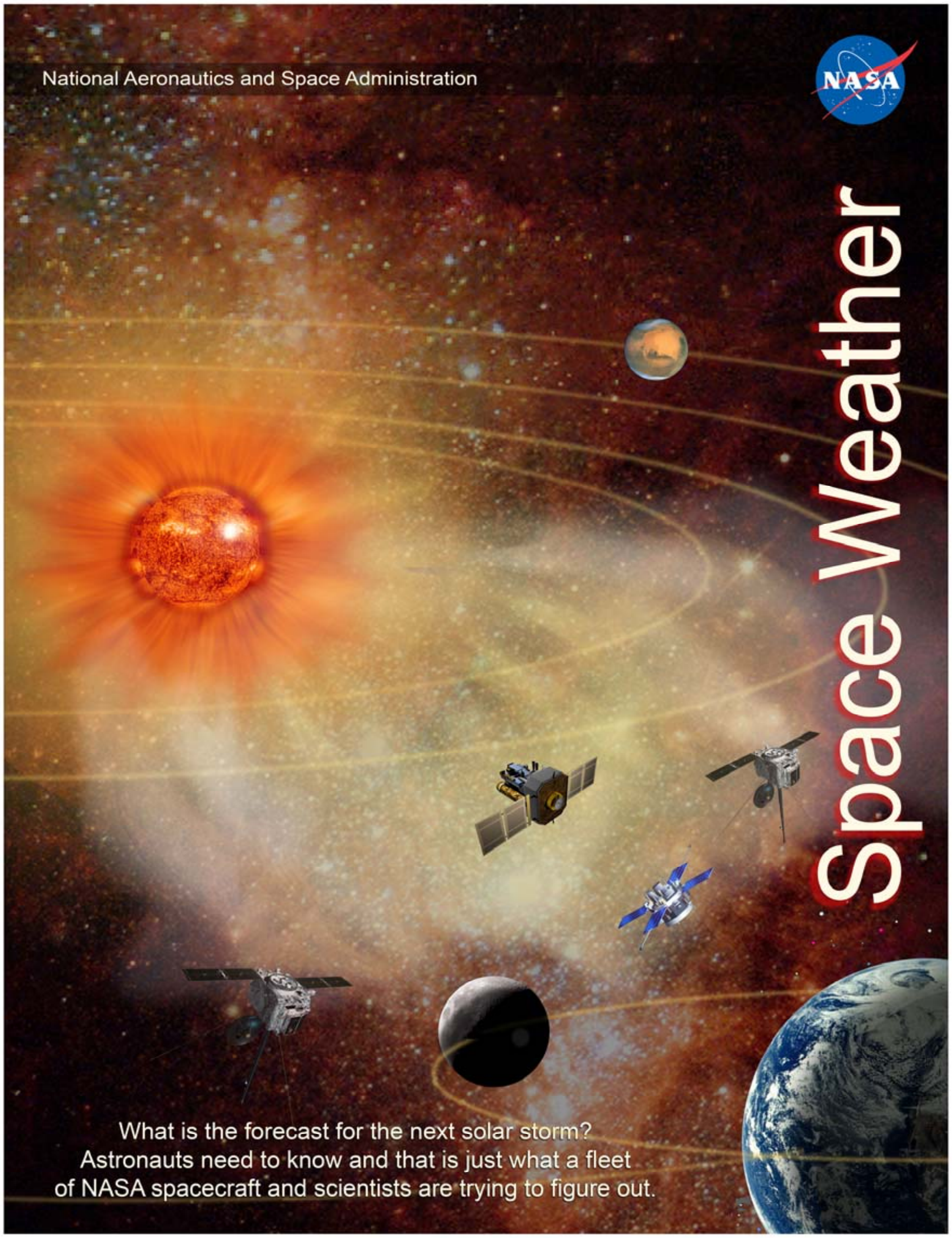
Space Weather Action Center
EDUCATOR'S INSTRUCTIONAL GUIDE



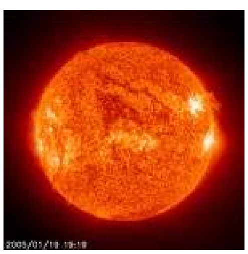
Instructional Objectives

These lessons are designed to allow your students to monitor the progress of an entire solar storm from the time it erupts from the sun and eventually sweeps past our small planet effecting enormous changes in our magnetic field. The activities that are outlined in this guide are designed to be very flexible to take into account the wide variability of the users. Some educators might use these activities as a "stand alone" unit, while others might find that the Space Weather Action Centers provide a fabulous on-going activity for their students throughout the school year. The activities introduced in this guide will get students and teachers started in this exciting field, and offer multiple opportunities for further exploration when desired. After students have collected and analyzed the data in each center, they will be ready to explore the data from the other links that are readily available in the Space Weather Resource Center.

Background

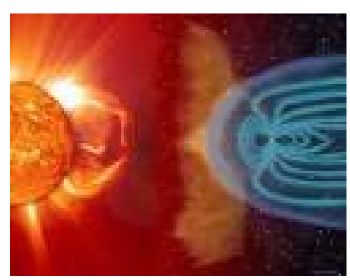
Imagine being able to monitor the progress of an entire solar storm from the time it erupts from our sun and eventually sweeps past our small planet effecting enormous changes in our magnetic field! To be able to accomplish this, students must be able to:

- Predict which sunspots may be a source of solar storms.
- Discover when solar storms occur and predict which ones will affect Earth.
- Measure disturbances to Earth's magnetic field and predict auroras.
- Know when to watch for auroras.



The Sun is an average variable star. The energy from the Sun is responsible for life on Earth, and conditions on Earth including climate, seasons, and weather. Once thought to be unchanging, the Sun is now known to vary constantly. Changes in the activity of the Sun occur in eleven-year cycles. Sunspots can appear and disappear over days or weeks. Flares and large ejections of mass (coronal mass ejections) occur in time spans of minutes to hours. The energy of the Sun constantly blows out a 'solar wind' of electrified particles that is the extended atmosphere of the Sun.

Abrupt changes on the Sun can create flares and coronal mass ejections that blast brief but powerful "solar storms" into space. Earth is surrounded by a magnetic field (magnetosphere) that protects us from the worst effects of solar storms. However, solar storms can cause fluctuations in the magnetosphere called "magnetic storms". These magnetic storms have disabled satellites and burned out transformers, shutting down power grids. The storms also can endanger astronauts. These storms contribute to more intense auroras that can be seen closer to the equator than is usual



National Standards

Benchmarks for Scientific Literacy

Technology:

- Students use technology to locate, evaluate, and collect information from a variety of sources.

Transfer of Energy:

- The sun is a major source of energy for changes on the earth's surface. The sun loses energy by emitting light. A tiny fraction of that light reaches the earth, transferring energy from the sun to the earth.
- The sun's energy arrives as light with a range of wavelengths, consisting of visible light, infrared, and ultraviolet radiation.

Earth in the Solar System:

- The Earth is the third planet from the sun in a system that includes the moon, the sun, eight other planets and their moons, and smaller objects, such as asteroids and comets.

- The sun, an average star, is the central and largest body in the solar system.

- Most objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.

