



# Cannibal Coronal Mass Ejections



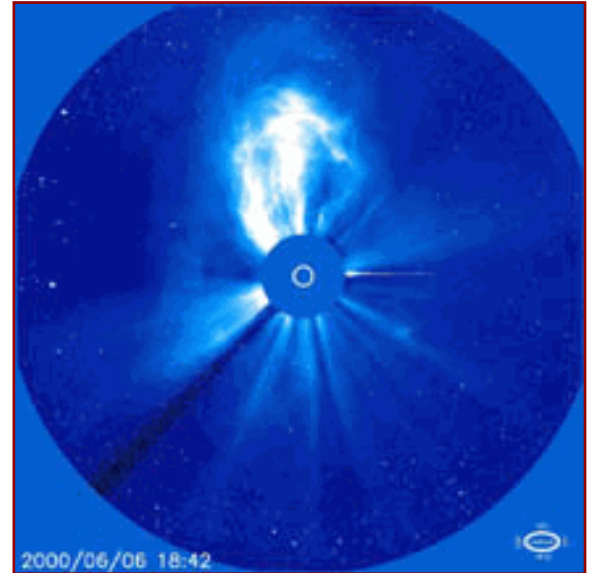
**Fast-moving solar eruptions that overtake and devour their slower-moving kin can trigger long-lasting geomagnetic storms when they strike Earth's magnetosphere.**



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**March 27, 2001** -- Fast-moving solar eruptions apparently overtake and often devour their slower-moving kin. This discovery was made by a team of astronomers working with a pair of NASA spacecraft.

Strange radio fireworks were first heard by the team using NASA's [Wind](#) spacecraft. The link to the cosmic collisions came when researchers matched the timing of the radio outbursts to images of solar eruptions consuming each other. The dynamic pictures of the so-called "cannibal coronal mass ejections" were captured by the Solar and Heliospheric Observatory ([SOHO](#)) spacecraft from NASA and the European Space Agency (ESA).



**Right:** A coronagraph on board the ESA-NASA SOHO spacecraft captured this example of CME cannibalism in action on June 6, 2000. [\[more information\]](#)

Solar eruptions directed toward Earth are potentially harmful to advanced technology, including communications and power systems, and this cannibalistic behavior may result in longer magnetic storms. These collisions change the speed of the eruption, which is important for space weather prediction because it alters the estimated arrival time of Earthbound coronal mass ejections (CMEs).

"Coronal mass ejection cannibalism is the most violent form of interaction between CMEs," says NASA Goddard's Dr. Natchimuthuk Gopalswamy, lead author of a research paper presented today during a meeting of the European Geophysical Society in Nice, France. "This happens when a slow CME is expelled before a fast one from the same general region on the Sun. The fast CME simply gobbles up the slow one," resulting in a single, complex outward-moving front.

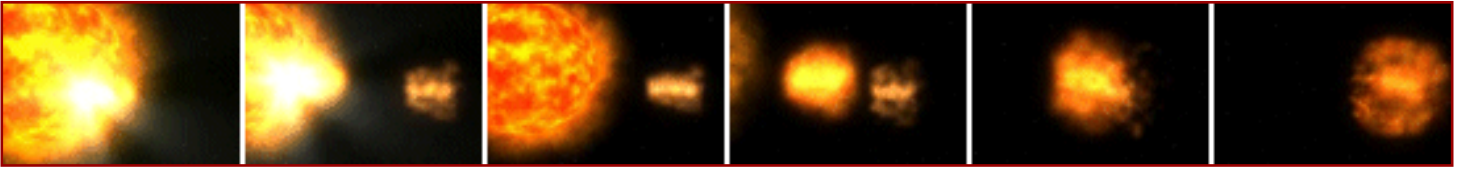
Coronal mass ejections are billion-ton clouds of electrified, magnetic gas that solar eruptions hurl into space at speeds ranging from a few hundred to 2000 km/s. Earth-directed CMEs can trigger magnetic storms when they strike our planet's magnetic field, distorting its



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shape and accelerating electrically charged particles trapped within.

The researchers believe cannibal eruptions may be larger and more complex in structure than typical eruptions. These traits cause "complex ejecta" CMEs to trigger protracted magnetic storms when they envelop the Earth.



**Above:** This sequence of images is from a computer animation illustrating an artist's concept of Coronal Mass Ejection (CME) cannibalism. Credit: NASA, Walt Feimer, Max-Q Digital Group, Honeywell [\[more information\]](#)

Severe solar weather is often heralded by dramatic auroral displays (also known as Northern and Southern Lights), but magnetic storms are occasionally harmful, potentially affecting satellites, radio communications and power systems. Understanding what happens to CMEs on their way to Earth is important for assessing their impact on the near-Earth space environment.

Observations from Wind's Radio and Plasma Wave experiment revealed occasional intense bursts of emission originating far away from the Sun. When Gopalswamy and his colleagues were searching for the source of these radio outbursts, they discovered the ejection interaction, which produces high-energy electrons and cause the radio outbursts.



After the initial discovery, 21 cannibalistic ejections have been identified since April 1997. There may be even more events that aren't detected because they are less energetic and do not produce a radio outburst, according to the researchers.

**Left:** This dramatic photo captured on March 24, 2001 by Jan Curtis (copyright 2001, all rights reserved) near Fairbanks, Alaska, shows what can happen when a CME strikes Earth's magnetosphere. To view more images of recent Northern Lights, visit SpaceWeather.com's [aurora gallery](#).

"Collisions between CMEs may be more common than previously thought and may play a key role in determining the interplanetary traffic of CMEs," Gopalswamy added.

The astronomers expect an elevated rate of CME interactions during the [current peak](#) in the 11-year cycle of violent solar activity, called solar maximum, because more ejections are expelled in quick succession. During solar minimum, only one ejection every few days is common; during maximum, several ejections can occur

in a day.

The cooperative SOHO project is part of NASA's and ESA's Solar Terrestrial Science Program (STSP), comprising of SOHO and CLUSTER. SOHO was launched Dec. 2, 1995. The SOHO spacecraft was built in Europe, and instruments were provided by European and American scientists.

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*Dr. Natchimuthuk Gopalswamy, a research professor with The Catholic University of America, Washington, DC, is stationed at NASA's Goddard Space Flight Center, Greenbelt, MD. He presented the research with his colleagues from Goddard, Catholic University and the Naval Research Laboratory.*

#### **Web Links**

[SpaceWeather.com](#) -- Keep track of coronal mass ejections and other forms of space weather as they happen. (external link)

[NOAA Space Environment Center](#) -- the official source of space weather warnings.

[What is a Coronal Mass Ejection?](#) -- more information from the Goddard Space Flight Center

[Sun-Earth Connection Program](#) -- The Sun-Earth Connection is one of four science themes within the Office of Space Science at the NASA.

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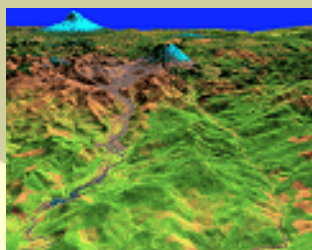
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An amusing accident in the Mojave desert has inspired a new kind of Mars rover -- a two-story high beach ball that can descend to the Martian surface and explore vast expanses of the Red Planet.

