Space Weather Action Center

FLIP CHART GUIDE (Version 3)

SWAC Flip Chart Guide

Introduction:

This Flip Chart Guide provides a snapshot of all four student flip charts: Sunspot Regions, Storm Signals, Magnetosphere, Aurora. Each section also contains a brief overview, helpful tips and copy of the questions from the student Data Collection Sheets. All student flip charts and data collection sheets can be downloaded from the SWAC website at: http://sunearthday.gsfc.nasa.gov/swac/gettingstarted/download.php

Each of the SWAC flip charts has been carefully designed to enable students easily move through the sequence of events that occur during typical Solar Storm and are therefore comprised of the following four main sections: Sunspot Regions, Storm Signals, Magnetosphere, Auroras. Each set of flip chart cards also includes 'easy to follow' **INSTRUCTION CARDS** and **INFORMATION CARDS**.

> **INSTRUCTION CARDS** contain every step necessary to obtain, analyze and record all required online data.
>
> **INFORMATION CARDS** contain a variety of sample images and helpful tips when interpreting and analyzing the data.

The flip charts may be downloaded and printed on a single 8x11 sheet of paper. Assemble your flip chart by inserting 2 flip chart sheets (back to back) into plastic sleeves. Place the plastic sleeves in a loose-leaf notebook; turning the notebook in a horizontal direction with the binding at the top.

A smaller flip chart can be assembled by reducing the printout sizes: 2 or 4 to a sheet depending on the size you prefer. Cut out and fasten the smaller flip chart sheets together. We suggest that you laminate or insert each sheet into a plastic sleeve for continued use.

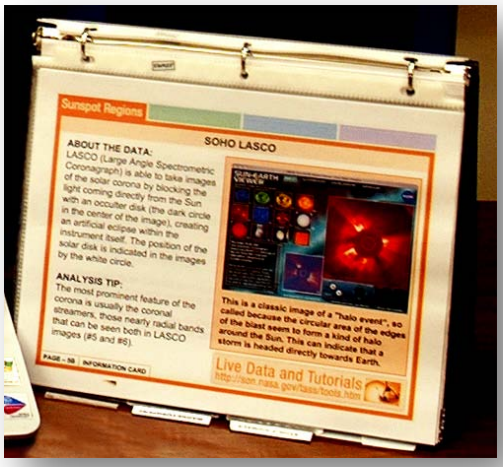
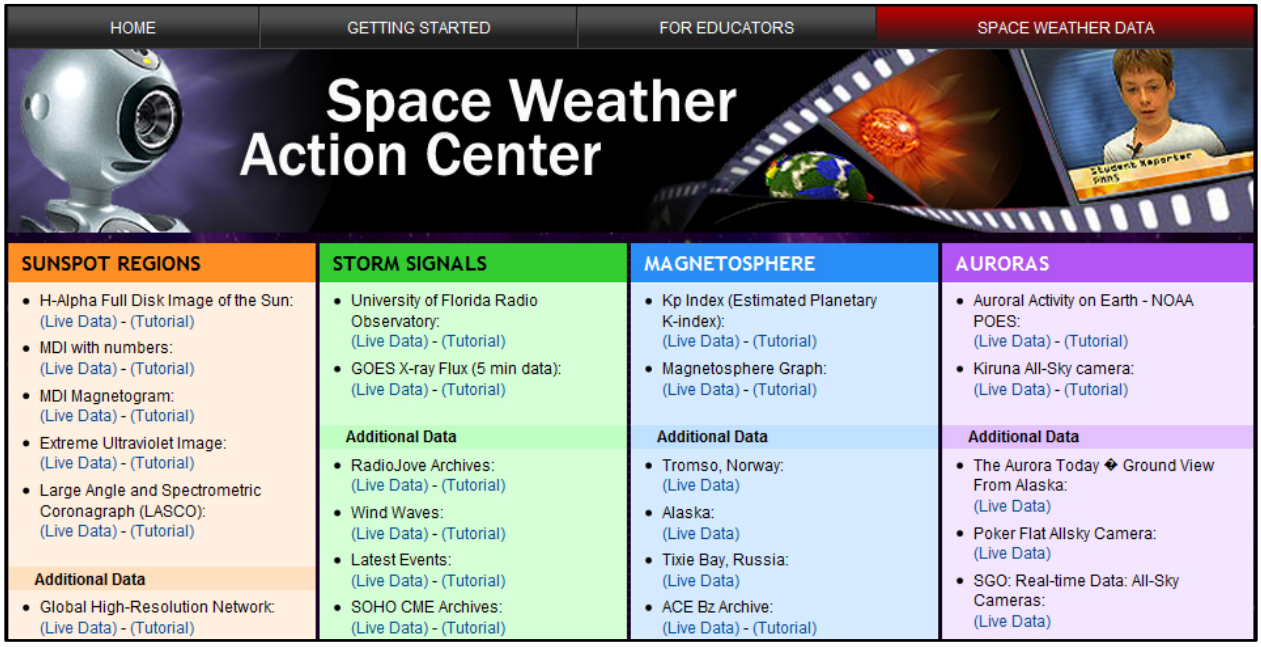


Figure 1: Sample Flip Chart

SPACE WEATHER DATA

All of the data links required to make your space weather observations are located on this single webpage. Beside each of the 'live data' links on that page you will also find 'tutorial' links containing easy to read tutorials that that will help you when interpreting the data. You can always find your place by returning to this page referred to throughout each of the flipcharts.



COLOR CODING

We have divided all of the Space Weather Action Center resources into four 'color-coded' categories: Sunspot Regions (orange), Storm Signals (green), Magnetosphere (blue) and Aurora (purple). The same color code scheme is used in the flipchart, the data collection sheets and on the Live Data and Tutorials webpage. You can always know which section you're in with one quick glance!

THE SPACE WEATHER MEDIA VIEWER

The Space Weather Media Viewer is one of the main observation tools that you will be using. Once this online tool is open, we recommend that you simply keep it open in a separate browser tab or window for faster data access when needed.

Sunspot Regions Flip Chart

Overview

Sunspots are the first indicators that a storm from the Sun is a possibility. However, not all sunspots cause problems for Earth. By following the steps in this flip chart your students will soon be able to answer the big question, ***"Do sunspot regions exist today that could be a source of solar storms?"***.

In the Sunspot Regions Flip Chart there are 5 sets of data:

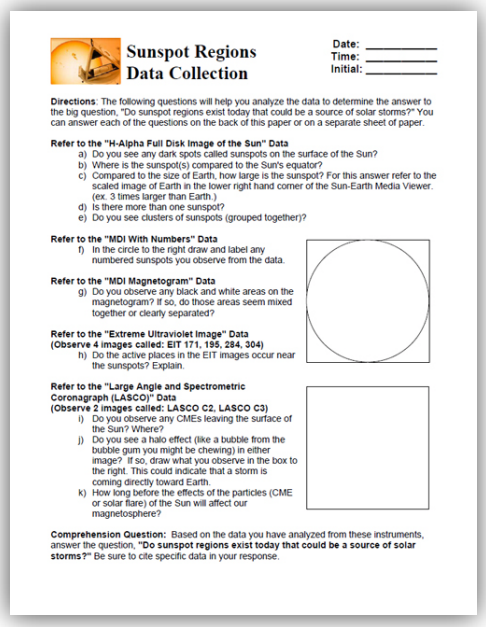
- H-Alpha Full Disk Image of the Sun
- MDI with Numbers
- MDI Magnetogram
- Extreme Ultraviolet Image
- Large Angle Spectrometric Coronagraph (LASCO)

In this section students will learn how to:

- Obtain and interpret data from ground-based professional observatories.
- Obtain and interpret data from NASA satellites.