Nature of Science:

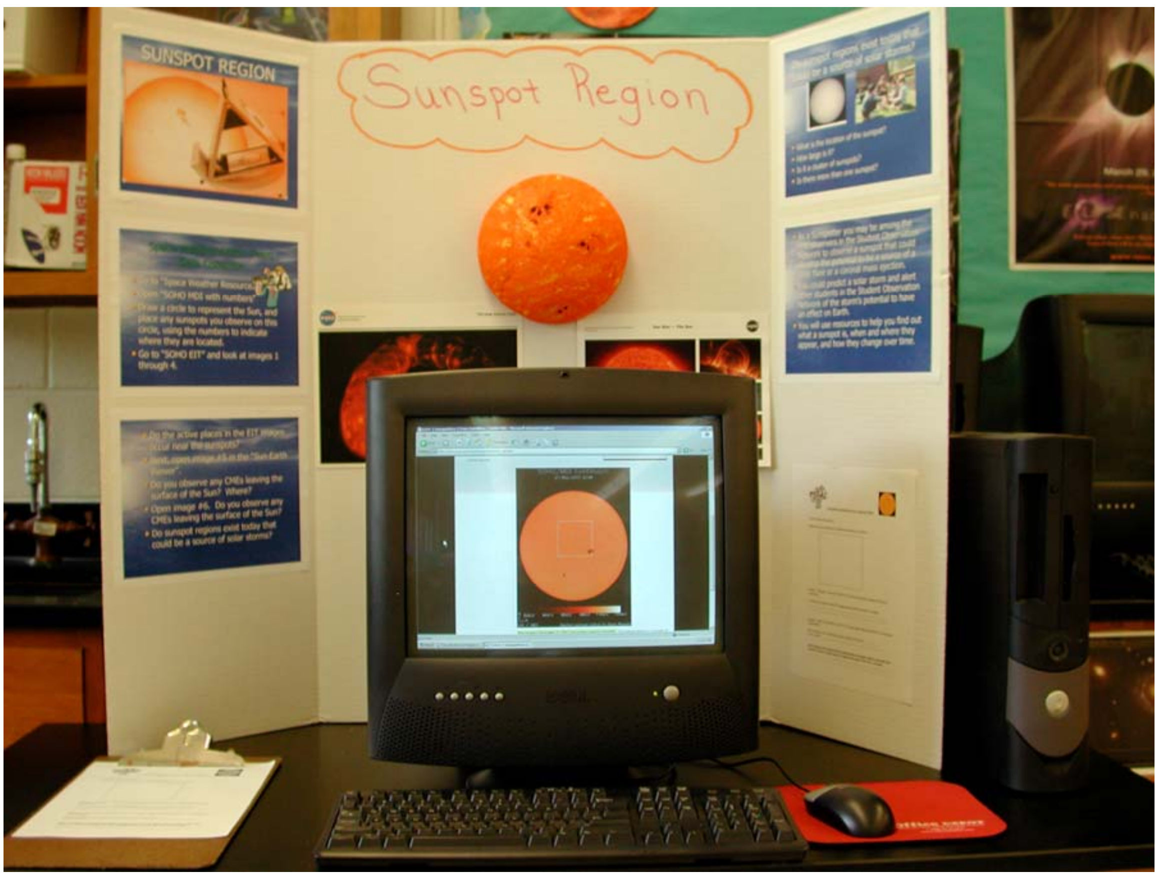
- Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models.
- Although all scientific ideas are tentative and subject to change and improvement in principle, for most major ideas in science, there is much experimental and observational confirmation. Those ideas are not likely to change greatly in the future. Scientists do and have changed their ideas about nature when they encounter new experimental evidence that does not match their existing explanations.

History of Science:

- Many individuals have contributed to the traditions of science. Studying some of these individuals provides further understanding of scientific inquiry, science as a human endeavor, the nature of science, and the relationships between science and society.

Mathematics Standards (NCTM):

- Develop an understanding of large numbers and recognize and appropriately use exponential, scientific, and calculator notation;
- Represent, analyze, and generalize a variety of patterns with tables, graphs, words, and, when possible, symbolic rules



Sample Image of Sunspot Region Station

Preparing for Activities

Overview of Student Stations for Tracking a Solar Storm

Students will move through four space weather "stations" where they will follow directions that enable them to collect and analyze data relevant to their topic. The four topics are "Sunspot Region", "Storm Signals", "Magnetosphere", and "Aurora".

- **Sunspot Region**, allows students to collect data to answer the question, *"Do sunspot regions exist today that could be a source of solar storms?"*
- **Storm Signals**, allows students to collect data to answer the question, *"Have radio signals been recorded today due to a flare or CME that could affect Earth?"*
- **Magnetosphere,** allows students to collect data to answer the question, *"Has there been a measurable disturbance in the Earth's magnetic field?"*
- **Auroras,** allows students to collect data to answer the question, *"Have auroras been seen within the last 24 hours due to a solar storm?"*

As students interact with the data and content in each station, they will

- Complete journal entries to document their exploration and results
- Complete group data collection sheets for their station
- Report in to the class to share their findings

Before students begin to work in the stations, you should complete the introductory lesson. After this lesson, you might want to let students circulate through all the centers by rotating the groups through on a weekly basis. This allows students to learn about all the stations, continue to collect and analyze data, and to make first-hand observations about how the data changes over time. By sharing and graphing the data over a month-long period, they can look for patterns or trends in the data and develop a thorough understanding of the targeted indicators.

After completing the introductory lesson, subsequent station activities will probably take about 15 to 20 minutes in stations, and then having an additional 10 to 15 minutes for students to share their results with the rest of the class.

If time permits, students can expand this activity by creating regular "Space Weather Action Center Newscasts! To learn more about this option, read the "Space Weather Action Center- Become a Space Weather Reporter! Educator's Set-up Guide".

Materials List

Computer/Internet Station Requirements

Four (4) Internet capable desktop or laptop computers: These computers will be used to access online components of the Space Weather Action Center. Each computer station will be used to present one of the four online components needed to track solar storms. However, if computer availability is limited, one computer with internet access can be used to switch between all four data access points.

Each station will be named after one of the four components in the Tracking a Solar Storm website found at http://son.nasa.gov/tass/index.htm and are fully explained in the SWAC content guide.

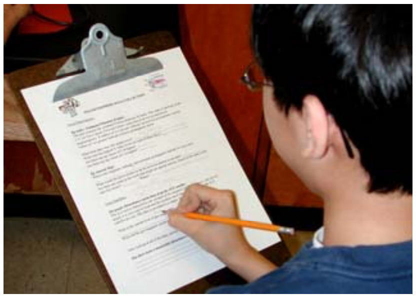
Station Names:

- Sunspot Region
- Storm Signals
- Magnetosphere
- Aurora

Two/Three (2-3) tables: It is recommended that the tables are large enough to allow the setup of one or two computers per tabletop and also allow some student space for papers and writing. If table top space is limited, clipboards would provide a stable writing surface as they write in their composition book journals. You can download templates of the student journals from the content guide. They can be glued into the journal as standard data collecting questions that students can review as necessary whenever they are recording space weather activity.

Four (4) cardboard science boards: These science boards will be used to create SWAC backdrops that will be placed behind each computer monitor at each of the four stations. (See sample images)

Four (4) composition books or clipboards: A clipboard, pencil, and a copy of the corresponding "data collection" sheet should accompany each station.



Journaling is based on a 7 day – weekly cycle. Each student will use their composition book journals at their computer station to document the space weather data. Daily journaling is recommended if the curriculum time allows. Students should be journaling a minimum of 2 to 3 times a week. Students will need to review the space weather data from previous days to stay current if journaling is not done on a daily basis.

Classroom Space Requirements

It is recommended that a secure area of a classroom or a separate room be established exclusively for the *Space Weather Action Center* program. The purpose is to minimize the impact on the rest of the classroom space that is utilized for teaching.

One Computer Classroom: If there is only one computer available for student access, then have the students group rotate on a specified time and day-to-day basis. Keep in mind that data recordation should be done through student journals and that the needed time be allotted so they can be successful in meeting their tasks.

Technology/Computer Classroom: If student computer access is through utilizing a technology/computer classroom, then have the students sit side-by-side based on their corresponding group subject area depending upon the number of computers available.

Additional Considerations: If technology in the classroom is limited and dedicated access to a technology/computer room is via a teacher's computer, teachers can print daily data and have students develop weekly line or bar graphs in their journals.

Engage:

A good pre-assessment and activator is to ask all of the students to draw a diagram of the Sun. Encourage them to include as many labeled parts as they can recall, and reassure them that this will not be graded. You may choose to allow a few students to share their diagrams and give explanations for their drawings.