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Saharan dust clouds travel thousands of miles and fertilize the water off the West Florida coast with iron, which kicks off blooms of toxic algae, according to a new study. Storm activity in the Sahara Desert region generates clouds of dust that originate from fine particles in the arid topsoil. Easterly trade winds carry the dust across the Atlantic Ocean and into the Gulf of Mexico. Toxic algal blooms, sometimes called red tides, have in the past killed huge numbers of fish, shellfish, marine mammals, birds, and can cause skin and respiratory problems in humans. The research was partially funded by a NASA grant as part of ECOHAB: Florida (Ecology and Oceanography of Harmful Algal Blooms), a multi-disciplinary research project designed to study harmful algae. ([Full Story](#))

(08/28/2001)

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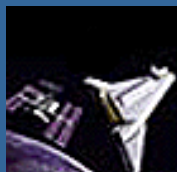
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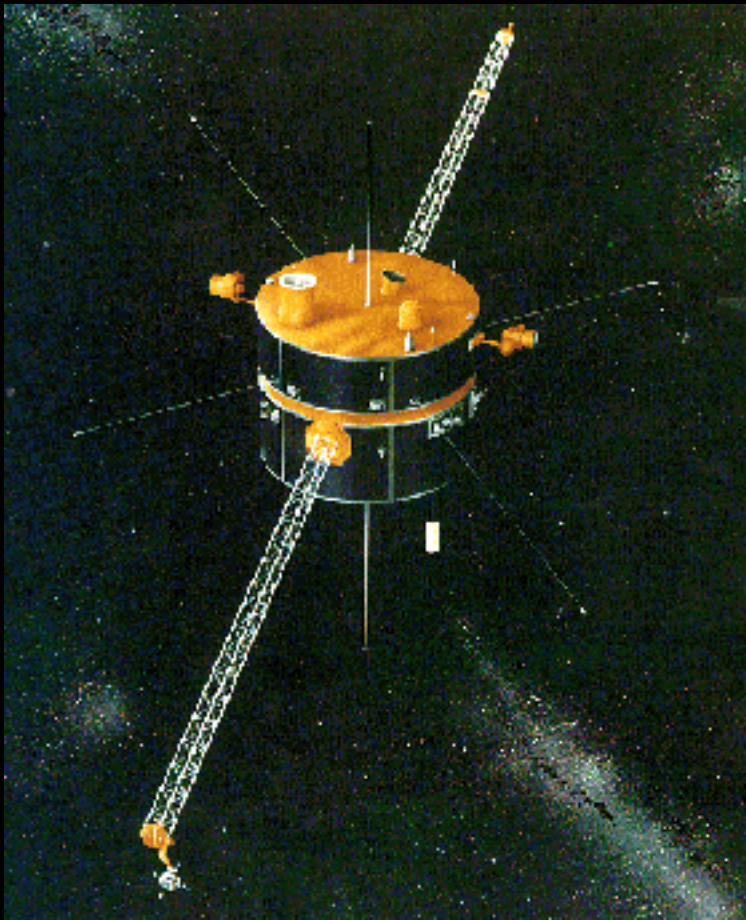
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*last updated August 28, 2000*

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# Wind



## Index

- [WIND Project Overview](#)
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  - [Spacecraft Diagram](#)
- [Principal Investigators](#)
- [Overview of the original mission Orbit](#)
  - [New WIND orbit Nov 1998 - April 1999](#)
- [WIND Orbits](#)
- [Operations Planning](#)
- [DSN Schedules](#)
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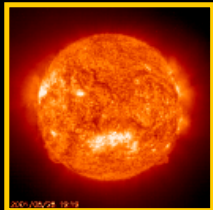
## Principal Investigator Sites

- [3DP - Three-Dimensional Plasma Analyzer](#)
  - [MFI - The Magnetic Fields Investigation](#)
  - [SWE - The Solar Wind Experiment](#)
  - [TGRS - Transient Gamma Ray Spectrometer](#)
  - [WAVES - The Radio and Plasma Waves Instrument](#)
  - [EPACT - Energetic Particle Acceleration, Composition and Transport](#)
  - [SMS - Solar Wind Ion Composition Study, the Mass Sensor, and Suprathermal Ion Composition Study](#)
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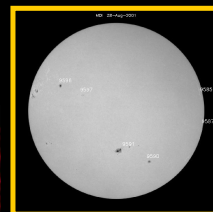
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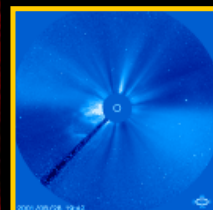
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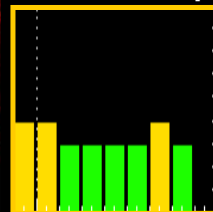
## SUNSPOTS



## SPACE WEATHER



## Estimated Kp



## SOLAR WIND

Speed:  
466 km/s

Density:  
6.3 p/cm<sup>3</sup>

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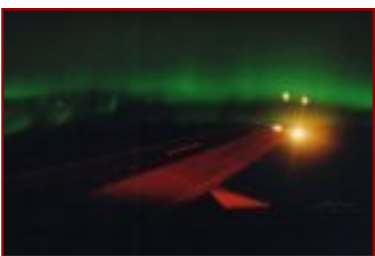
# March 19-24, 2001 Aurora Gallery




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**Summary:** The action began Monday, March 19th, when [a coronal mass ejection](#) from the Sun [hit Earth's magnetosphere](#). Modest geomagnetic disturbances began soon after the impact and then intensified when the interplanetary magnetic field ([IMF](#)) near Earth turned south. South-pointing IMFs create a weak spot in Earth's protective magnetosphere that can allow solar wind gusts to penetrate. The strong [G3-category](#) storm raged for [more than 24 hours](#).

Three days later on Thursday, March 22nd, a weak interplanetary shock wave --the leading edge of a coronal mass ejection that left the Sun on March 19th-- [buffeted Earth's magnetosphere](#). The impact sparked a period of high-latitude auroras that dazzled Alaskans and other northerners.

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	Photographer, Location	Images	Comments
	<a href="#">LeRoy Zimmerman</a> , Fairbanks, Alaska	<a href="#">#1</a> , <a href="#">#2</a> , <a href="#">more</a>	These stunning panorama shots by L. Zimmerman are must-sees! <i>March 20, 2001</i>
	<a href="#">Jan Curtis</a> , Fairbanks, Alaska	<a href="#">#1</a> , <a href="#">#2</a> , <a href="#">#3</a> , <a href="#">#4</a> , <a href="#">#5</a> , <a href="#">#6</a> , <a href="#">#7</a> , <a href="#">#8</a> , <a href="#">#9</a> , <a href="#">more</a>	J. Curtis: "The past two nights were absolutely incredible; beyond words." <i>March 23-24, 2001</i>
	<a href="#">Roar Hansen</a> , 20 miles south of Bergen, Norway	<a href="#">#1</a> , <a href="#">#2</a> , <a href="#">#3</a> , <a href="#">#4</a> , <a href="#">#5</a>	Photo details: Nikon FE camera, 28 mm f/2.8, 40-60 s, 400 ASA Ektacrome-Elite film. <i>March 19-20, 2001</i>
	<a href="#">Rick Stankiewicz</a> , 35,000 feet above Canada	<a href="#">#1</a> , <a href="#">#2</a> , <a href="#">#3</a>	R. Stankiewicz captured these pictures during a flight from Hamilton, Ontario to Winnipeg, Manitoba, about 35,000 feet above Thunder Bay, Ontario. Photo details: 200 ASA print film, a Canon F1 camera, 24mm lens, f/2.8, 30 sec. <i>March 20, 2001</i>

