

Solar Events

Student Activity Book

I. Introduction

The sun gives us light and warmth, but it also gives us problems. The sun sends ions (charged atoms) and electrons into space at incredible speeds. When these particles interact with Earth's atmosphere, they cause several major problems ranging from power failures to zapped satellites.

Continue with this activity to see how the sun is not only beneficial but how it can be harmful.

Get Info Objectives

1. List effects of solar events.
2. Describe solar effects on human activities
3. Describe solar effects on electric companies.

Gather Data Objectives

1. Describe the relationship of geomagnetic disturbances to solar events.
2. Use averaged solar data to determine the best time to debug electronic equipment.
3. Compute the diameter, escape velocity, and surface speed of the sun.

Application Objectives

1. Explain observations of the average sunspot number.
2. Justify the cost of an early warning system for geomagnetic storms.
3. Explain the international nature of solar event problems.

Before doing anything else, add the NOAA Research "Solar Events" page to Bookmarks or Favorites on your web browser.

II. Get Info

A. General information on solar problems

- Click on the "Solar Events" site.
- Read the information and answer the following question.

1. What problems do solar events cause?

- Click "Back" to return to the Solar Events "Get Info" web page.



B. Details of Solar Events



- Click on the "Space Environment" site.
- Scroll down to the "Coronal Holes" section.
- Read from "Coronal Holes" through the end of the page and answer the following questions as you read.

1. What effect do coronal holes have on the solar wind?

2. What types of energy do solar flares release?

3. Auroras are also called the Northern Lights and Southern Lights. How are the lights formed?

4. What causes geomagnetic storms on Earth?

5. What does the ionosphere usually do to help communication that is changed by geomagnetic storms?

6. What dangers are there due to geomagnetic storms' disruption of the ionosphere?

7. How do geomagnetic storms affect satellites?

8. How can airlines be in danger due to geomagnetic storms?



- Click "Back" to return to the Solar Events "Get Info" web page.

C. Solar "Power" Problems

- Click on the "University of Michigan Power Grid" site.

1. Why do geomagnetic storms affect structures made by people more than they affect natural structures?

- Click "Back" to return to the Solar Events "Get Info" web page.

- Scroll to the bottom of the page and click "Return."

- Click "Gather Data."

III. Gather Data

A. Solar Flares and Magnetic Disturbance

- Click on the "Solar Flare Effect" site.

Scroll down to the graph.

1. Describe the relationship between x-ray radiation and the magnetic field variation.

- Click "Back" to return to the Solar Events "Gather Data.1" web page.





B. Sunspots and Geomagnetic Storms

- Click on "Occurrence of Geomagnetic Disturbances" site.
- Scroll down to the graph.

1. Describe the relationship between the sunspot number and the number of days with geomagnetic storms.

- Click "Back" to return to the Solar Events "Gather Data.1" web page.

C. Monthly Storms

- Click on "Seasonal Distribution" site.
- Scroll down to the graph.

1. What two months have the highest number of geomagnetic storms?

2. What three months have the lowest average of geomagnetic storms?

3. Recalling the effects of geomagnetic storms, in what months would you want to test a new computer network?



4. Why did you choose these months?



- Click "Back" to return to the Solar Effects "Gather Data.1" web page.
- Click "Forward" at the bottom of the page.

D. Annual Sunspot Numbers



- Click on the "Yearly Average Sunspot Numbers" site.
- Read the legend below the graph for help answering the questions.



1. Yearly sunspot numbers have been calculated using the average of the daily number of sunspots. Which solar minimum year had the lowest yearly average? _____



- Click "Back" to return to the Solar Events "Gather Data.2" web page.

E. Math Facts and Solar Measurements



- Click on the "Solar Facts" site.



1. The gravity on earth is 9.8 meters per second per second. How much stronger is the gravity on the surface of the sun?

2. Escape velocity is how fast you have to go to escape the sun's gravity and not get sucked back into the sun. What is the escape velocity of the sun in kilometers per hour?



3. What is the diameter of the sun? _____ meters



4. Use the diameter you found in question 3 to find the circumference of the sun. ($C = \pi d$)



5. Use the rotation period of the sun, the number of hours in a day, the number of meters in a kilometer, and the circumference of the sun to figure out what the surface speed of the sun is in kilometers per hour. (How fast is it moving on the surface?)

6. Use the fact that there are about 1.6 kilometers per mile to convert the speed you found in question 5 to miles per hour.



- Click "Back" to return to the NOAA Research "Solar Events" main page, or choose "Solar Events" from your Favorites or Bookmarks.
- Click on "Application".

IV. Application

A. Variation



- Click on the "Variation" web page.
- The "aa" index is used to measure the geomagnetic disturbances on Earth.



1. What does the graph seem to tell us about the average number of geomagnetic disturbances? _____
2. Besides the explanation that there are more disturbances, what other explanation is possible to explain the fact that the number of disturbances measured is increasing?



- Click "Back" to return to the Solar Events "Application" web page.

B. Cost vs. Cost



- Click on the "University of Michigan Solar Storm Cost" site.



1. What kinds of problems can be avoided if power companies get early warnings of coming geomagnetic storms?



- Click "Back" to return to the Solar Events "Application" web page.
- Click on the "Start-Up Problem" site.



2. Why should you turn off your electric appliances whenever there is a power failure?



- Click "Back" to return to the Solar Effects "Application" web page.

C. International Accord

1. Explain why the cost for maintaining an early warning system for geomagnetic storms is justified.

2. Why should all industrialized nations work together to set up the warning system?

- Click "Back" to return to NOAA Research "Solar Events" home page or click "Return" at the bottom of the page.
- Click "Enrichment."



V. Enrichment Activities

A. Research

1. Research the Aurora Borealis. Find out when, where, and how they occur. Draw a diagram showing the areas on Earth where they occur most often.
2. Research when the next solar eclipse will be. What locations on Earth will see a total eclipse? A partial eclipse?
3. Research Earth's escape velocity. What is it and how is it different from the Sun's escape velocity? Ideally, satellites would be launched from the equator. What difference does it make where you launch a satellite?
4. Find out about ancient cultures and how they created calendars and measured time based on the sun.

B. Interviews

1. Interview an astronomer at a local planetarium about locally-seen eclipses.
 2. Work in groups and list all the songs you can think of that mention the sun.
- Click "Forward" to go to the "Enrichment.2" web page.



C. Related Web Sites

1. NASA Eclipse Homepage
<http://sunearth.gsfc.nasa.gov/eclipse/eclipse.html>
2. SEC Frequently Asked Questions
<http://www.sec.noaa.gov/info/FAQ.html>
3. NASA Eclipse Resource Page
<http://sunearth.gsfc.nasa.gov/eclipse/resource.html>
4. National Geophysical Data Center site on geomagnetic data
<http://www.ngdc.noaa.gov/seg/potfld/geomag.html>
5. Technically oriented National Geophysical Data Center site on cosmic rays
http://www.ngdc.noaa.gov/stp/SOLAR/COSMIC_RAYS/cosmic.html
6. Meteors and Meteor Showers
<http://csep10.phys.utk.edu/astr161/lect/meteors/showers.html>