Data Collection Sheet:

Each flip chart has a corresponding Data Collection Sheet that can be downloaded from the SWAC website. They are designed to help students quickly record and analyze necessary sets of data. A comprehension question at the bottom of each data sheet provides an opportunity for students to summarize the data and make a prediction for verification over the next several days.



Sunspot Regions
Data Collection

Date: _____
Time: _____
Initial: _____

Directions: The following questions will help you analyze the data to determine the answer to the big question, "Do sunspot regions exist today that could be a source of solar storms?" You can answer each of the questions on the back of this paper or on a separate sheet of paper.

Refer to the "H-Alpha Full Disk Image of the Sun" Data

a) Do you see any dark spots called sunspots on the surface of the Sun?
b) Where is the sunspot(s) compared to the Sun's equator?
c) Compared to the size of Earth, how large is the sunspot? For this answer refer to the scaled image of Earth in the lower right hand corner of the Sun-Earth Media Viewer. (ex. 3 times larger than Earth.)
d) Is there more than one sunspot?
e) Do you see clusters of sunspots (grouped together)?

Refer to the "MDI With Numbers" Data

f) In the circle to the right draw and label any numbered sunspots you observe from the data.

Refer to the "MDI Magnetogram" Data

g) Do you observe any black and white areas on the magnetogram? If so, do those areas seem mixed together or clearly separated?

Refer to the "Extreme Ultraviolet Image" Data
(Observe 4 images called: EIT 171, 195, 284, 304)

h) Do the active places in the EIT images occur near the sunspots? Explain.

Refer to the "Large Angle and Spectrometric Coronagraph (LASCO)" Data
(Observe 2 images called: LASCO C2, LASCO C3)

i) Do you observe any CMEs leaving the surface of the Sun? Where?
j) Do you see a halo effect (like a bubble from the bubble gum you might be chewing) in either image? If so, draw what you observe in the box to the right. This could indicate that a storm is coming directly toward Earth.
k) How long before the effects of the particles (CME or solar flare) of the Sun will affect our magnetosphere?

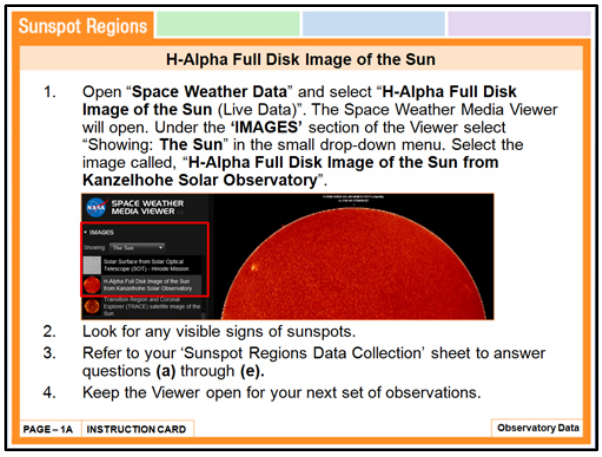
Comprehension Question: Based on the data you have analyzed from these instruments, answer the question, **"Do sunspot regions exist today that could be a source of solar storms?"** Be sure to cite specific data in your response.

Keep a set of **Data Collection Sheets** and/or clipboards nearby in order for students to collect all of the information they will need to complete their Space Weather News Report!

Space Weather Data:

The SWAC website is an extremely robust "one stop shopping' learning tool complete with step-by-step tutorials on how to interpret live or 'near real time' space weather data from 10 missions and 36 instruments. All of the data links required to make your space weather observations are located on a single webpage called Space Weather Data. Beside each of the 'live data' links you will also find 'tutorial' links containing easy to read tutorials that that will help you when interpreting the data. A link to this webpage is at the bottom of every INSTRUCTIONAL CARD in the flip chart.

H-Alpha Full Disk Image of the Sun



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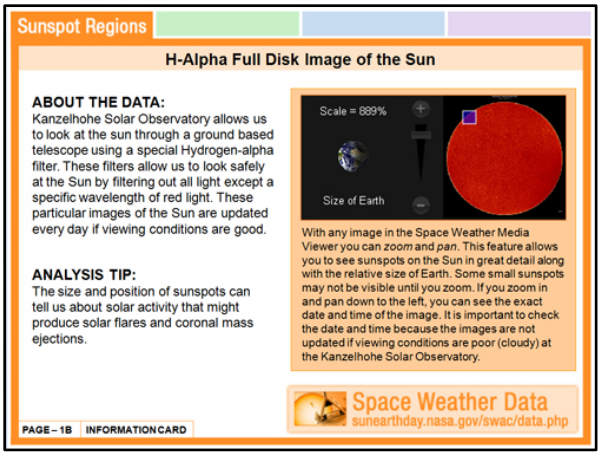

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The Kanzelhohe Solar Observatory in Treffen, Austria, provides the near-real time images that you see in the Space Weather Media Viewer.

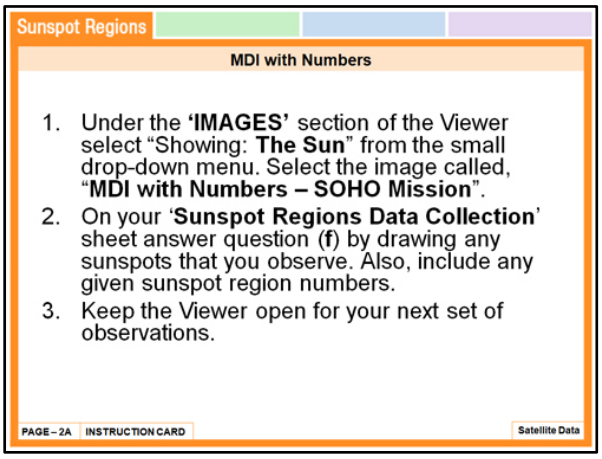
Tips

- Your students can use these images to compare with the NASA satellite images they will retrieve in the next few sections.
- Kanzelhohe Solar Observatory allows us to look at the sun through a ground based telescope using a special Hydrogen-alpha filter. These filters allow us to look safely at the Sun by filtering out all light except a specific wavelength of red light. These particular images of the Sun are updated every day if viewing conditions are good.

Questions from the Student Data Collection Sheet

a) Do you see any dark spots called sunspots on the surface of the Sun?
b) Where is the sunspot(s) compared to the Sun's equator?
c) Compared to the size of Earth, how large is the sunspot? For this answer refer to the scaled image of Earth in the lower right hand corner of the Sun-Earth Media Viewer. (ex. 3 times larger than Earth.)
d) Is there more than one sunspot?
e) Do you see clusters of sunspots (grouped together)?