	<a href="#"><u>Tom Eklund</u></a> , Valkeakoski, Finland	<a href="#"><u>#1</u></a> , <a href="#"><u>#2</u></a> , <a href="#"><u>#3</u></a> , <a href="#"><u>#4</u></a> , <a href="#"><u>#5</u></a> , <a href="#"><u>more</u></a>	Photo details: Kodak Elitechrome 100 pushed 2 stops to 400ASA. 15 seconds exposure with 28 mm F/1.8 Sigma lens. <i>March 19-20, 2001</i>
	<a href="#"><u>Mark Simpson</u></a> , Calgary, Alberta, Canada	<a href="#"><u>#1</u></a> , <a href="#"><u>#2</u></a> , <a href="#"><u>#3</u></a> , <a href="#"><u>#4</u></a> , <a href="#"><u>more</u></a>	M. Simpson snapped these pictures of auroras over Banff National Park in Canada. The aurora in picture <a href="#"><u>#2</u></a> was so bright that it illuminated the scene. <a href="#"><u>#1</u></a> has jupiter in the top right corner. <a href="#"><u>#4</u></a> shows the gothic Banff Springs hotel poking out above the trees. Photo details: Film: NHGII Fuji Pro, 800ASA. Lens: 28mm, f2.8 30 second exposures. <i>March 19, 2001</i>
	<a href="#"><u>John Russell</u></a> , Nome, Alaska	<a href="#"><u>#1</u></a> , <a href="#"><u>#2</u></a> , <a href="#"><u>#3</u></a> , <a href="#"><u>#4</u></a> , <a href="#"><u>more</u></a>	J. Russell: "Beautiful active displays lasted until daylight on March 20th. Very hazy early-on, but I rather like the effect." Photo details: Nikon N90s, Nikkor 35mm @f2.0, 8, 10 and 13 second exposures. Kodak Porta 800 and Fuji NHG800 films." <i>March 20, 2001</i>
	<a href="#"><u>Lyndon Anderson</u></a> , Bismarck, ND	<a href="#"><u>#1</u></a>	L. Anderson took this photograph from a spot just north of Bismarck, ND, at approximately 11 p.m. (CDT) on Monday, March 19, 2001. Photo details: Royal Gold 400 film. 50 mm lens, 1.4 aperture, 20 seconds. <i>March 19, 2001</i>
	<a href="#"><u>Petri Kekkonen</u></a> , Oulu, Finland	<a href="#"><u>#1</u></a> , <a href="#"><u>#2</u></a>	P. Kekkonen: "These auroras were photographed near Oulu, Finland, on 19 March, 2001, at 19-21 UT." Photo details: 15 second exposure on Fuji MS 100/1000 film @ 200 ISO with Nikkor AF 28mm f/1.4 D lens. <i>March 19, 2001</i>

 <p><b>Aurora Movie!</b> (click here)</p>	<p><a href="#"><u>Poker Flat Research Range</u></a>, University of Alaska, Fairbanks</p>	<p><a href="#"><u>600 kb MPG movie</u></a></p>	<p>Observers at the Poker Flat Research Range near Fairbanks captured this wide-angle movie of auroras spanning a 2-hr interval on <i>March 22, 2001</i>.</p>
	<p><a href="#"><u>Duane Clausen</u></a>, Menominee, Michigan</p>	<p><a href="#"><u>#1</u></a>, <a href="#"><u>#2</u></a>, <a href="#"><u>#3</u></a>, <a href="#"><u>#4</u></a>, <a href="#"><u>more</u></a></p>	<p>With the aide of a flash unit, Duane Clausen captured several unusually beautiful pictures of auroras over Michigan, including this one with a group of bedazzled cows. <i>March 20-21, 2001</i></p>
	<p><a href="#"><u>Jan Curtis</u></a>, Fairbanks, Alaska</p>	<p><a href="#"><u>#1</u></a>, <a href="#"><u>#2</u></a>, <a href="#"><u>#3</u></a>, <a href="#"><u>#4</u></a>, <a href="#"><u>more</u></a></p>	<p>J. Curtis: "A major aurora storm is an unbelievable event, but photographing it is difficult because of the extreme brightness and rapid movement of the aurora. These images are a poor example of what the experience is like in person. Film: (<a href="#"><u>#1</u></a> &amp; <a href="#"><u>#4</u></a>) Fuji Superia 800, f/2.0, 35mm lens, 8 secs; (<a href="#"><u>#2</u></a> &amp; <a href="#"><u>#3</u></a>) Kodak Supra 800, same settings." <i>March 20, 2001</i></p>
	<p><a href="#"><u>Marek Dudka</u></a>, Sun Prairie, WI</p>	<p><a href="#"><u>#1</u></a>, <a href="#"><u>#2</u></a>, <a href="#"><u>#3</u></a>, <a href="#"><u>#4</u></a></p>	<p>M. Dudka: "As I was walking my dog, I noticed a strange greenish blue light about 25-30 degrees over the northern horizon. This cloud of light suddenly became alive. It grew brighter and brighter and it started pulsing hypnotic waves and rays throughout the entire northern sky. The display started around 11:30 PM and lasted till nearly 3:30 am (local time). I can't wait for other aurora displays..." <i>March 19, 2001</i></p>
	<p><a href="#"><u>Marko Grönroos</u></a>, Turku, Finland</p>	<p><a href="#"><u>#1</u></a>, <a href="#"><u>more</u></a></p>	<p>M. Grönroos captured this unusual panorama of the Northern Lights using a Casio QV-3000EX/Ir digital camera. Photo details: 13 s exposure, aperture F2, about ISO 320 equiv. CCD (ISO 100 + 2 gain setting), temperature about -8 degrees Celsius (temperature affects CCD noise greatly), 35mm equivalent lens. <i>March 20, 2001</i></p>



 A photograph of the Aurora Borealis in Finland, showing vibrant green and yellow-green curtains of light against a dark night sky.	<u>Jouni Jussila</u> , Oulu, Finland	<u>#1</u>	J. Jussila captured this dazzling image from a spot near the University of Oulu in Finland on 19 March, 2001, at ~21 UT. Photo details: Fuji Provia 100F, pushed 1 stop to 200ASA, 15 seconds exposre with 24 mm F/1,4 (Canon) lens. <i>March 19, 2001</i>
 A photograph of the Aurora Borealis in Alaska, showing a bright green aurora over a snowy landscape with silhouettes of evergreen trees and distant lights.	<u>Andre Clay</u> , Fairbanks, Alaska	<u>#1</u> , <u>#2</u>	Andre Clay snapped these photos using a Sony DSC-S70 digital camera, ISO 100, 8 second exposure. <i>March 20, 2001</i>

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# The Sun Does a Flip



**NASA scientists who monitor the Sun say that our star's awesome magnetic field is flipping -- a sure sign that solar maximum is here.**