Explore:

Doing a "**K-W-L**" (a chart that lists columns for "What We **K**now", "What We **W**ant to Know", and "What We **L**earned") is a great way to have students begin a new project. This strategy helps students focus on and share what they already know about a subject. The teacher becomes aware of the general knowledge basis that different students possess, and alerts him/her to possible misconceptions students may have about particular topics. The teacher may choose to have each student develop their own "KWL" chart, work in small groups to complete the chart, or do it as a whole-class activity.

After students finish the first two sections, "What We Know about the Sun" and "What We Wonder about the Sun", encourage them to share in their responses if they haven't done this as a whole class. One student can act as recorder and can compile a whole class KWL chart. Don't have them complete the last section, "What We Learned about the Sun" until they finish this lesson.

To introduce the students to the concepts of "Space Weather" and "Solar Storms", the teacher can use the "Blackout" VODcasts/PODcasts on Sun-Earth Day website.

Next, the students will begin to do some research in topic-specific groups. Before they begin this research, here are some "Sun Facts" you will want to share with your students.

- The Sun is a medium size star
- The Sun's atmosphere stretches beyond Pluto, and it is called the "**heliosphere**"
- The core of the Sun is hot- 15 million degrees C, creating a process called **fusion** where hydrogen atoms are fused together to create helium (a process that has not been duplicated on Earth)
- 1 million Earths could fit on the surface of the Sun
- 109 Earths can be placed side by side to cover the diameter of the Sun
- The Sun is approximately 5 billion years old
- The Sun rotates about once every 27 days
- The nine planets in our solar system revolve around the Sun

Understanding the Sun:
Using the Sun Earth Viewer students will discover the basics of the Sun:

- http://ds9.ssl.berkeley.edu/viewer/flash/ or
- http://sunearth.gsfc.nasa.gov/sunearthday/media_viewer/flash.html

Use the questions below to present guidelines for student research. The questions are grouped together for a team approach. Each team will then present an oral report about their specific area to provide a complete understanding of a storm from the Sun. Explain that they should use their journals to write down their answers as they conduct their research.

Another option-
Students can individually conduct their own research. Each student can answer a single question using their journal to record their findings. The team then shares their combined expertise as a documentary for a TV broadcast.

Team 1- Sunspot Region
Draw and label the interior layers of the Sun.
How does the structure of the Sun form an active Sun?
What is a sunspot?
What is a solar cycle?
What is a solar flare/Coronal Mass Ejection (CME)?

Team 2- Storm Signals
Why are radio waves important when monitoring a solar storm?
What wave lengths reach the surface of the Earth?
How long does it take radio waves to reach Earth?
How can we monitor radio waves from the Sun?

Team 3-Magnetosphere
What is a magnetosphere?
How big is our magnetosphere?
How does the magnetosphere act like a magnet?
If the magnetosphere were visible, what would it look like?
Why is our magnetosphere considered a protective shield against solar storms?
Why is this system necessary for life on Earth?

Team 4- Aurora
Why do scientists agree that an aurora verifies a solar storm?
What can an aurora tell us about the Sun-Earth system?
What is the connection of auroras and the solar wind?
Why are auroras different colors?

Have students share their information with the whole class, and encourage students to take notes in their journals. Explain to them that all students will eventually rotate to each of the four stations, and it will be very helpful for them to have information about each topic area.

At the end of this session, have students complete the last section of the “KWL” chart, entitled “What We Learned”. As before, this can be done as an individual, small group, or whole class activity.

Explain:

Now the students are ready to access and analyze NASA satellite and observatory data. The class should be divided up into four groups, and each group will be responsible for accessing, analyzing, and reporting on data for one of the four topic areas. Refer to the “Educator’s Setup Guide” for complete setup instructions for each of the Space Weather Action Center stations. Directions for accessing, analyzing, and recording necessary data is given below.

Sunspot Region (Station #1)

Here is the link to the slides that you will want to download and post at this station. We recommend that you organize the slides into and easily accessible 'Flip Chart'.

http://sunearthday.nasa.gov/swac/sunspot_regions_slides.pdf

Here is the link to the student data collection sheet that you will want to have copied and available at this station.

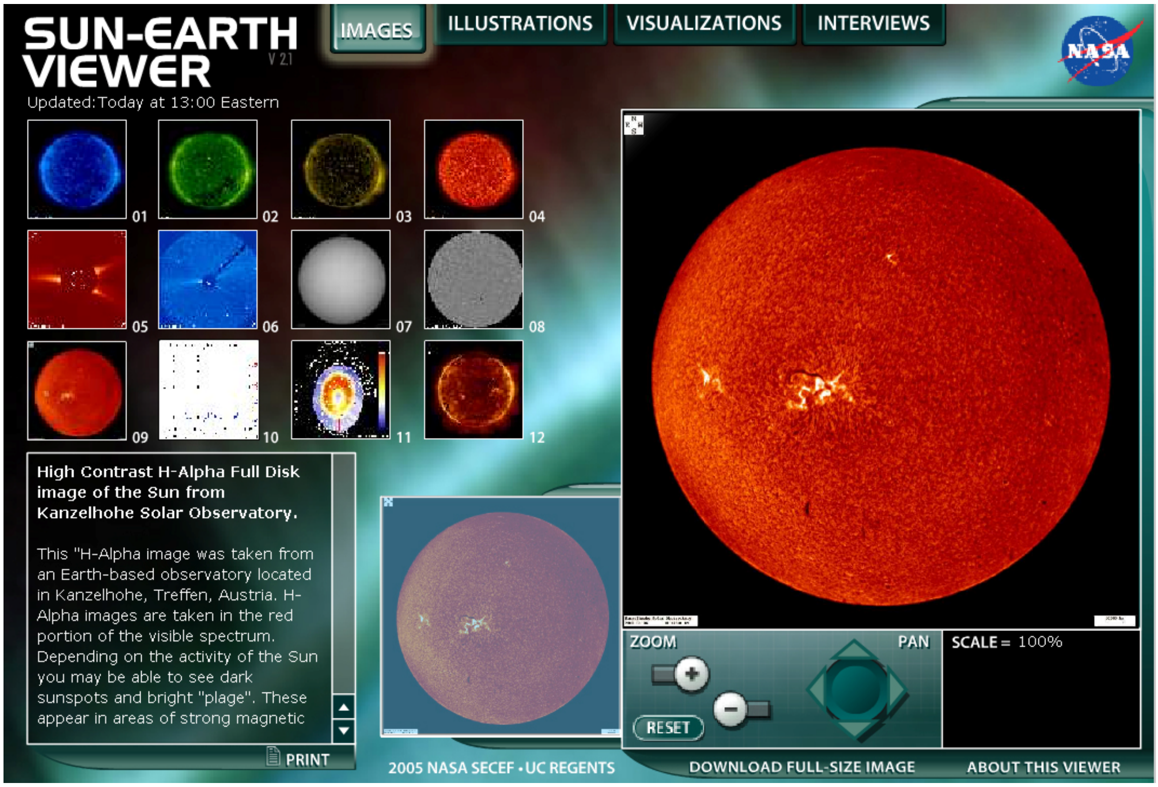
http://sunearthday.nasa.gov/swac/sunspot_regions.pdf

The sunspot is the first indication that a storm from the Sun is a possibility. Not all sunspots cause problems for Earth. These students will be attempting to answer the big question, “Do sunspot regions exist today that could be a source of solar storms?” To answer this question, they will need to consider the following:

- What is the location of the sunspot?
- How large is it?
- Is it a cluster? (This indicates the probability of magnetic twisting that will cause an eruption from the Sun.)

Students begin by looking at Image #9 in the Sun-Earth Viewer from the ground based observatory in Kanzelhohe, Treffen Austria.