MDI with Numbers



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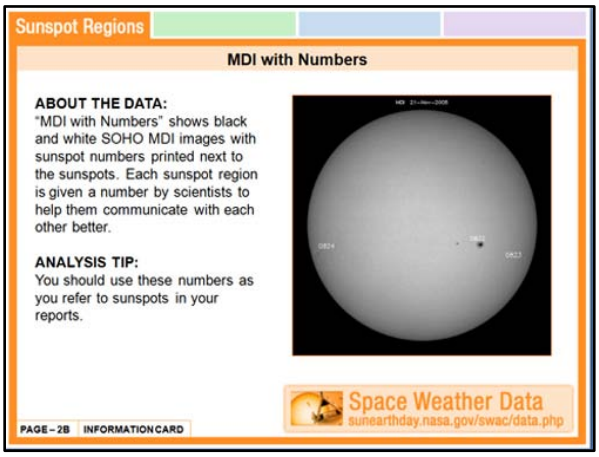

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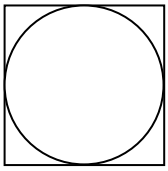
MDI with Numbers (Michelson Doppler Imager) produces images that appear most nearly as the Sun would look at sunrise or sunset. The most prominent features are the sunspots. Each sunspot region is given a number by scientists to help them communicate better with each other.

Tips

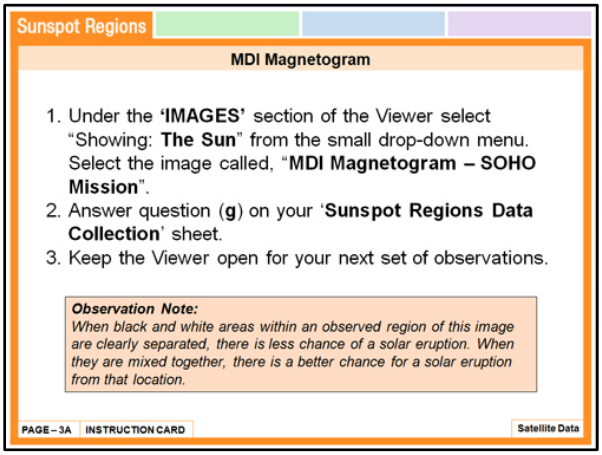
- The easiest way to view this image is by opening the Space Weather Media Viewer. In the "**IMAGES**" section select "**The Sun**" from the small drop-down menu. Select the image called, "**MDI with Numbers- SOHO Mission**". Don't forget to zoom in and pan to the top center of the image in order to see the exact date and time of the image.
- "MDI with Numbers" shows black and white SOHO MDI images with sunspot numbers printed next to the sunspots.
- You should encourage students to use these numbers when referring to sunspots in their reports.

Questions from the Student Data Collection Sheet

f) In the circle to the right draw and label any numbered sunspots you observe from the data.



MDI Magnetogram



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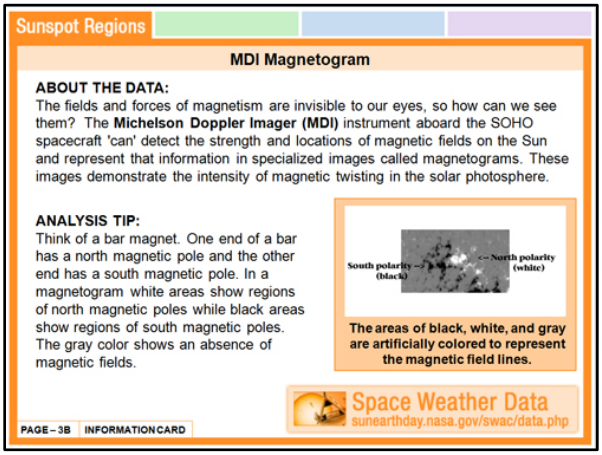

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The MDI (Michelson Doppler Imager) instrument aboard the SOHO spacecraft 'can' detect the strength and locations of magnetic fields on the Sun and represent that information in specialized images called magnetograms.

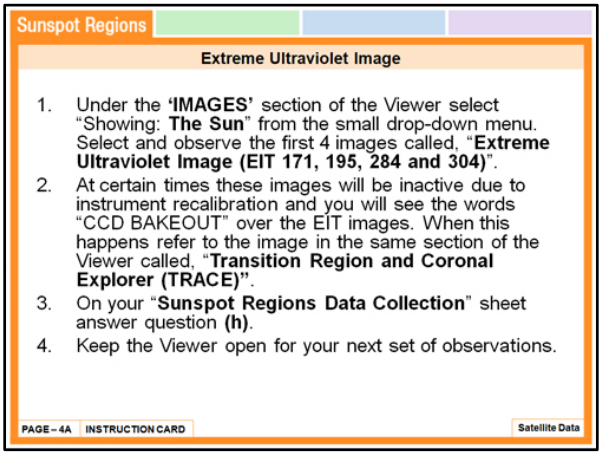
Tips

- The easiest way to view this image is by opening the Space Weather Media Viewer. In the "**IMAGES**" section select "**The Sun**" from the small drop-down menu. Select the image called, "**MDI Magnetogram- SOHO Mission**". Don't forget to zoom in and pan to the top center of the image in order to see the exact date and time of the image.
- These images demonstrate the intensity of magnetic twisting in the solar photosphere. When the black and white areas next to each other are clearly separated, there is less chance of a solar eruption. When black and white areas are mixed together, there is a better chance for a solar eruption from that location.
- Students in grades K + 4 can understand that the MDI images are pictures of the Sun, and they can make observations of the spots on the Sun and watch the spots changes position and size.

Questions from the Student Data Collection Sheet

g) Do you observe any black and white areas on the magnetogram? If so, do those areas seem mixed together or clearly separated?

Extreme Ultraviolet Image



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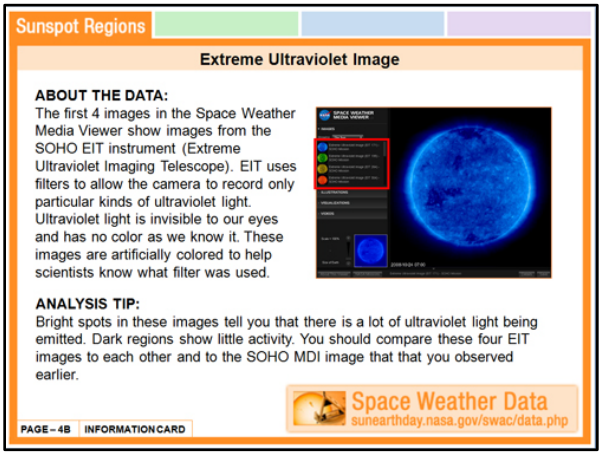

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The first four images in the Space Weather Media Viewer are from the SOHO EIT instrument (Extreme Ultraviolet Imaging Telescope). This instrument uses filters to allow the camera to record only particular kinds of ultraviolet light. These images are artificially colored to help scientists know what filter was used. (Ultraviolet light is invisible to our eyes and has no color as we know it.)