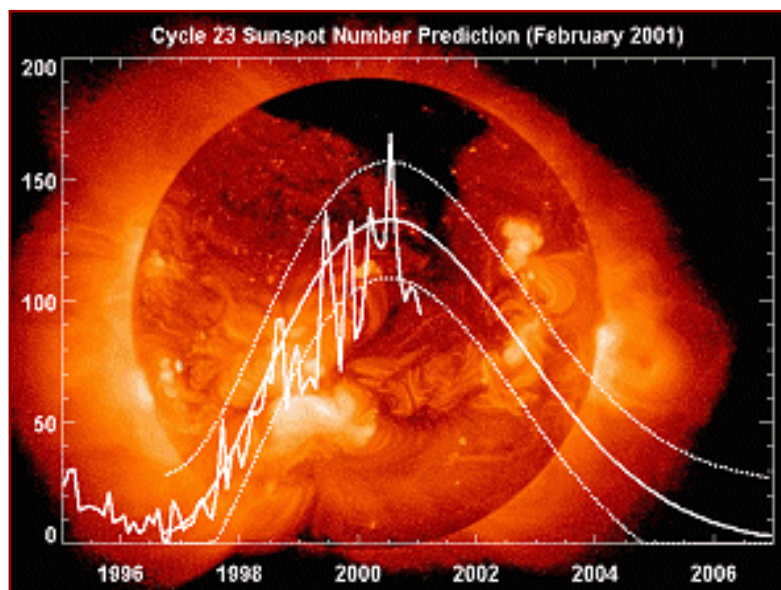
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**February 15, 2001** -- You can't tell by looking, but scientists say the Sun has just undergone an important change. Our star's magnetic field has flipped.

The Sun's magnetic north pole, which was in the northern hemisphere just a few months ago, now points south. It's a topsy-turvy situation, but not an unexpected one.

"This always happens around the time of solar maximum," says David Hathaway, a solar physicist at the Marshall Space Flight Center.

"The magnetic poles exchange places at the peak of the sunspot cycle. In fact, it's a good indication that Solar Max is really here."



**Above:** Sunspot counts, plotted here against an x-ray image of the Sun, are nearing their maximum for the current solar cycle. [\[more information\]](#)

The Sun's magnetic poles will remain as they are now, with the north magnetic pole pointing through the Sun's southern hemisphere, until the year 2012 when they will reverse again. This transition happens, as far as we know, at the peak of every 11-year sunspot cycle -- like clockwork.

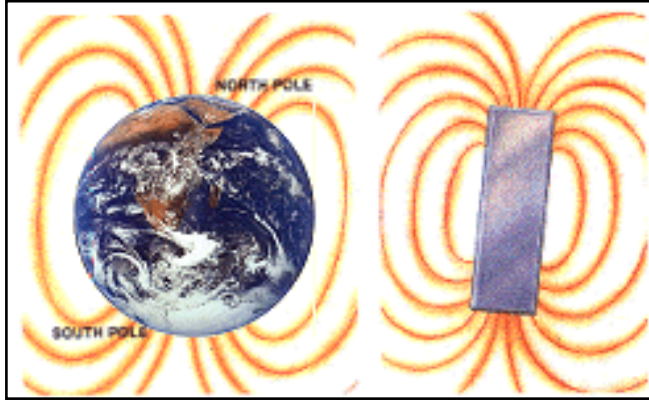
Earth's magnetic field [also flips](#), but with less regularity. Consecutive reversals are spaced 5 thousand years to 50 *million* years apart. The last reversal happened 740,000 years ago. Some researchers think our planet is overdue for another one, but nobody knows exactly when the next reversal might occur.

Although solar and terrestrial magnetic fields behave differently, they do have something in common:



their shape. During solar minimum the Sun's field, like Earth's, resembles that of an iron bar magnet, with great closed loops near the equator and open field lines near the poles. Scientists call such a field a "dipole." The Sun's dipolar field is about as strong as a refrigerator magnet, or 50 gauss (a unit of magnetic intensity). Earth's magnetic field is 100 times weaker.

**Below:** The Sun's basic magnetic field, like Earth's, resembles that of a bar magnet.

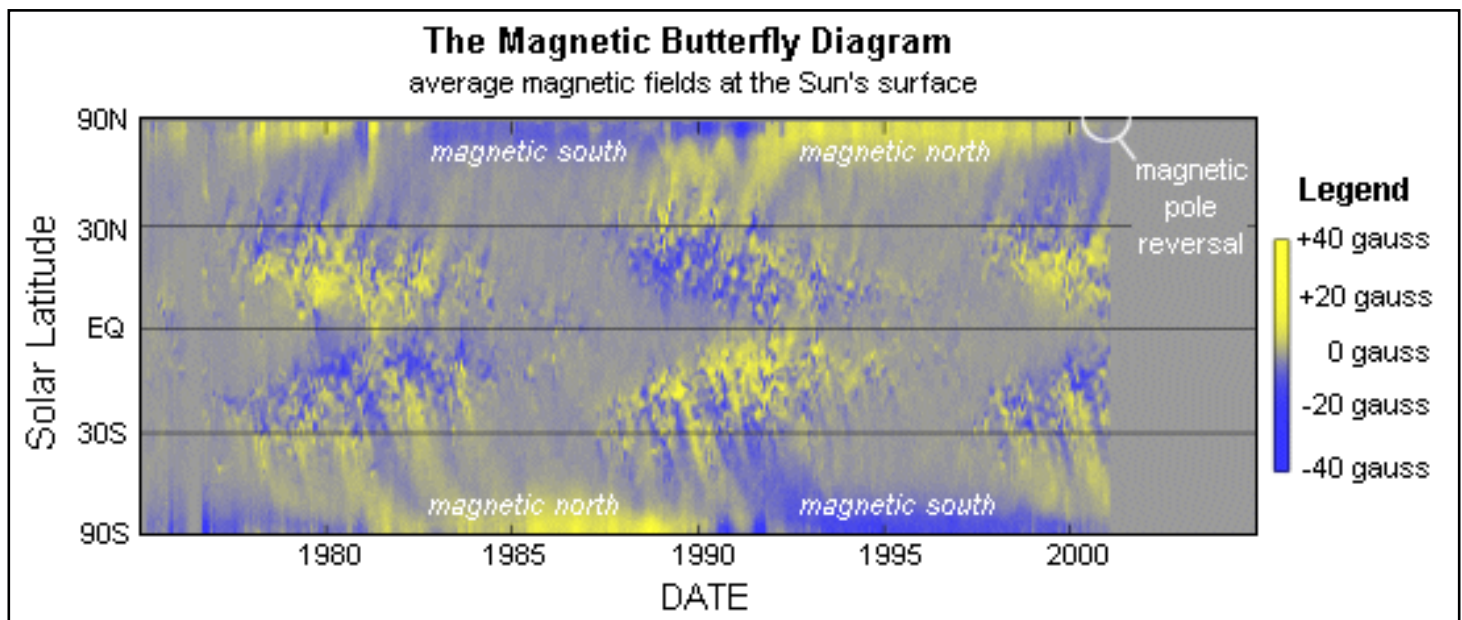


When solar maximum arrives and sunspots pepper the face of the Sun, our star's magnetic field begins to change. Sunspots are places where intense magnetic loops -- hundreds of times stronger than the ambient dipole field -- poke through the photosphere.