- http://ds9.ssl.berkeley.edu/viewer/flash/ or
- http://sunearth.gsfc.nasa.gov/sunearthday/media_viewer/flash.html

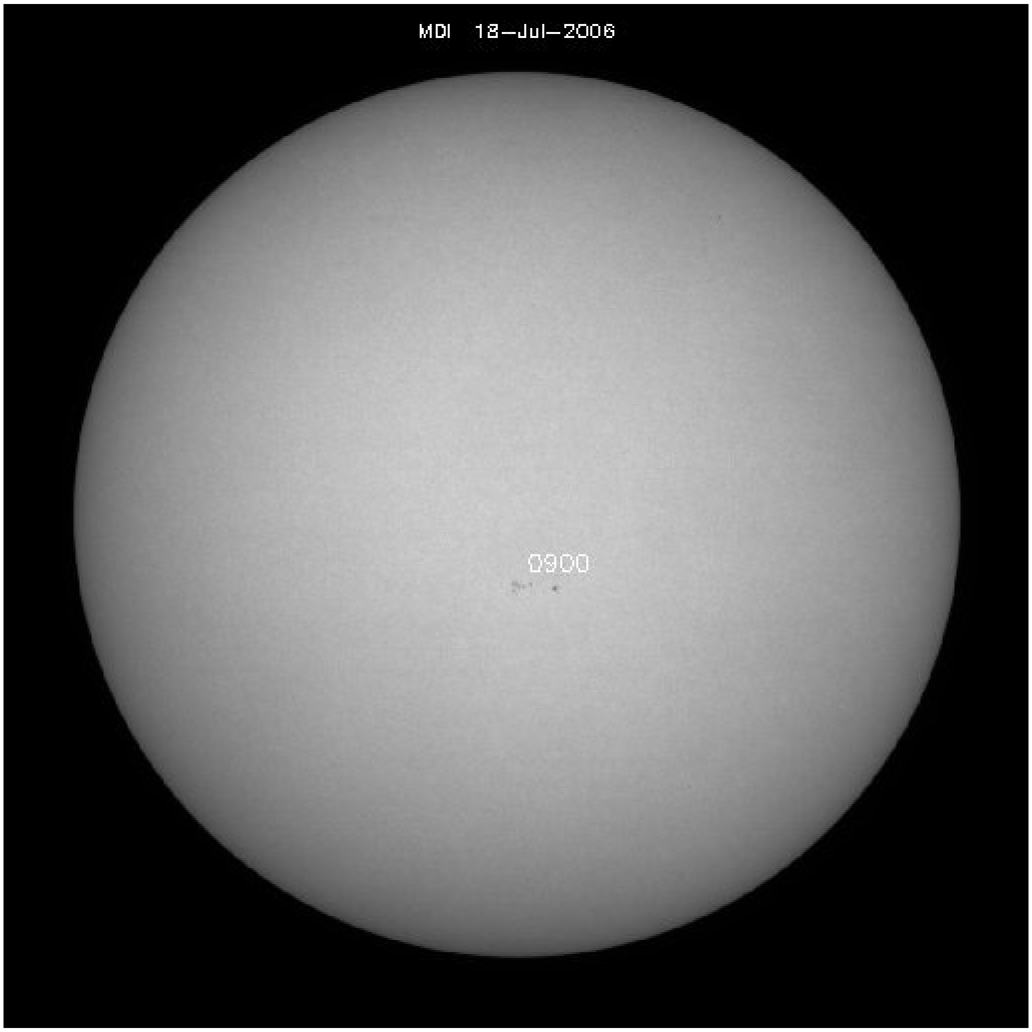


This image makes it possible for students to see dark spots called “sunspots” on the surface of the Sun. The special filter, H-Alpha, looks at the red portion of visible light. Tell students this is similar to using a filter on a large powerful telescope, which protects our eyes, so they can look directly at the Sun.

Using the Sun-Earth Viewer:, students should now look at the satellite instrument by looking at Image # 8- SOHO MDI magnetogram. This image is a picture of magnetic activity near the Sun’s surface. The black and white indicate different polarities; the more intricate this appears the more likely there will be an eruption from the Sun.

Next, students will look at the “SOHO MDI with numbers” data. Each sunspot region is given a number by scientists to help them communicate with each other better.

- http://sohowww.nascom.nasa.gov/data/synoptic/sunspots/mdi_sunspots.gif

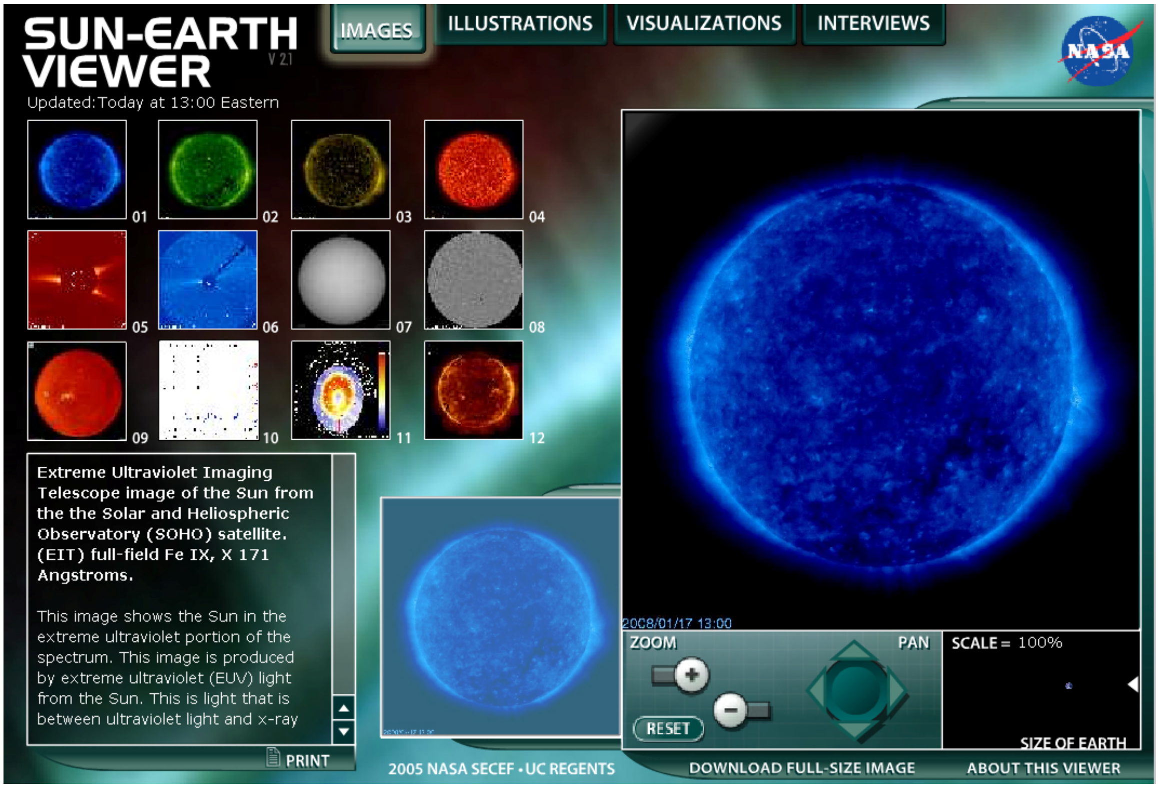


This is an example of what they will see in this image, and they are instructed to
"Draw the Sun, and label any numbered sunspots you observe."

Next, they go to the "SOHO EIT" and look at images 1 through 4.