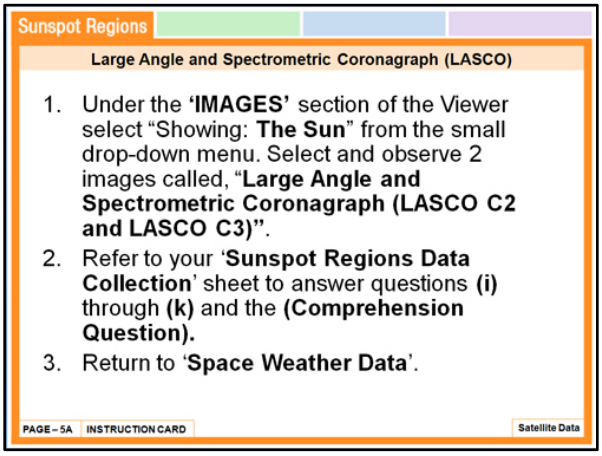
Tips

- The bright spots in these images tell you that there is a lot of ultraviolet light being emitted. Dark regions show little activity. You should compare the four EIT images to each other and to the SOHO MDI images that show you where sunspots are.
- At certain times these images will be inactive due to instrument recalibration and you will see the words "CCD BAKEOUT" over the EIT images. When this happens refer to the image called, "Transition Region and Coronal Explorer (TRACE)". It is important to note that these images are updated about every two hours. However, not all images are updated at the same time. This means that an image might be a few hours before or after others. You can download full size images and save them by clicking on the "Save" button in the lower right side of the viewer.
- In the images taken at 304 Angstroms (orange image) the bright material is at 60,000 to 80,000 degrees Kelvin. In those taken at 171 Angstroms (blue image), the bright material is at 1 million degrees. 195 Angstrom (green image) images correspond to about 1.5 million Kelvin. 284 Angstrom (yellowish image) images correspond to 2 million degrees. The hotter the temperature, the higher you look in the solar atmosphere.

Questions from the Student Data Collection Sheet

h) Do the active places in the EIT images occur near the sunspots? Explain.

Large Angle and Spectrometric Coronagraph (LASCO)



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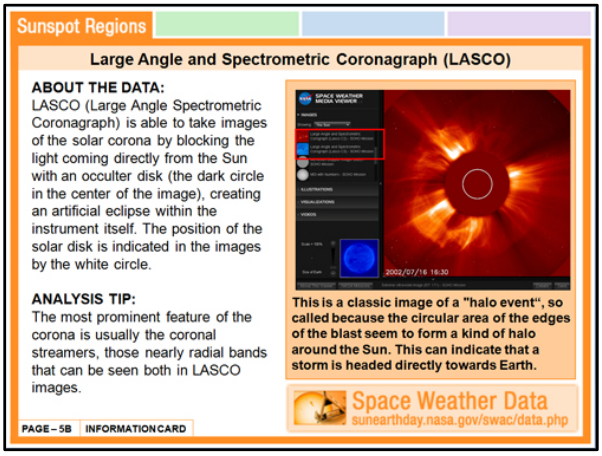

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LASCO (Large Angle Spectrometric Coronagraph) is able to take images of the solar corona by blocking the light coming directly from the Sun with an occulter disk (the dark circle in the center of the image), creating an artificial eclipse within the instrument itself.

Tips

- In the Space Weather Media Viewer students should observe the 2 images called, "Large Angle and Spectrometric Coronagraph (LASCO C2 and LASCO C3)". It is important to note the date and time for each image. If the images become speckled with white specks or a halo around the image appears, this can indicate that a storm headed directly toward Earth.
- While viewing the LASCO images, don't forget to look for the constellations and planets that can be seen behind the Sun!

Questions from the Student Data Collection Sheet

i) Do you observe any CMEs leaving the surface of the Sun? Where?

j) Do you see a halo effect (like a bubble from the bubble gum you might be chewing) in either image? If so, draw what you observe in the box to the right. This could indicate that a storm is coming directly toward Earth.

k) How long before the effects of the particles (CME or solar flare) of the Sun will affect our magnetosphere?

Comprehension Question: Based on the data you have analyzed from these instruments, answer the question, **"Do sunspot regions exist today that could be a source of solar storms?"** Be sure to cite specific data in your response.

Storm Signals Flip Chart

Overview

When a solar flare or CME erupts from the Sun, a radio signal is emitted that reaches Earth in a little over 8 minutes! By following the steps in this flip chart your students will soon be able to answer the big question, ***"Have signals been recorded today due to a flare or CME that could affect Earth?"***

In the Storm Signals Flip Chart there are 2 sets of data:

- University of Florida Radio Observatory
- GOES X-ray Flux (5 minute data)

In this section students will learn how to:

- Obtain and interpret radio emissions from ground-based professional observatories.
- Obtain and interpret radio, x-ray and ultraviolet emissions from NASA satellites.

Data Collection Sheet:

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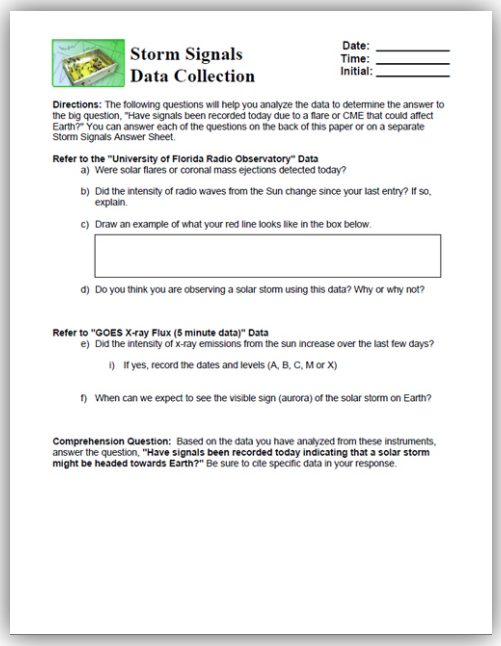


Storm Signals
Data Collection

Date: _____
Time: _____
Initial: _____

Directions: The following questions will help you analyze the data to determine the answer to the big question, "Have signals been recorded today due to a flare or CME that could affect Earth?" You can answer each of the questions on the back of this paper or on a separate Storm Signals Answer Sheet.

Refer to the "University of Florida Radio Observatory" Data

a) Were solar flares or coronal mass ejections detected today?

b) Did the intensity of radio waves from the Sun change since your last entry? If so, explain.

c) Draw an example of what your red line looks like in the box below.

d) Do you think you are observing a solar storm using this data? Why or why not?

Refer to "GOES X-ray Flux (5 minute data)" Data

e) Did the intensity of x-ray emissions from the sun increase over the last few days?

i) If yes, record the dates and levels (A, B, C, M or X)

f) When can we expect to see the visible sign (aurora) of the solar storm on Earth?

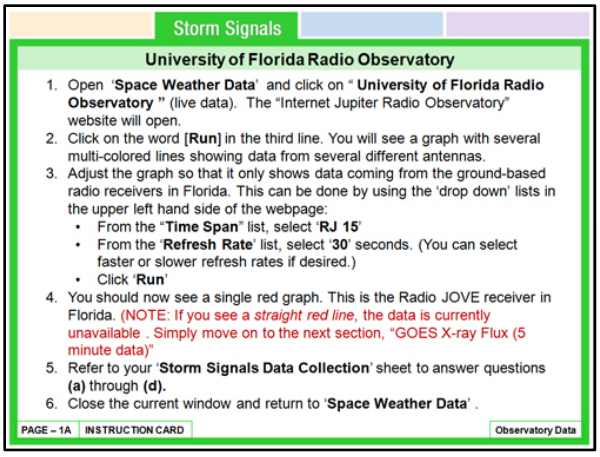
Comprehension Question: Based on the data you have analyzed from these instruments, answer the question, **"Have signals been recorded today indicating that a solar storm might be headed towards Earth?"** Be sure to cite specific data in your response.