"Meridional flows on the Sun's surface carry magnetic fields from mid-latitude sunspots to the Sun's poles," explains Hathaway. "The poles end up flipping because these flows transport south-pointing magnetic flux to the north magnetic pole, and north-pointing flux to the south magnetic pole." The dipole field steadily weakens as oppositely-directed flux accumulates at the Sun's poles until, at the height of solar maximum, the magnetic poles change polarity and begin to grow in a new direction.

Hathaway noticed the latest polar reversal in a "magnetic butterfly diagram." Using data collected by astronomers at the U.S. National Solar Observatory on Kitt Peak, he plotted the Sun's average magnetic field, day by day, as a function of solar latitude and time from 1975 through the present. The result is a sort of strip chart recording that reveals evolving magnetic patterns on the Sun's surface. "We call it a butterfly diagram," he says, "because sunspots make a pattern in this plot that looks like the wings of a butterfly."

In the butterfly diagram, pictured below, the Sun's polar fields appear as strips of uniform color near 90 degrees latitude. When the colors change (in this case from blue to yellow or *vice versa*) it means the polar fields have switched signs.

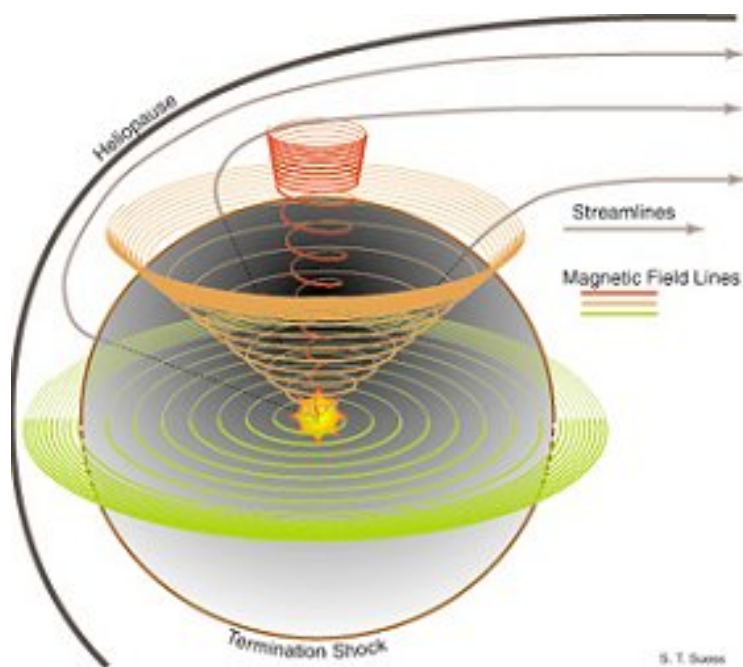


**Above:** In this "magnetic butterfly diagram," yellow regions are occupied by south-pointing magnetic fields; blue denotes north. At mid-latitudes the diagram is dominated by intense magnetic fields above sunspots. During the sunspot cycle, sunspots drift, on average, toward the equator -- hence the butterfly wings. The uniform blue and yellow regions near the poles reveal the orientation of the Sun's underlying dipole magnetic field. [\[more information\]](#)

The ongoing changes are not confined to the space immediately around our star, Hathaway added. The Sun's magnetic field envelops the entire solar system in a bubble that scientists call the "heliosphere." The heliosphere extends 50 to 100 astronomical units ([AU](#)) beyond the orbit of Pluto. Inside it is the solar system -- outside is interstellar space.

"Changes in the Sun's magnetic field are carried outward through the heliosphere by the solar wind," explains Steve Suess, another solar physicist at the Marshall Space Flight Center. "It takes about a year for disturbances to propagate all the way from the Sun to the outer bounds of the heliosphere."





Because the Sun rotates (once every 27 days) solar magnetic fields corkscrew outwards in the shape of an Archimedian spiral. Far above the poles the magnetic fields twist around like a child's Slinky toy.

**Left:** Steve Suess (NASA/MSFC) prepared this figure, which shows the Sun's spiraling magnetic fields from a vantage point ~100 AU from the Sun.

Because of all the twists and turns, "the impact of the field reversal on the heliosphere is complicated," says Hathaway. Sunspots are sources of intense magnetic knots that spiral outwards even as the dipole field vanishes. The heliosphere doesn't simply wink out of existence when the poles flip -- there are plenty of complex

magnetic structures to fill the void.

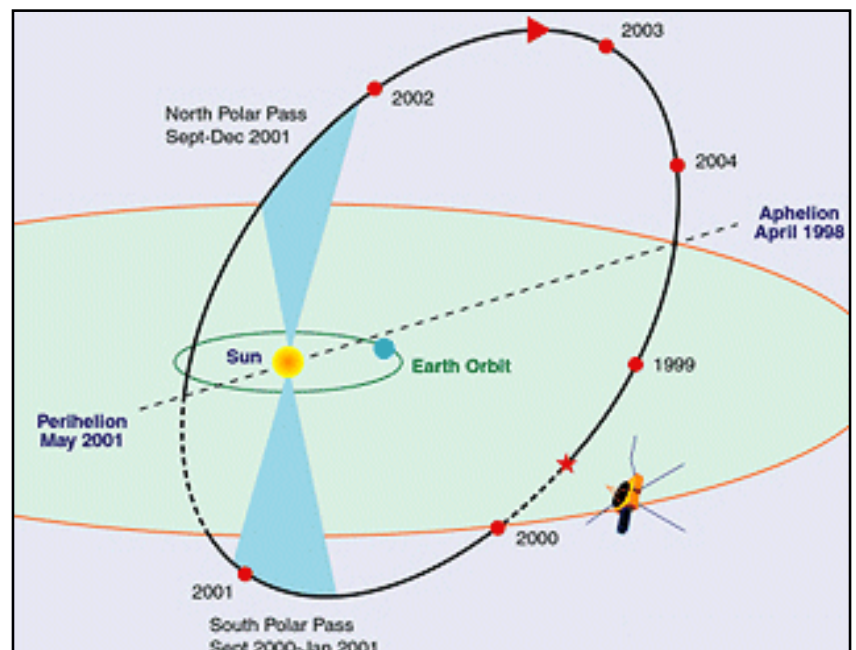
Or so the theory goes.... Researchers have never seen the magnetic flip happen from the best possible point of view -- that is, from the top down.

But now, the unique [Ulysses](#) spacecraft may give scientists a reality check. Ulysses, an international joint venture of the European Space Agency and NASA, was launched in 1990 to observe the solar system from very high solar latitudes. Every six years the spacecraft flies 2.2 AU over the Sun's poles. No other probe travels so far above the orbital plane of the planets.

"Ulysses just passed under the Sun's south pole," says Suess, a mission co-Investigator. "Now it will loop back and fly over the north pole in the fall."

**Right:** Following an encounter with Jupiter in 1992, the Ulysses spacecraft went into a high polar orbit. It's maximum solar latitude is 80.2 degrees south. [\[more\]](#)

"This is the most important part of our mission," he says. Ulysses last flew over the Sun's poles in 1994 and 1996, during solar minimum, and the craft made several [important discoveries](#) about cosmic rays, the solar wind, and more. "Now we get to see the Sun's poles during the other extreme: Solar Max. Our data



will cover a complete solar cycle."