- http://ds9.ssl.berkeley.edu/viewer/flash/ or
- http://sunearth.gsfc.nasa.gov/sunearthday/media_viewer/flash.html

(If images 1-4 are labeled Bake-Out then image 12 TRACE is active and should be used to look at the Sun)

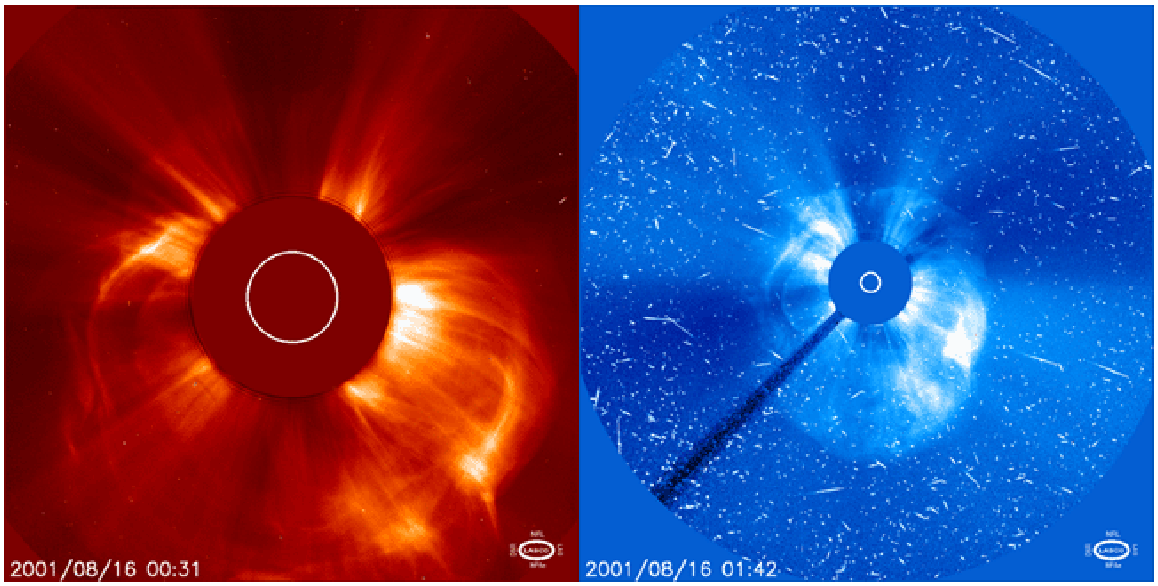


The first four images show images from SOHO EIT instrument (Extreme Ultraviolet Imaging Telescope). EIT uses filters to allow the camera to record only particular kinds of ultraviolet light. Ultraviolet light is invisible to our eyes and has no color as we know it. These images are artificially colored to help scientists know what filter was used. The bright spots in these images tell you that there is a lot of this kind of ultraviolet light being emitted. Dark regions show little activity. ***The students should compare these four EIT images to each other and to the SOHO MDI images that shows you where sunspots are. On their data collection sheet, they will answer this question:***

"Do the active places in EIT images occur near sunspots?

You may want to encourage them to use the Earth in the bottom right zoom box to help you determine the size of the area of bright spots by comparing the area with the size of the Earth.

Finally, the students observe images 5 and 6 at the same link (SOHO EIT). In these images, they are looking at images taken using the LASCO (Large Angle Spectrometric Coronagraph) instrument. This instrument is able to take images of the solar corona by blocking the light coming directly from the Sun with an occulter disk (the dark circle in the center of the image), creating an artificial eclipse within the instrument itself. The position of the solar disk is indicated in the images by the white circle. The corona is the outer edge of the Sun and is only seen during an eclipse which is one of the reasons many scientists are eclipse chasers. (#5 and #6). Occasionally, a coronal mass ejection can be seen being expelled away from the Sun and crossing the fields of view of both images.



If the images become speckled with white specks or a halo around the image appears this means that there is a storm coming directly toward Earth.

Now these students answer their big question, and should cite specific data in their answer.
Answer the question: **Do sunspot regions exist today that could be a source of solar storms?**

Storm Signals (Station #2)

Here is the link to the slides that you will want to download and post at this station. We recommend that you organize the slides into and easily accessible 'Flip Chart'.

http://sunearthday.nasa.gov/swac/storm_signals_slides.pdf

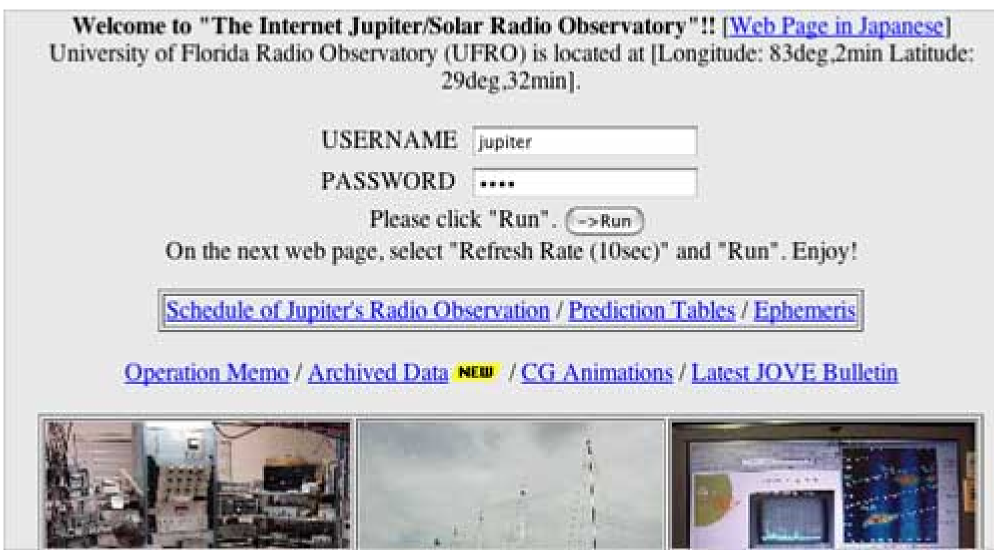
Here is the link to the student data collection sheet that you will want to have copied and available at this station.

http://sunearthday.nasa.gov/swac/storm_signals.pdf

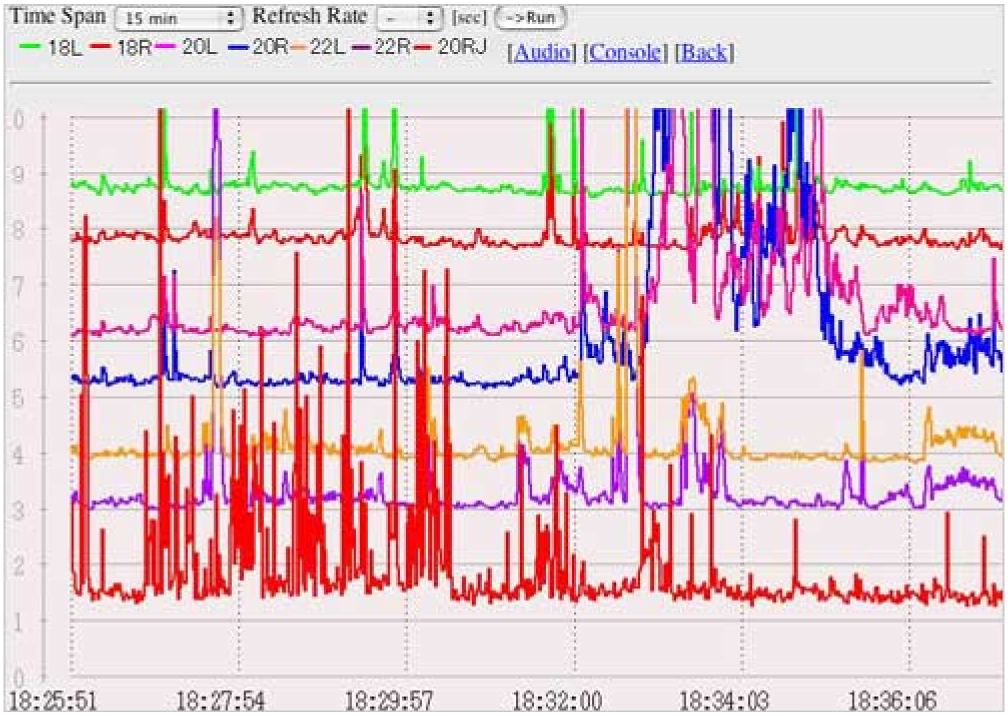
The students will begin by obtaining ground-based observatory data from the University of Florida Radio Observatory. Then they will obtain satellite data from GOES 12.