Keep a set of **Data Collection Sheets** and/or clipboards nearby in order for students to collect all of the information they will need to complete their Space Weather News Report!

Space Weather Data:

The SWAC website is an extremely robust "one stop shopping' learning tool complete with step-by-step tutorials on how to interpret live or 'near real time' space weather data from 10 missions and 36 instruments. All of the data links required to make your space weather observations are located on a single webpage called Space Weather Data. Beside each of the 'live data' links you will also find 'tutorial' links containing easy to read tutorials that that will help you when interpreting the data. A link to this webpage is at the bottom of every INSTRUCTIONAL CARD in the flip chart.

University of Florida Radio Observatory



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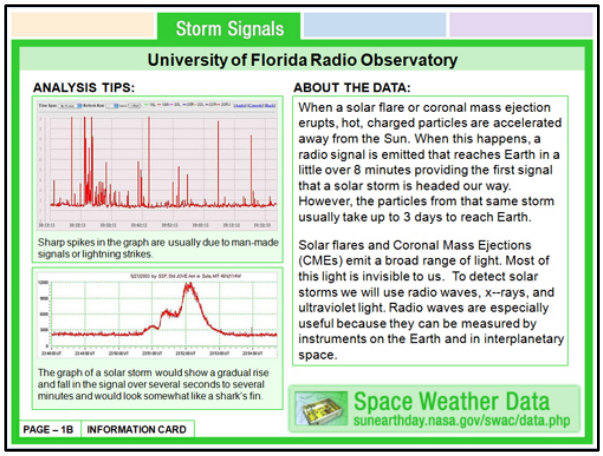

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The ground-based radio antennas at the University of Florida provide real-time measurements of radio emissions from the Sun and archives of results from earlier measurements. Radio waves are especially useful because they can be measured by instruments on the Earth and in interplanetary space.

Tips

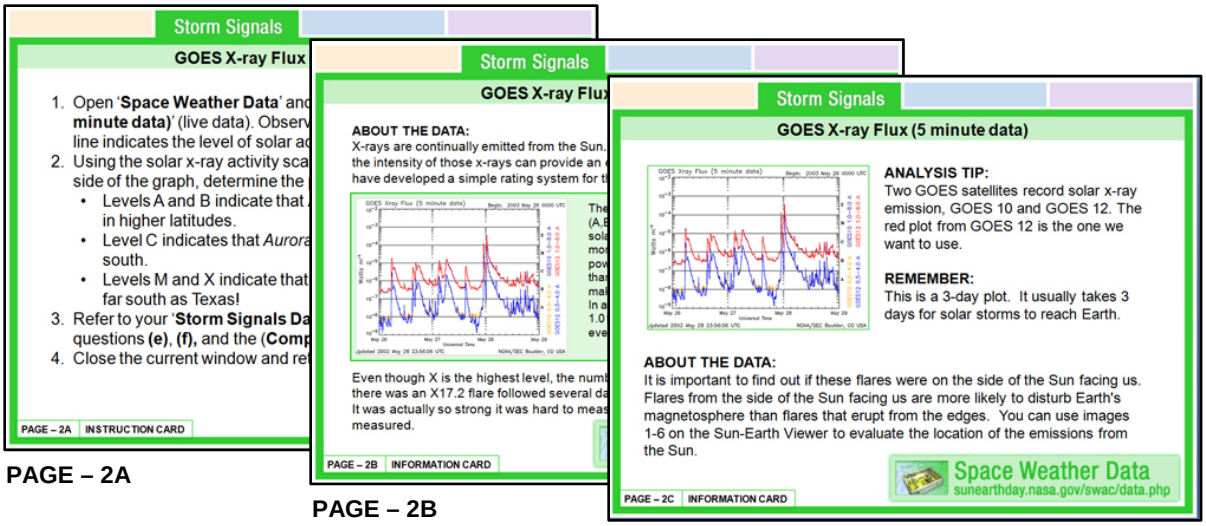
- At times this graph will show a straight red line which indicates that the data is currently unavailable. When this happens simply move on to the next section, "**GOES X-ray Flux (5 minute data)**".
- When a solar flare or coronal mass ejection erupts, hot, charged particles are accelerated away from the Sun. When this happens, a radio signal is emitted that reaches Earth in a little over 8 minutes providing the first signal that a solar storm is headed our way. However, the particles from that same storm usually take up to 3 days to reach Earth.
- To conduct research on past solar storms, visit the RadioJove Archives under "**Additional Data"** on the "**Space Weather Data**" webpage.

Questions from the Student Data Collection Sheet

a) Were solar flares or coronal mass ejections detected today?
b) Did the intensity of radio waves from the Sun change since your last entry? If so, explain.
c) Draw an example of what your red line looks like in the box below.

d) Do you think you are observing a solar storm using this data? Why or why not?

GOES X-ray Flux (5-min data)



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X-rays are continually emitted from the Sun. The GOES satellites, while primarily studying Earth and Earthly weather, monitor the Sun for x-ray radiation and provide us with information about the solar wind and space weather.

Tips

- Two GOES satellites record solar x-ray emission, GOES 10 and GOES 12. However, GOES 12 x-ray data is a good indicator that a solar storm is likely coming toward Earth and should be used to verify the student data from the Radio JOVE. When observing the data from the GOES 5 Min X-ray Plot, the red plot from GOES 12 is the one we want use.
- In the "**Storm Signals"** section of the "**Space Weather Data**" web page you will find "**Additional Data**". This section contains a link to The Latest Events web site that offers a wealth of data over several days in one place. You will also find a links to several easy to use archives including the Latest Events Archives and the SOHO CME Archives.

Questions from the Student Data Collection Sheet

e) Did the intensity of x-ray emissions from the sun increase over the last few days?
   i) If yes, record the dates and levels (A, B, C, M or X)

f) When can we expect to see the visible sign (aurora) of the solar storm on Earth?

Comprehension Question: Based on the data you have analyzed from these instruments, answer the question, **"Have signals been recorded today indicating that a solar storm might be headed towards Earth?"** Be sure to cite specific data in your response.

Magnetosphere Flip Chart

Overview

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. By following the steps in this flip chart your students will soon be able to answer the big question, ***"Has there been a measurable disturbance in Earth's magnetic field?"***

In the Storm Signals Flip Chart there are 2 sets of data:

- University of Florida Radio Observatory
- GOES X-ray Flux (5 minute data)

In this section students will learn how to:

- Obtain and interpret data from ground-based professional observatories.
- Obtain and interpret data from NASA satellites.