*To learn more about the Sun's changing magnetic field and how it is generated, please visit "[The Solar Dynamo](#)," a web page prepared by the NASA/Marshall solar research group. Updates from the Ulysses spacecraft may be found on the Internet from JPL at <http://ulysses.jpl.nasa.gov>.*

### **SEND THIS STORY TO A FRIEND**

#### **Web Links**

[Ulysses Home Page](#) -- learn more about NASA's exploration of the inner heliosphere from JPL

[Magnetic Reversals and Moving Continents](#) -- How do we know Earth's magnetic field flips? This excellent web site from NASA/Goddard reveals the answer.

[Magnetism - the Key to Understanding the Sun](#) -- an introduction to solar magnetism presented by the NASA/Marshall Space Flight Center solar research group

[The Dynamo Process](#) -- a nice tutorial on magnetic dynamos

[The Sun's Magnetic Cycle](#) -- from the Goddard Space Flight Center

[The Spiral of the Interplanetary Magnetic Field](#) -- includes an eye-catching lawn sprinkler animation that illustrates the Sun's spiraling magnetic field.

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## SPACE WEATHER Current Conditions



### Solar Wind

velocity: **487.6** km/s

density: **2.0** protons/cm<sup>3</sup>

[explanation](#) | [more data](#)

Updated: Today at 2226 UT

### X-ray Solar Flares

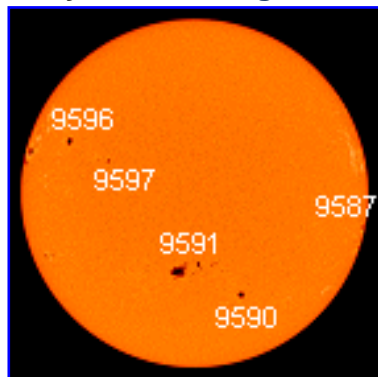
6-hr max: **C6** 1630 UT Aug28

24-hr: **M1** 1610 UT Aug28

[explanation](#) | [more data](#)

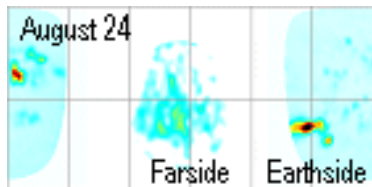
Updated: Today at 2225 UT

### Daily Sun: 28 Aug '01



Sunspot 9591 has a twisted [delta-class](#) magnetic field and continues to pose a threat for powerful X-class solar flares. A new large sunspot is emerging on the northeast limb. Image credit: SOHO/MDI

### The Far Side of the Sun



This [holographic image](#) reveals no substantial sunspots on the far side of the Sun. Image credit: SOHO/MDI

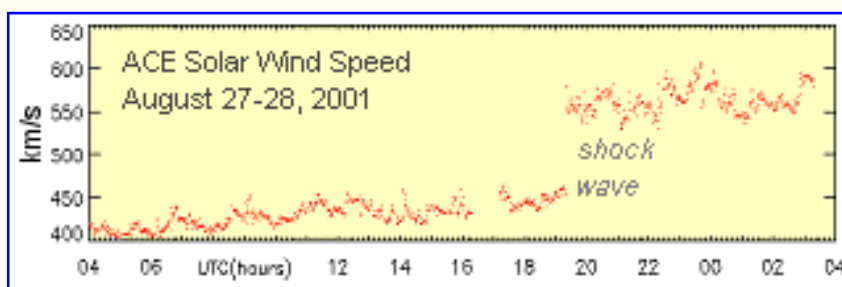
### Sunspot Number: 182

[More about sunspots](#)

## What's Up in Space -- 28 Aug 2001

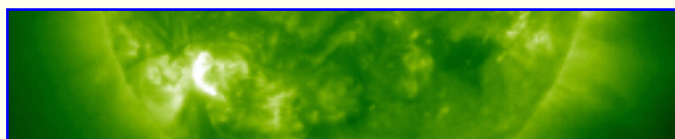
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**IMPACT!** An interplanetary shock wave buffeted Earth's magnetosphere on Monday, August 27th, at 19:52 UT (3:52 p.m. EDT). The impact triggered only [modest geomagnetic activity](#), and middle-latitude sky watchers did not spot auroras last night.



**Above:** NASA's ACE spacecraft registered a sudden increase in solar wind speed at 1920 UT on August 27th.

The shock wave was the leading edge of [a solar coronal mass ejection](#) (CME) that left the Sun on Saturday, August 25th, when sunspot group 9591 unleashed a powerful [X5-class](#) solar flare. The CME took two days to cross the divide between the Sun and our planet and finally reached Earth yesterday. Sunspot 9591 has a twisted magnetic field that harbors energy for more such eruptions in the days ahead.



**Above:** This false-color movie captured by an extreme ultraviolet telescope aboard the [Solar and Heliospheric Observatory](#) shows Saturday's explosion above sunspot 9591.

**LISTEN:** Saturday's X5-category solar flare sparked radio emissions within the Sun's corona that were detectable from Earth. Using a 50 MHz receiver located in Lamy, New Mexico, [Tom Ashcraft](#) recorded the sounds of impulsive solar radio bursts during the flare. Select one of the following audio formats to hear a two-minute sampler: [365 kB mp3](#), [1.6 MB RealPlayer](#), or [1.3 MB wav](#).

Updated: 27 Aug 2001

**Radio Meteor Rate**24 hr max: **27** per hr[Listen to the Meteor Radar!](#)

Updated: 28 Aug 2001

**Interplanetary Mag. Field** $B_{\text{total}}$ : **4.0** nT $B_z$ : **1.7** nT **north**[explanation](#) | [more data](#)

Updated: Today at 2227 UT

**Coronal Holes:**

A small coronal hole is forming northeast of sunspot 9591. Image credit: SOHO Extreme UV Telescope.  
[More about coronal holes](#)

**SPACE WEATHER**  
**NOAA**  
**Forecasts**


**Solar Flares:** Probabilities for a medium-sized ([M-class](#)) or a major ([X-class](#)) solar flare during the next 24/48 hours are tabulated below.

Updated at 2001 Aug 28 2200 UT

FLARE	0-24 hr	24-48 hr
CLASS M	80 %	80 %
CLASS X	20 %	20 %

**Geomagnetic Storms:**

Probabilities for significant disturbances in Earth's magnetic field are given for three activity levels: [active](#), [minor storm](#), [severe storm](#)

Updated at 2001 Aug 28 2200 UT

**NEW COMET:** Last weekend amateur astronomer Vance Petriew peered through the eyepiece of his telescope and saw a curious-looking smudge. Intrigued, he consulted his star charts and found ... nothing. The uncharted blob was no galaxy or nebula -- he had found a new comet! Haul out your telescopes and see Comet Petriew for yourself as it glides through the early morning sky in the weeks ahead. [\[Full Story\]](#)



WEB LINKS: [NOAA FORECAST](#) | [GLOSSARY](#) | [SPACE WEATHER TUTORIAL](#) | [LESSON PLANS](#) | [BECOME A SUBSCRIBER](#)

## Near-Earth Asteroids

Potentially Hazardous Asteroids ([PHAs](#)) are space rocks larger than approximately 100m that can come closer to Earth than 0.05 AU. None of the known PHAs are on a collision course with our planet, although astronomers are finding [new ones](#) all the time.