University of Florida Radio Observatory

The best time to observe is between 10:00 am and 2:00pm ET. Florida also has intense electrical storms during the summer. To protect their equipment, the site is closed from June to late September. We can use the data from the *Radio JOVE* student program to detect the radio wave from the Sun. If you have your own receiver or want to use the more advanced student data part of Radio JOVE you can use Radio Waves from your own receiver or receivers in other locations. The radio waves are translated into sound for students to hear the frequency increases.



Click Run. The next page should look something like this:



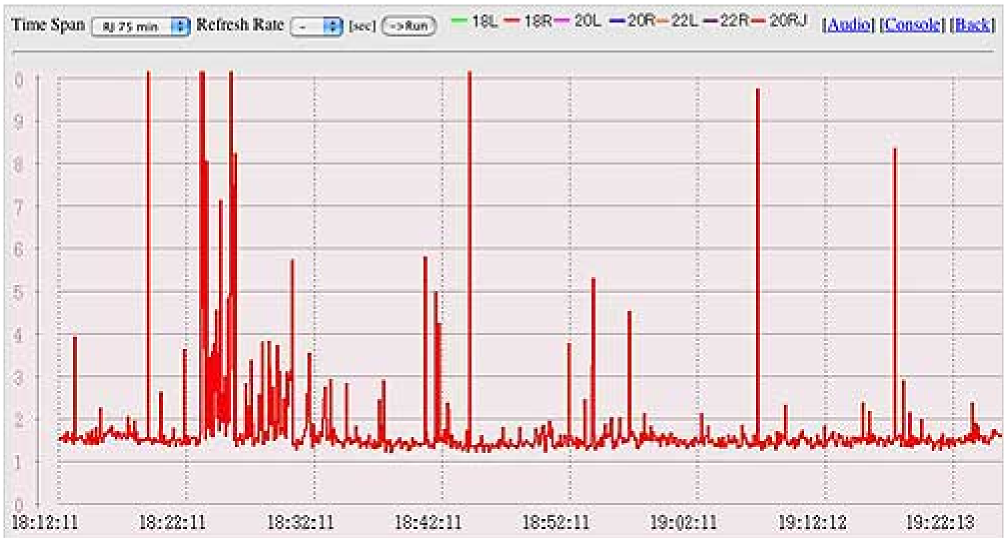
This plot looks pretty complicated because it shows the radio signal from several antennas at once. Each antenna is recording a different radio frequency. It is rather like listening to a radio that is bringing in several stations at once. Universal Time is used, which could be something you want to have your students investigate further. Additional information is available at http://son.nasa.gov/tass/ut.htm

On the student's data collection sheet, they are instructed how to enter the appropriate information in order to get the frequency they will be analyzing. Additional information is given below in case questions should arise.

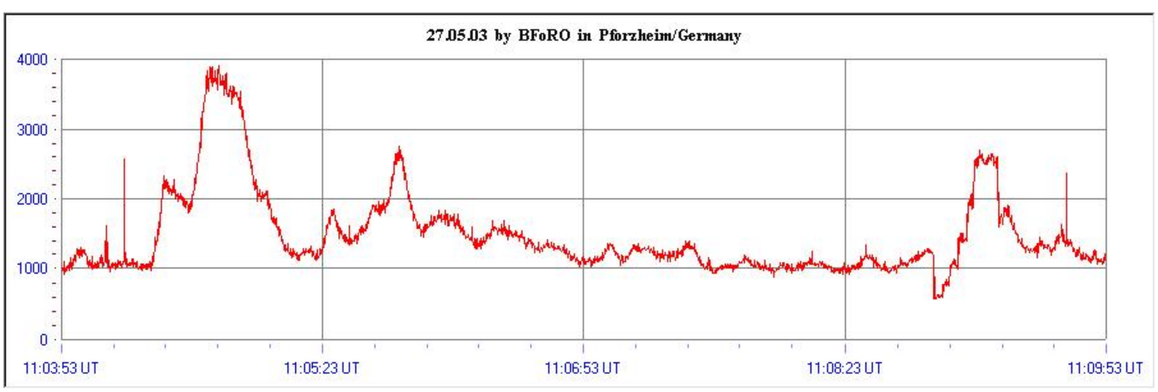
The first menu information you need to enter is 'Time Span'. When you click and 'pull down' that menu, you will have 6 options; 15 min, 75 min, 150 min, RJ15 min, RJ75 min, RJ 150 min. The 15, 75 and 150 min allow you to set the horizontal time axis to 15, 75 or 150 min and still show all the signals from all the different antennas. We recommend that you select one of the **RJ 15**(for Radio JOVE) settings + again the 15, 75 and 150 indicate how many minutes will be displayed.

The second menu information is the "Refresh Rate". It lets you choose how often the graph is updated or 'refreshed'. When you first enter the page the Refresh Rate is off. Set your sec/each field to something compatible to the speed of your network connection. If you have a slow connection (i.e. dialup-modem), then your browser may not keep up with a high refresh rate (3 to 10 seconds), so set this field to a high number between 20 and 40 so that the image is refreshed every 20 or 40 seconds. If you have a fast connection (i.e. cable, DSL, or LAN), you can set this field to a lower number so that it refreshes the image more quickly. In the student's directions, they are instructed to set this at 10 seconds.

Important: You must click the Run button after you make changes to the Time Span or Refresh Rate. After you have set the menus as suggested you will see a graph similar to the one below.



The sharp spikes in the above graph are usually due to man-made signals or lightning strikes. The number of spikes and the weather forecast for Florida on the day this graph was made is consistent with lightning. A solar storm would show a gradual rise and fall in the signal over several seconds to several minutes. The graph would look somewhat

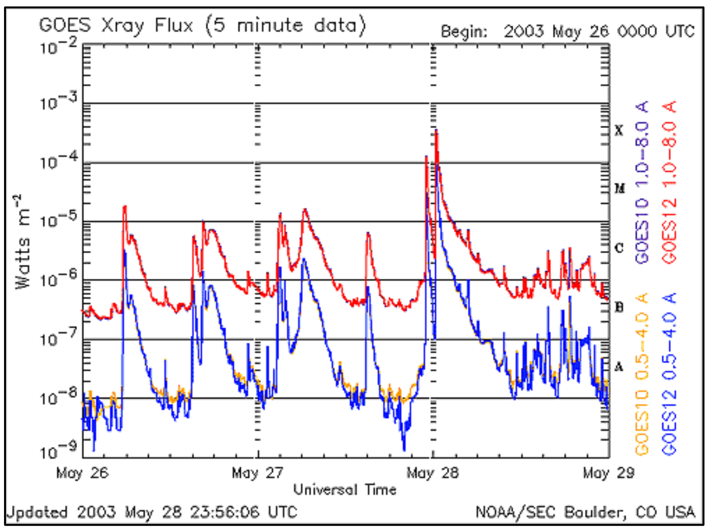


On the student's data collection sheet, they are asked, **"What does the line look like on the graph you are looking at?** They are prompted to **"Drawn an example of what your line looks like in the box below."** They are asked, **"Do you think you are observing a solar storm using this data? Why or why not?"**

Next, students will collect and analyze data from the GOES 12 satellite. **A**lthough GOES 12 is x-ray data, it does provide a good second indicator that a solar storm is likely coming toward Earth. The GOES satellites provide information about the strength of x-ray emissions from the Sun.

It is important to verify the radio wave transmission by using the GOES satellite of x-ray emissions. The Sun is constantly producing x-rays, so you are looking for significant increases in the intensity of x-ray above a background. The lighter the area appears, then the greater the x-ray activity.