Data Collection Sheet:

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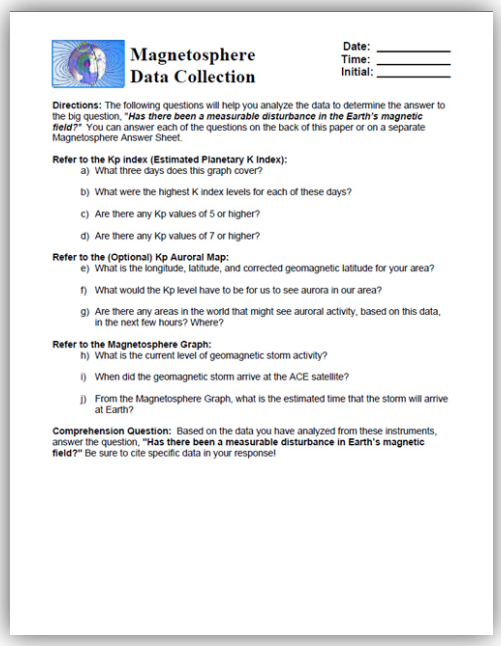

Magnetosphere Data Collection

Date: _____
Time: _____
Initial: _____

Directions: The following questions will help you analyze the data to determine the answer to the big question, "***Has there been a measurable disturbance in the Earth's magnetic field?***" You can answer each of the questions on the back of this paper or on a separate Magnetosphere Answer Sheet.

Refer to the Kp index (Estimated Planetary K Index):

a) What three days does this graph cover?

b) What were the highest K index levels for each of these days?

c) Are there any Kp values of 5 or higher?

d) Are there any Kp values of 7 or higher?

Refer to the (Optional) Kp Auroral Map:

e) What is the longitude, latitude, and corrected geomagnetic latitude for your area?

f) What would the Kp level have to be for us to see aurora in our area?

g) Are there any areas in the world that might see auroral activity, based on this data, in the next few hours? Where?

Refer to the Magnetosphere Graph:

h) What is the current level of geomagnetic storm activity?

i) When did the geomagnetic storm arrive at the ACE satellite?

j) From the Magnetosphere Graph, what is the estimated time that the storm will arrive at Earth?

Comprehension Question: Based on the data you have analyzed from these instruments, answer the question, "**Has there been a measurable disturbance in Earth's magnetic field?**" Be sure to cite specific data in your response!

Keep a set of **Data Collection Sheets** and/or clipboards nearby in order for students to collect all of the information they will need to complete their Space Weather News Report!

Space Weather Data:

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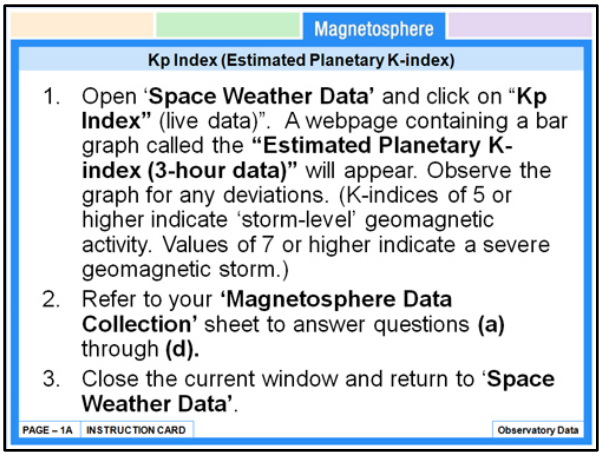
Kp Index (Estimated Planetary K-Index)



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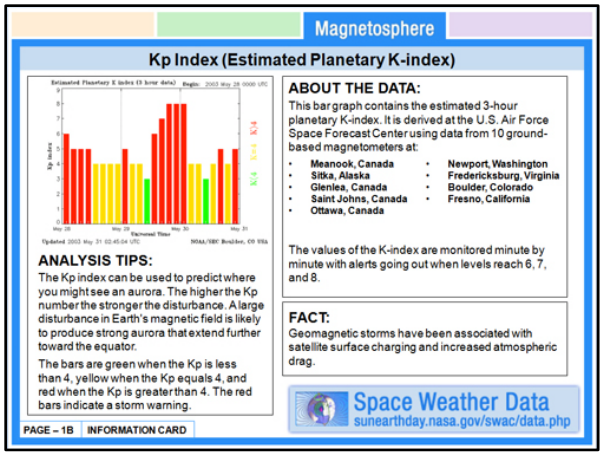

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The Kp Index combines the disturbances in the Earth's magnetic field measured at 9 separate observatories in North America. It is the easiest way to find out if there has been a disturbance in the Earth's magnetic field and how severe the disturbance was.

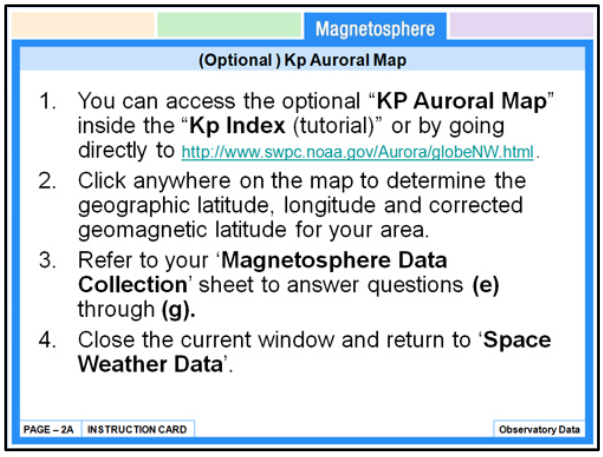
Tips:

- In this section of SWAC you will be using real-time data from magnetic observatories located around the world. These data are updated every few minutes so that you can see exactly how Earth's field is changing right now.
- 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 Earth's magnetic field is likely to produce strong aurora that extend further toward the equator.
- Scientists measure the strength and direction of Earth's field with sensitive instruments called magnetometers. They put 'magnetic observatories' all over the world, but most are in the polar regions of Earth where the field is known to change rapidly. Magnetic disturbances often indicate that a solar storm has occurred. Strong magnetic disturbances can cause brilliant auroras that we can easily see from the ground.

Questions from the Student Data Collection Sheet:

a) What three days does this graph cover?
b) What were the highest K index levels for each of these days?
c) Are there any Kp values of 5 or higher?
d) Are there any Kp values of 7 or higher?

(Optional) Kp Auroral Map



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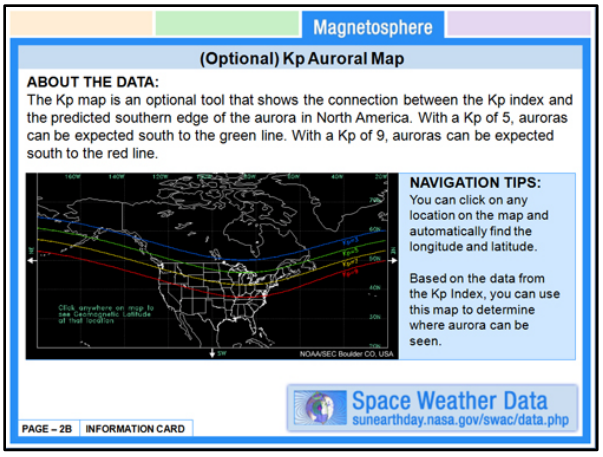

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This map shows the connection between 'Kp index data' and the predicted southern edge of the aurora in North America.

