. Leave the Resolution at 512. Leave the Start and End Dates blank. Enter 20 for Latest *n* images. Then click search. This will give you near real-time data for the last 20 images taken. Ask each group to select and identify at least one sunspot to track over 4 days. Click the step button to move through the images. Ask: *What do you notice as we step through these images?* Students should notice that their sunspot or sunspot groups appear to be moving across the surface of the sun. Ask: *Do you think the sunspot is moving? Why or why not?* Encourage students to observe their sunspot in relation to other sunspots they see. Some students should be able to relate that they think the sun is rotating. Click the step button again to move through the images a second time. Allow students time to plot each point representing the sunspot or sunspot groups they have chosen on their worksheets.

4. Have students revisit the KWL chart.

Ask: *What new information have we learned from this investigation?* Ask students to summarize what they have learned about the sun and solar activity. List the information on the board in column 3 as students volunteer it.

5. Have students make a math connection.
Ask: *How can you determine the period of rotation of an object with fixed features on its surface?* (Rotation can be determined by tracking the fixed features for a number of days.) Distribute a copy of the worksheet Calculate the Sun's Rotation to each small group. Read through the directions with students and answer any questions they may have. Allow groups ample time to complete the worksheet. Rotate around the room, providing support as needed.

6. Discuss reasons for apparent motion of sunspots.
Remind students that sunspots appear to move across the face of the sun over time. Ask groups to list all of the possible reasons that might be responsible for that apparent motion. Then have a whole-class discussion in which each small group shares their list with the class. Possible reasons students may suggest include:

- Sunspots move across a non-rotating sun.
- The sun rotates.
- The Earth moves around the sun, causing sunspots to appear to move.
- Sunspots appear and disappear in different places, appearing to move.

Ask students to discuss each of the possible explanations within their small groups and decide which explanation their group thinks is the most likely. Then have a whole-class discussion. Make sure students understand that the correct answer is that the sun rotates. The sunspots stay reasonably stable as they appear to travel across the sun's surface. Sunspots seem to disappear on the righthand side of the sun, then reappear on the lefthand side. Students should observe that sunspots keep a similar shape and stay at the same latitude and move at a constant rate at the same longitudes. The sun has a faster rate of rotation at its equator of about 25 days and a slower rate of rotation at the poles of about 36 days. Ask: *What are some possible ways to prove your explanation is correct?* (Possible responses: Watch to see if some sunspots move faster than others at the same latitude. Follow sunspots to see if they change latitude as they change longitude. Follow sunspots to see if they move at the same rate and keep a similar shape and stay at the same latitude. Track how far the sunspots appear to move each day. See if they move at a consistent rate or if the rate changes. Pay attention to where the sunspots seem to appear or disappear. Watch for a pattern.)

Tip

Sunspot graph data will fluctuate depending on the solar activity of the day. The calculations for the chart should leave students with an average rotational period of between 25 and 36 days. You may want to check the current solar activity before you set up the activity. If there isn't enough for students to track, select a date range on the SOHO website that will provide enough sunspot activity for them to track.

Informal Assessment

Check students' plotting and data. Ask: *What did you determine about the apparent movement of sunspots across the surface of the sun?* Students should be able to explain that the sun rotates, and how that affects the apparent motion of sunspots.

Extending the Learning

Go to the Solar Stormwatch website. Have your students practice citizen science for Solar Stormwatch. Citizen science is the collection of scientific data by individual volunteers who are not professional scientists. Tell students they will help scientists spot explosions on the sun and track them across space to Earth. Students' input will help scientists better understand these potentially dangerous storms and help to forecast their arrival time at Earth.

OBJECTIVES

Subjects & Disciplines

Earth Science

- Astronomy

- Experiential Learning
- Mathematics

Learning Objectives

Students will:

- describe the rotation of the sun
- calculate an average solar rotation rate between 25 and 36 days
- identify and track sunspots

Teaching Approach

- Learning-for-use

Teaching Methods

- Brainstorming
- Discussions
- Hands-on learning
- Inquiry
- 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
  - Understanding

National Standards, Principles, and Practices

NCTM PRINCIPLES AND STANDARDS FOR SCHOOL MATHEMATICS

• **Algebra (6-8) Standard 2:**
Represent and analyze mathematical situations and structures using algebraic symbols
• **Algebra (6-8) Standard 3:**
Use mathematical models to represent and understand quantitative relationships
• **Geometry (6-8) Standard 2:**
Specify locations and describe spatial relationships using coordinate geometry and other representational systems

NATIONAL SCIENCE EDUCATION STANDARDS

• **(5-8) Standard D-3:**

Earth in the solar system

- **(5-8) Standard F-3:**

Natural hazards

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- Pencils
- Pens

REQUIRED TECHNOLOGY

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

PHYSICAL SPACE

- Classroom

GROUPING

- Small-group instruction

OTHER NOTES

You will need to sign up for a free account to take part in the Solar Stormwatch citizen science project. Set up a classroom account before starting this activity.

BACKGROUND & VOCABULARY

Background Information

The sun is responsible for all life on Earth; it gives us light and heat. The sun is not a solid body; it is a giant ball of gas made mostly of hydrogen and helium. Energy is produced deep within its core by means of nuclear fusion. Because of the sun's relative proximity to Earth,

astronomers can gain important knowledge about other stars by studying our sun. It is the only star close enough to display a corona and a visible surface, which allows for observation of sunspot and solar activity. The sun does not rotate as a solid body because of its gaseous composition. The period of rotation varies from 25 to 35 days depending on the latitude (it is a shorter period at the equator). The surface of the sun is called the photosphere. Sunspots are cooler regions on the sun. They can be very large and are caused by the sun's magnetic field. Sunspots occur where the sun's magnetic field loops up out of the solar surface and cools it slightly, making that section less bright. Complex sunspot groups cause the eruptions of solar flares and can appear to be spectacular loops and prominences.

Prior Knowledge

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Recommended Prior Activities

- Build a Magnetometer
- Magnetic Fields Lab

Vocabulary

Term	Part of Speech	Definition
heliosphere	*noun*	large region around the sun affected by the sun's magnetic field and the solar wind.
latitude	*noun*	distance north or south of the Equator, measured in degrees.
longitude	*noun*	distance east or west of the prime meridian, measured in degrees.
magnetic field	*noun*	area around and affected by a magnet or charged particle.
magnetic storm	*noun*	interaction between the Earth's atmosphere and charged particles from solar wind.
photosphere	*noun*	lowest visible layer of a star and the boundary from which the star's diameter is measured.
solar flare	*noun*	explosion in the sun's atmosphere, which releases a burst of energy and charged particles into the solar system.
solar prominence	*noun*	huge eruption of cool gases from the surface of the sun, often shaped like a giant loop.

Term	Part of Speech	Definition
solar rotation	*noun*	movement of the sun around its axisthe time is variable, but about once every 27 days.
solar storm	*noun*	sudden change in the Earth's magnetosphere, caused by the solar wind interacting with the Earth's magnetic field. Also called a geomagnetic storm.
sunspot	*noun*	dark, cooler area on the surface of the sun that can move, change, and disappear over time.

For Further Exploration

Websites

- Solar and Heliospheric Observatory (SOHO): Real Time GIF Movies
- NASA: Living with a Star—The Sun-Earth Connection
- National Solar Observatory
- National Geographic Education: Article—How's the Weather Up There?
- National Geographic Science: Space
- High Altitude Observatory (HAO): Questions and Answers About the Sun
- NASA: Solar and Heliospheric Observatory (SOHO)
- Nat Geo Movies: Wildest Weather in the Solar System
- Stanford Solar Center

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