On 28 Aug 2001 there were **316** known Potentially Hazardous Asteroids

**August 2001 Earth-asteroid encounters**

ASTEROID	DATE (UT)	MISS DISTANCE	MAG.
<a href="#">2000 PH5</a>	July 25	4.8 LD	17.4
<a href="#">2001 OT</a>	Aug. 02	24.4 LD	17.5
<a href="#">1996 PC1</a>	Aug. 22	38.6 LD	17.5
<a href="#">2000 QX69</a>	Aug. 25	26.7 LD	21.7
<a href="#">1998 HD14</a>	Aug. 26	29.5 LD	19.4

Notes: **LD** is a "Lunar Distance." 1 LD = 384,401 km, the distance between Earth and the Moon. 1 LD also equals 0.00256 AU. **MAG** is the visual magnitude of the asteroid on the date of closest approach.

## Galleries

- **PERSEIDS 2001:** Perseid watchers on August 12th spotted meteors, auroras, and a disintegrating Russian rocket! [\[gallery\]](#)
- **MORNING PLANETS:** In July and Aug. 2001, the Moon, Jupiter, Saturn, Venus, and Mercury put on a dazzling early-morning sky show. [\[gallery\]](#)
- **C/2001 A2 (LINEAR):** This volatile comet is still visible through small telescopes as it recedes from Earth. [\[gallery\]](#)

### Mid-latitudes

	24 hr	48 hr
ACTIVE	20 %	20 %
MINOR	05 %	05 %
SEVERE	01 %	01 %

### High latitudes

	24 hr	48 hr
ACTIVE	25 %	25 %
MINOR	10 %	10 %
SEVERE	01 %	01 %

- **ECLIPSE SAFARI:** Onlookers [cried out](#) in delight on June 21, 2001, when the Moon covered the African Sun, revealing the dazzling corona. [\[gallery\]](#)
- **TOTAL LUNAR ECLIPSE:** On Jan. 9, 2001, the full Moon glided through Earth's copper-colored shadow. [\[gallery\]](#)
- **CHRISTMAS ECLIPSE:** Sky watchers across North America enjoyed a partial solar eclipse on Christmas Day 2000 [\[gallery\]](#)
- **LEONIDS 2000:** Observers around the globe enjoyed three predicted episodes of shooting stars. [\[gallery\]](#)

## Space Weather Headlines

**July 27, 2001:** [Meteorites Don't Pop Corn](#) -- A fireball that dazzled Americans on July 23rd probably didn't scorch any cornfields, contrary to widespread reports.

**June 12, 2001:** [The Biggest Explosions in the Solar System](#) -- NASA's HESSI spacecraft aims to unravel an explosive mystery: the origin of solar flares.

**Feb. 21, 2001:** [Nature's Tiniest Space Junk](#) -- Using an experimental radar, NASA scientists are monitoring tiny but hazardous meteoroids that swarm around our planet.

**Feb. 15, 2001:** [The Sun Does a Flip](#) -- NASA scientists who monitor the Sun say our star's enormous magnetic field is reversing -- a sure sign that solar maximum is here.

**Jan. 25, 2001:** [Earth's Invisible Magnetic Tail](#) -- NASA's IMAGE spacecraft, the first to enjoy a global view of the magnetosphere, spotted a curious plasma tail pointing from Earth toward the Sun.

**Jan. 4, 2001:** [Earth at Perihelion](#) -- On January 4, 2001, our planet made its annual closest approach to the Sun.

**Dec. 29, 2000:** [Millennium Meteors](#) -- North Americans will have a front-row seat for a brief but powerful meteor shower on January 3, 2001.

**Dec. 28, 2000:** [Galileo Looks for Auroras on Ganymede](#) -- NASA's durable Galileo spacecraft flew above the solar system's largest moon



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this morning in search of extraterrestrial "Northern Lights"

**Dec. 22, 2000:** [Watching the Angry Sun](#) -- Solar physicists are enjoying their best-ever look at a Solar Maximum thanks to NOAA and NASA satellites.

### [MORE SPACE WEATHER HEADLINES](#)



*Editor's Note:* Space weather forecasts that appear on this site are based in part on data from NASA and NOAA satellites and ground-monitoring stations. Predictions and explanations are formulated by Dr. Tony Phillips; they are not official statements of any government organ or guarantees of space weather activity.

### Essential Web Links

[NOAA Space Environment Center](#) -- The official U.S. government bureau for real-time monitoring of solar and geophysical events, research in solar-terrestrial physics, and forecasting solar and geophysical disturbances.

[Solar and Heliospheric Observatory](#) -- Realtime and archival images of the Sun from SOHO.  
([European Mirror Site](#))

[Daily Sunspot Summaries](#) -- from the NOAA Space Environment Center.

[Current Solar Images](#) --a gallery of up-to-date solar pictures from the National Solar Data Analysis Center at the Goddard Space Flight Center.

SOHO Farside Images of the Sun from [SWAN](#) and [MDI](#).

[The Latest SOHO Coronagraph Images](#) -- from the Naval Research Lab

[List of Potentially Hazardous Asteroids](#) -- from the Harvard Minor Planet Center.

[Observable Comets](#) -- from the Harvard Minor Planet Center.

[What is the Interplanetary Magnetic Field?](#) -- A lucid answer from the University of Michigan.

[Real-time Solar Wind Data](#) -- from NASA's ACE spacecraft.

[More Real-time Solar Wind Data](#) -- from the Solar and Heliospheric Observatory Proton Monitor.

[Aurora Forecast](#) --from the University of Alaska's [Geophysical Institute](#)

[Daily Solar Flare and Sunspot Data](#) -- from the NOAA Space Environment Center.

[Lists of Coronal Mass Ejections](#) -- from 1998 to 2001.

NOAA geomagnetic latitude maps: [North America](#), [Eurasia](#), [South Africa & Australia](#), [South America](#)

[Solar Flare and Sunspot Data: January - December 1999](#) -- from the NOAA Space Environment Center.

[Solar Flare and Sunspot Data: January - December 2000](#) -- from the NOAA Space Environment Center.

[Quarterly Solar Flare and Sunspot Data: January - March 2001](#) -- from the NOAA Space Environment Center.

[Quarterly Solar Flare and Sunspot Data: April - June 2001](#) -- from the NOAA Space Environment Center.

[Quarterly Solar Flare and Sunspot Data: July - Sept 2001](#) -- from the NOAA Space Environment Center.

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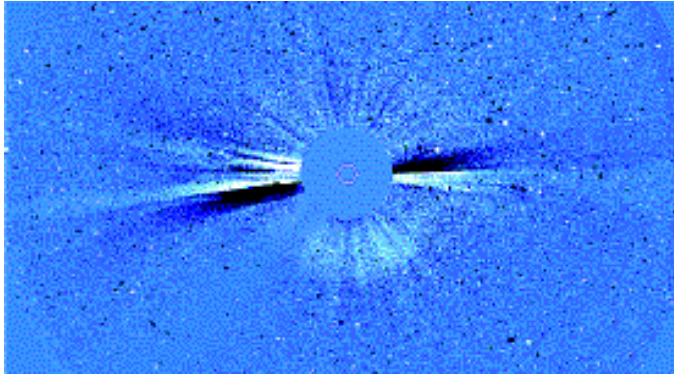


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# Hurricane Sol

One of the most important solar events from Earth's perspective is the coronal mass ejection (CME), the solar equivalent of a hurricane. A CME is the eruption of a huge bubble of plasma from the Sun's outer atmosphere, or corona. The corona is the gaseous region above the surface that extends millions of miles into space. Thin and faint compared to the Sun's surface, the corona is only visible to the naked eye during a total solar eclipse. Temperatures in this region exceed one million degrees Celsius, 200 times hotter than the surface of the Sun.