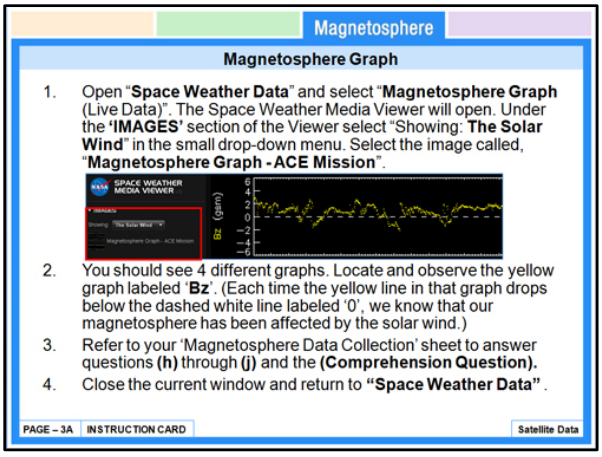
Tips:

- You can click on any location on the map and automatically find the longitude and latitude. Based on the data from the Kp Index, you can use this map to determine where aurora can be seen.
  - **Kp of 3:** Aurora could be expected south to the BLUE line.
  - **Kp of 5:** Aurora could be expected south to the GREEN line.
  - **Kp of 9:** Aurora could be expected south to the RED line.
  - **Kp of 9+:** Aurora could be seen as far south as Texas and Florida.

Questions from the Student Data Collection Sheet:

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

Magnetosphere Graph



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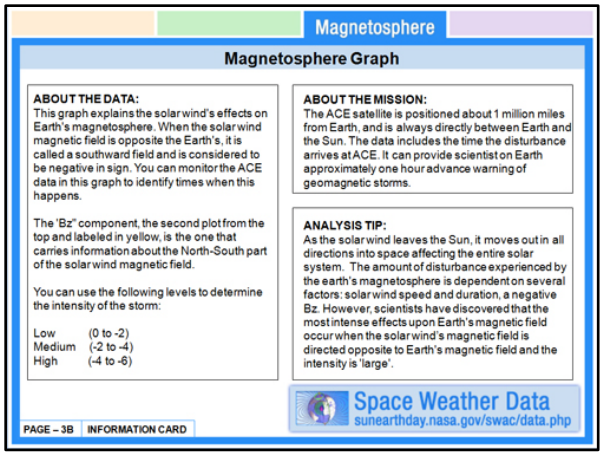

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The ACE Satellite, positioned about one million miles from Earth, and always directly between Earth and the Sun, monitors the speed, composition and magnetic field of the solar wind. This graph explains the solar wind's effects on Earth's magnetosphere.

Tips:

- The easiest way to view this image is by opening the Space Weather Media Viewer. In the 'IMAGES' section select "The Solar Wind" in the small drop-down menu. Next, select the image called, "Magnetosphere Graph-ACE Mission". In this image you will see 4 different graphs. Locate and observe the yellow graph labeled 'Bz'. (Each time the yellow line in that graph drops below the dashed white line labeled '0', we know that our magnetosphere has been affected by the solar wind.)
- This graph explains the solar wind's effects on Earth's magnetosphere. When the solar wind magnetic field is opposite the Earth's, it is called a southward field and is considered to be negative in sign. You can monitor the ACE data in this graph to identify times when this happens. Visit the Magnetosphere Graph Tutorial for more information.

Questions from the Student Data Collection Sheet:

h) What is the current level of geomagnetic storm activity?
i) When did the geomagnetic storm arrive at the ACE satellite?
j) From the Magnetosphere Graph, what is the estimated time that the storm will arrive at Earth?

Comprehension Question: Based on the data you have analyzed from these instruments, answer the question, **"Has there been a measurable disturbance in Earth's magnetic field?"** Be sure to cite specific data in your response!

Auroras Flip Chart

Overview

By following the steps in this flip chart your students will soon be able to answer the big question, ***"Have auroras been seen within the last 24 hours due to a solar storm?"***

In the Auroras Flip Chart there are 2 sets of data:

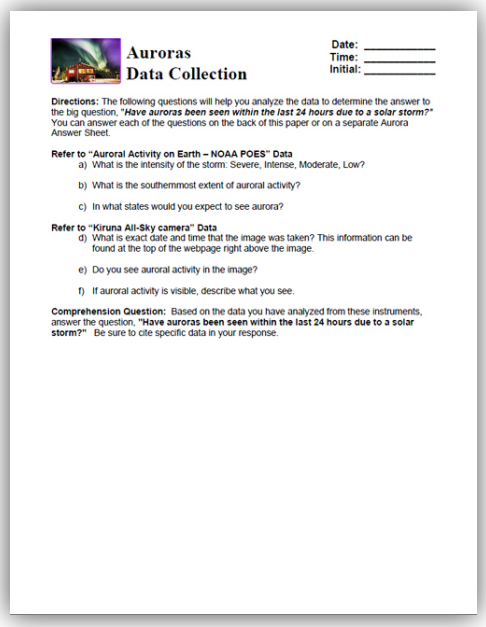
- Auroral Activity on Earth – NOAA POES
- Kiruna All-Sky Camera

In this section students will learn how to obtain and interpret:

- Data from NASA satellite that provide an estimate of the location, extent, and intensity of the auroral oval in the northern hemisphere.
- Data from a ground based "all-sky camera".

Data Collection Sheet:

Each flip chart has a corresponding Data Collection Sheet that can be downloaded from the SWAC website. They are designed to help students quickly record and analyze necessary sets of data. A comprehension question at the bottom of each data sheet provides an opportunity for students to summarize the data and make a prediction for verification over the next several days.



Auroras
Data Collection

Date: _____
Time: _____
Initial: _____

Directions: The following questions will help you analyze the data to determine the answer to the big question, "***Have auroras been seen within the last 24 hours due to a solar storm?***" You can answer each of the questions on the back of this paper or on a separate Aurora Answer Sheet.

Refer to "Auroral Activity on Earth – NOAA POES" Data

a) What is the intensity of the storm: Severe, Intense, Moderate, Low?

b) What is the southernmost extent of auroral activity?

c) In what states would you expect to see aurora?

Refer to "Kiruna All-Sky camera" Data

d) What is exact date and time that the image was taken? This information can be found at the top of the webpage right above the image.

e) Do you see auroral activity in the image?

f) If auroral activity is visible, describe what you see.

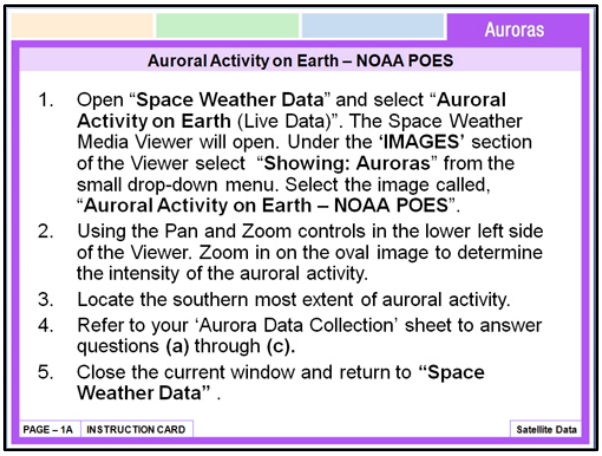
Comprehension Question: Based on the data you have analyzed from these instruments, answer the question, **"Have auroras been seen within the last 24 hours due to a solar storm?"** Be sure to cite specific data in your response.