Scientists have developed a simple rating system for solar x-ray activity. They have created five levels; A, B, C, M, and X. A is the lowest level, B is 10 times more powerful than A, C is 10 times more powerful than B, M is 10 times more powerful than C, and X is 10 times stronger than M. So this makes an X event 10,000 times stronger than A. In addition, each level can be further divided from 1.0 to 9.9. This means you could have a C2.3 event, or a B7.9 or an M6.5 However, since X is the highest level, the numbers don't stop at X9.9. This could be a great mathematics activity for students using base 10! This also gives students a background into understanding the level of intensity of the storm and the levels scientists use. On October 28, 2003 there was an X17.2 flare followed several days later by an approximately X28 flare (actually it was so strong it was hard to measure). These are the biggest flares ever measured.



Two GOES satellites record solar x-ray emission, GOES 10 and GOES 12. The red plot from GOES 12 is the one we want.

Students are asked the following questions on their data collection sheet:
Have there been any solar flares detected over the last few days?
If yes, when were these flares detected? How strong were they?

Based on the data you have analyzed from these instruments, answer this question.
Has any data been recorded today that indicates that a solar storm might be heading toward Earth? Be sure to cite specific data in your response.

Magnetosphere (Station #3)

Here is the link to the slides that you will want to download and post at this station. We recommend that you organize the slides into and easily accessible 'Flip Chart'.

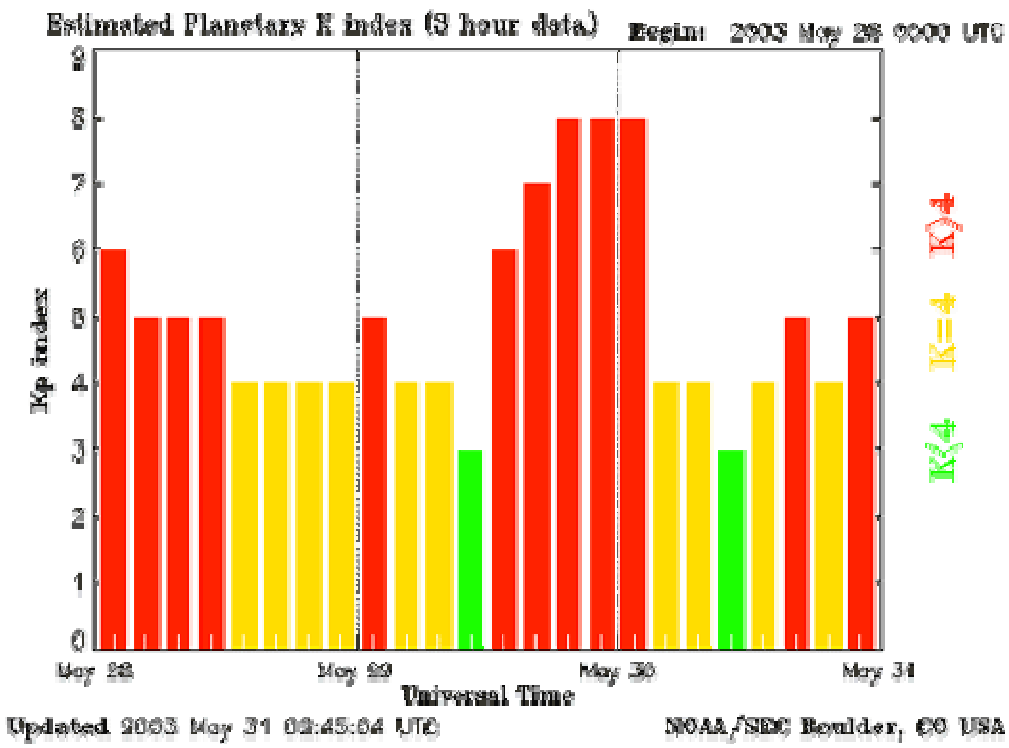
http://sunearthday.nasa.gov/swac/magnetosphere_slides.pdf

Here is the link to the student data collection sheet that you will want to have copied and available at this station.

http://sunearthday.nasa.gov/swac/magnetosphere.pdf

Students will begin by collecting and analyzing data from observatories. They will go into the link for "Kp index: Estimated Planetary K index". This is a tool that helps to predict auroral activity.

The Kp index can be used to predict where you might see an aurora. The higher the Kp number, the stronger the disturbance. A large disturbance in the Earth's magnetic field is likely to produce strong aurora that extend further toward the equator.



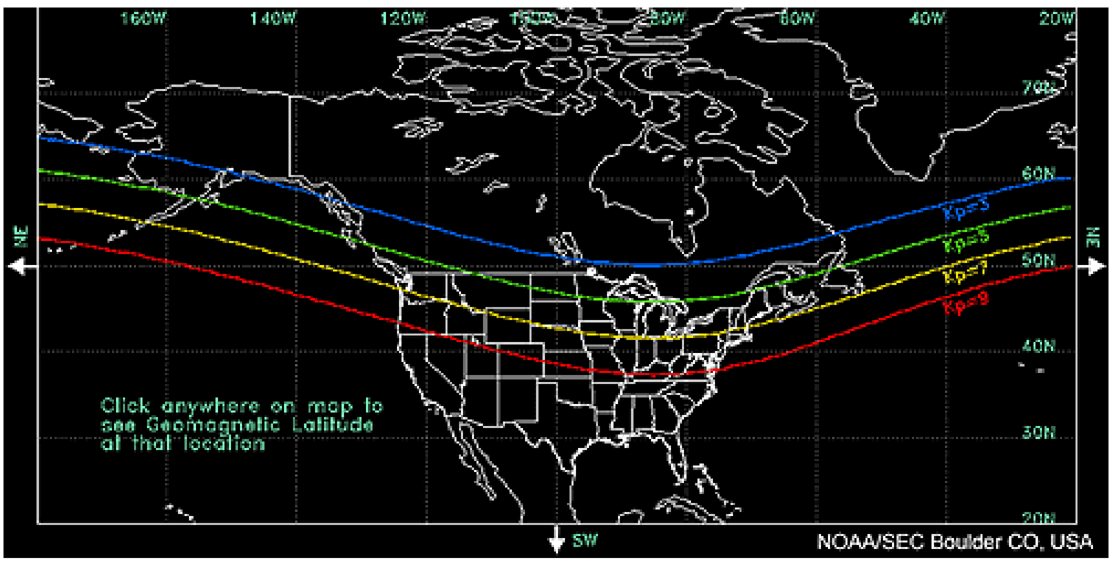
The horizontal axis is Universal Time (UT) http://son.nasa.gov/tass/ut.htm

Each bar stands for 3-hour intervals. The vertical axis shows the Kp index from 0 to 9. Kp values below 4 indicates little disturbance. The bars are green when the Kp is less than 4, yellow when the Kp equals 4, and red when the Kp is greater than 4. The red bars indicate a storm warning. Values greater than 7 indicate a large disturbance. For example, the disturbance at the end of May 29 and the early hours of May 30 was significant and long lasting.

From the Kp you can predict where an aurora might be visible and how far from the poles the aurora might be seen. Kp is an average from 10 ground based observatories.

On the data collection sheet, the students are asked,
What three days does this graph cover?
What were the highest K index levels for each of these days?
Are there any kp values of 5 or higher?
Are there any kp values of 7 or higher?"

Next, students go to the "Kp Auroral Map". This map shows the connection between Kp and the predicted southern edge of the aurora in North America. When the Kp equals 5, aurora could be expected south to the green line. With a Kp of 9 auroras could be expected south to the red line. In some cases when the Kp equaled 9 auroras were seen in



The magnetic disturbance of May 29 and 30, 2003 had a Kp index of 8. The aurora was visible in Virginia.