Keep a set of **Data Collection Sheets** and/or clipboards nearby in order for students to collect all of the information they will need to complete their Space Weather News Report!

Space Weather Data:

The SWAC website is an extremely robust "one stop shopping' learning tool complete with step-by-step tutorials on how to interpret live or 'near real time' space weather data from 10 missions and 36 instruments. All of the data links required to make your space weather observations are located on a single webpage called Space Weather Data. Beside each of the 'live data' links you will also find 'tutorial' links containing easy to read tutorials that that will help you when interpreting the data. A link to this webpage is at the bottom of every INSTRUCTIONAL CARD in the flip chart.

Auroral Activity on Earth – NOAA POES



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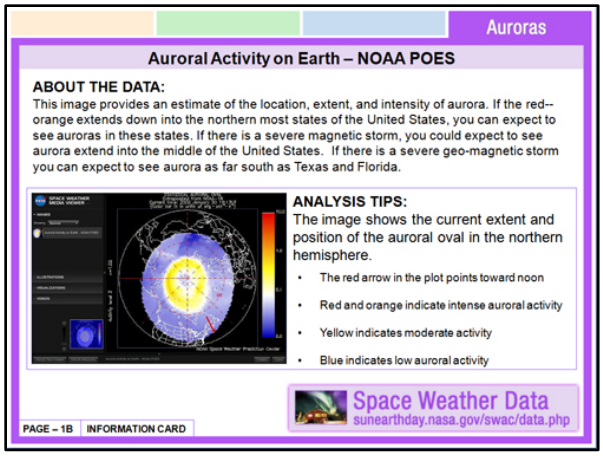

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This plot shows the current extent and position of the auroral oval in the northern hemisphere, extrapolated from measurements taken during the most recent polar pass of the NOAA POES satellite. This data also provides an estimate of the location, extent, and intensity of aurora.

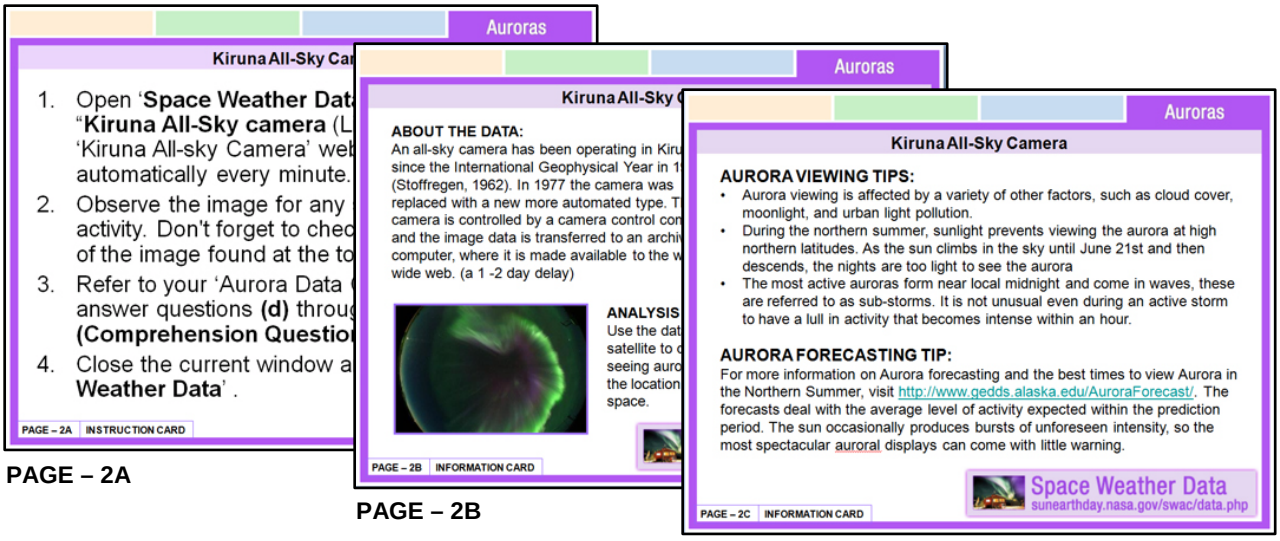
Tips:

- In this image you should be able to see an auroral 'oval,' roughly centered on the north magnetic pole. Bright areas in this region are the 'Northern Lights.' During intense magnetic storms, the aurora can expand to lower latitudes causing brilliant auroras across the lower United States.
- Use the data from the Kp index and the ACE satellite to determine the best possibility of seeing aurora. The POES satellite will show the location and intensity of the storm from space.
- It is important to note that auroras are present all of the time. When the Earth's magnetosphere is calm and stable, the aurora at the North and South poles are roughly over the Arctic and Antarctic Circle and are dim even in dark, remote wilderness. Observers in the far north see aurora quite regularly and may not consider a sighting worth reporting. However, when the Earth's magnetic field is disturbed by especially energetic solar winds, the auroral oval moves outward from the poles and becomes brighter. Auroras cannot be seen during the day, no matter how energetic they are.

Questions from the Student Data Collection Sheet:

a) What is the intensity of the storm: Severe, Intense, Moderate, Low?
b) What is the southernmost extent of auroral activity?
c) In what states would you expect to see aurora?

Kiruna All-Sky Camera



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An all-sky camera has been operating in Kiruna since the International Geophysical Year in 1957. The image refreshes once every minute and can provide visual proof that a solar storm is in progress!

Tips:

- For more information on Aurora forecasting and the best times to view Aurora in the Northern Summer, visit http://www.gedds.alaska.edu/AuroraForecast/ .The forecasts deal with the average level of activity expected within the prediction period. The sun occasionally produces bursts of unforeseen intensity, so the most spectacular auroral displays can come with little warning.
- Aurora viewing is affected by a variety of other factors, such as cloud cover, moonlight, and urban light pollution. The most active auroras form near local midnight and come in waves; these are referred to as sub-storms. It is not unusual even during an active storm to have a lull in activity that becomes intense within an hour. Auroral forms are more than 80 km (55 miles) above the earth, so they can be seen from as far as 400 km (250 miles) away.

Questions from the Student Data Collection Sheet:

d) What is exact date and time that the image was taken? This information can be found at the top of the webpage right above the image.
e) Do you see auroral activity in the image?
f) If auroral activity is visible, describe what you see.

Comprehension Question: Based on the data you have analyzed from these instruments, answer the question, ***"Have auroras been seen within the last 24 hours due to a solar storm?"*** Be sure to cite specific data in your response.

For More Information:

The Space Weather Action Center is brought to you by the Sun-Earth Connection Education Forum. For more information visit the Space Weather Action Center website at http://sunearthday.nasa.gov/swac .

Questions or Comments? Contact producers Elaine Lewis (elaine.m.lewis@nasa.gov) and Troy Cline (troy.d.cline@nasa.gov).