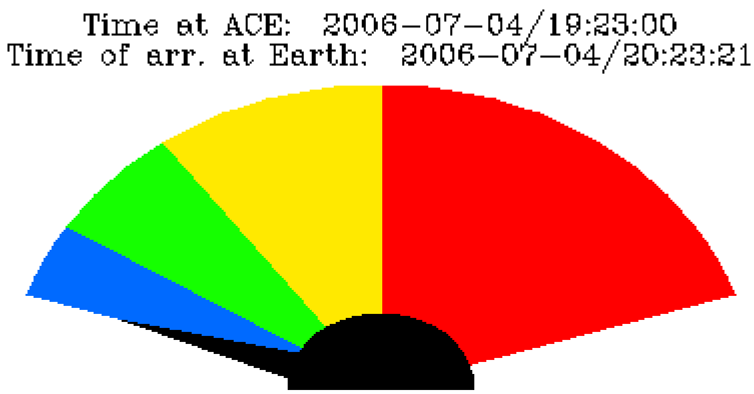
Low-Blue
Medium-Green
High-Yellow
Red- Extreme

On the data collection sheet, the students are asked,

What is the longitude, latitude, and corrected geomagnetic latitude for your area?
What would the kp level have to be for us to see aurora in our area?
Are there any areas in the world that might see auroral activity, based on this data, in the next few hours? Where?

Now the students refer to satellite data from the ACE satellite.
http://sohowww.nascom.nasa.gov/data/synoptic/sel/dst.gif

This is a simple intensity gauge tool to characterize the strength of the magnetic field disturbance. "Dst" stands for "Disturbance storm-time". Like the Kp graph, it is very easy to read and the scientists have interpreted data from the ACE satellite for you. This data is provided in a simple 'dial' format.. Students use this to determine the possibility of a solar storm interacting with the magnetosphere within the next few hours.



Low-Blue
Medium-Green
High-Yellow
Red- Extreme

The students answer these questions regarding this data, "**What is the current level of geo-magnetic storm activity? When did the geo-magnetic storm arrive at Earth**?"

After looking at all of this data, students are instructed to cite specific data as they answer this question, "***Has there been a measurable disturbance in the Earth's magnetic field?"***

Aurora (Station #4)

Here is the link to the slides that you will want to download and post at this station. We recommend that you organize the slides into and easily accessible 'Flip Chart'.

http://sunearthday.nasa.gov/swac/aurora_slides.pdf

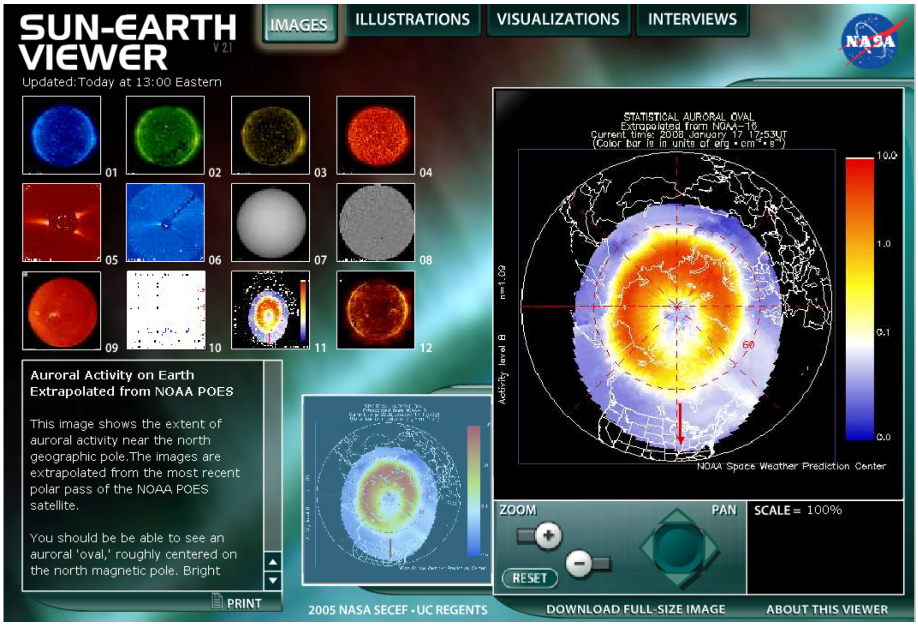
Here is the link to the student data collection sheet that you will want to have copied and available at this station.

http://sunearthday.nasa.gov/swac/aurora.pdf

Students are directed to go to POES under "satellites"
http://sunearth.gsfc.nasa.gov/sunearthday/media_viewer/flash.html

They will open image #11, which is an image from the POES satellite and just about in "real time" (the actual time). You can use the controls under the main box on the right to zoom and pan.

This plot shows the current extent and position of the auroral oval in the northern hemisphere. The red arrow in the plot points toward noon. The colors indicate intensity. Red and orange indicate intense auroral activity and blue is low auroral activity. This image provides an estimate of the location, extent, and intensity of aurora. If the red-orange extends down into the northern most states of the United States, you can expect to see auroras in these states. If there is a severe magnetic storm, you could expect to see the red-orange extend into the middle of the United States, and you might see aurora into Texas and Florida.



Students use data from this image to answer the questions,
"Where might one see auroras in the United States in the coming week? Have auroras been seen within the last 24 hours due to a solar storm?"

Evaluate:

The following script serves as an evaluation. Students should also be encouraged to make modifications to the script based on their unique styles of communication and results obtained during exploration and research phases.

[Opening]

Good (morning, afternoon, evening) this is (your name) bringing you (school name)'s Space Weather Report for (date).

For the past several weeks our Sun has been (pretty quiet, somewhat active, very active).

[Sunspot Region]

The surface of the Sun showed (no, some, many) sign/s of the familiar dark blemishes called sunspots. Sunspots are (intense magnetic areas on the Sun's visible surface that are cooler then their surrounding areas and therefore appear darker). One ground based telescope in Austria using an H-Alpha filter gave us our first observation of a sunspot region that could cause an eruption.

The magnetogram image of the sun taken from the SOHO spacecraft, indicates (some, moderate, intense) twisting of the magnetic fields on the Sun. This also indicates (a strong, a possible, little, no) chance for an eruption from that sunspot region.

Finally, our EIT images were taken at four different wavelenths and four colors in order of wavelength. As you can see, they also show a rather active sunspot region. The sunspot region to watch is number (???).

[Storm Signals]

Ground based observatories in Florida recorded a (low) radio signal indicating that an eruption from the Sun headed towards Earth (is, isn't) likely.

The GOES satellite provides information about the strength of x-ray emissions from the sun which is a good second indicator that a solar storm could be headed towards earth. It shows that a (A,B,C,M,X) class event occurred on (date).

[Magnetosphere]

The Magnetometer average for the ground based observatories taken from the Kp index, indicates a level (1-9) event. (A possible aurora may be seen as far south as region name). *or* (A possible view is of the Aurora is unlikely).

As was expected, the DST gauge aboard the ACE spacecraft indicated a(n) (extreme, high, medium, low) disturbance of our magnetosphere. We will continue to monitor that data over the next few hours.

[Aurora]
Finally, the POES satellite revealed a (red, orange, yellow, white, blue) color in the upper latitudes, indicating aurora activity of (extreme, high, medium, low) intensity could be seen in (those regions, lower latitudes as well).

We will keep you informed as we continue to monitor Sunspot number (???).
Thank you and we'll see you next time!

Extension:

Once students have mastered the beginning steps to "Tracking a Solar Storm" they can use more advanced data or add data from Action Region Monitor. Use the tutorials to learn how to analyze the data.

Note:

For more information visit:

The Sun-Earth Connection Education Forum
http://sunearth.gsfc.nasa.gov/index.php

Tracking a Solar Storm
http://son.nasa.gov/tass/index.htm

Sun-Earth Day
http://sunearthday.nasa.gov/index.php

S.W.A.C
http://sunearthday.nasa.gov/swac