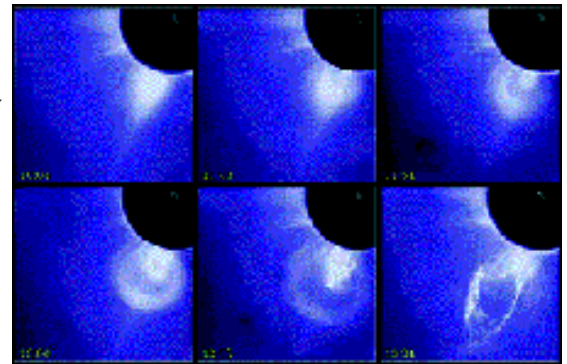


How the corona can be so much hotter than the surface remains a mystery to scientists, but most suspect that it has to do with the complicated magnetic fields that burst from the interior and extend above the surface in great arches and loops. The buildup and interaction of these magnetic loops—which can stretch over, under, and around each other—seems to supply the energy to heat the corona and produce the violent explosion of a CME.

According to some of the newest observations and theories, the larger and higher magnetic loops of the Sun's field are believed to hold down the newer, smaller fields emerging from the surface. They also tie down the hot plasma carried by those fields. Much like a net holding down a helium balloon, this network of magnetic loops restrains the plasma and magnetic fields trying to rise into the corona. This causes tremendous energy to build. Eventually, some of the overlying magnetic loops merge and cancel each other, cutting a hole in the magnetic net and allowing the CME to escape at high speed.

Researchers compare this process to that of filling helium balloons. If you inflate a balloon without holding it down, it will slowly drift upward. But if you hold the balloon down with a net, you can generate a lot of force when you fill it, causing it to push upward. Once you remove the net, the balloon shoots skyward.

Once it escapes the Sun's gravity, a CME speeds across the gulf of space at velocities approaching one million miles per hour (400 km/sec), with the fastest CMEs accelerating to 5 million mph. A typical CME can carry more than 10 billion tons of plasma into the solar system, a mass equal to that of 100,000 battleships. The energy in the bubble of solar plasma packs a punch comparable to that of a hundred hurricanes combined.



Just hours after blowing into space, a CME cloud can grow to dimensions exceeding those of the Sun itself, often as wide as 30 million miles across. As it ploughs into the solar wind, a CME can create a shock wave that accelerates particles to dangerously high energies and speeds. Behind that shock wave, the CME cloud flies through the solar system bombarding planets, asteroids, and other objects with radiation and plasma. If a CME erupts on the side of the Sun facing Earth, and if our orbit intersects the path of that cloud, the results can be spectacular and sometimes hazardous.

**NEXT PANEL:** [Storm Front](#)

Comments/Questions/Suggestions: [webmaster@www-istp.gsfc.nasa.gov](mailto:webmaster@www-istp.gsfc.nasa.gov)

Official NASA Contact: Mr. William Mish ([wmish@istp1.gsfc.nasa.gov](mailto:wmish@istp1.gsfc.nasa.gov))

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Last Updated: 04/28/98



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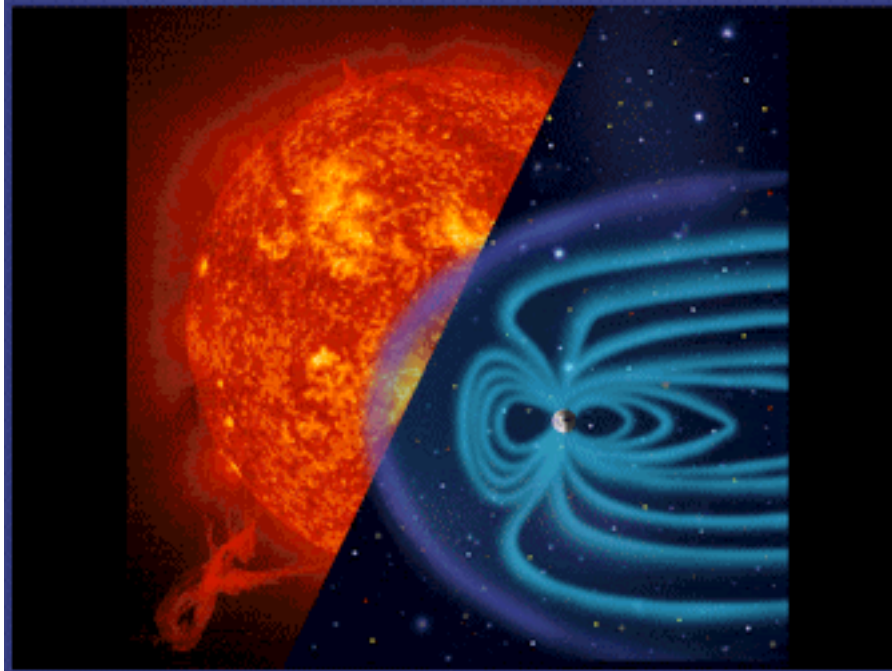
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\(MOWG's\)](#)

[Supporting  
Research &  
Technology  
\(SR&T\) Program](#)



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# 2001 Headlines Archive












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## YEAR 2001 HEADLINES








Subject	August Articles Date & Title
Earth Science	<b>August 28:</b> <a href="#">Fighting Wildfires Before They Start</a> - Using space-based satellite data and sophisticated computer programs, scientists are learning more about capricious wildfires -- including where they're likely to start and what we can do to prevent them.
Comets	<b>August 24:</b> <a href="#">A New Comet</a> - Last weekend an amateur astronomer peered through his telescope and found a new comet the old-fashioned way -- by looking!
Moons of Jupiter	<b>August 22:</b> <a href="#">The Strange Spires of Callisto</a> - NASA's Galileo spacecraft has spotted curious icy spires jutting from the surface of Jupiter's moon Callisto. The bizarre-looking natural features have researchers wondering if the surface of the frigid moon might be a more dynamic place than they once thought.
Earth Science	<b>August 21:</b> <a href="#">Smoke Sentry in Space</a> - In the past firefighters looked toward the sky for relief from relentless wildfires, wishing for rain or perhaps a cool breeze. Now there's a different kind of aid beaming down from the heavens.
Mars Exploration	<b>August 17:</b> <a href="#">Having a Ball on Mars</a> - An amusing accident in the Mojave desert has inspired a new kind of Mars rover -- a two-story high beach ball that can descend to the Martian surface and explore vast expanses of the Red Planet.
Earth Science	<b>August 16:</b> <a href="#">Into the Storm</a> - While most people are trying to avoid the perils of this year's hurricanes, scientists will soon be flying right into the mighty storms!
Materials Science	<b>August 15:</b> <a href="#">Samples of the Future</a> - The advanced space ships of tomorrow will be crafted from far-out materials with extraordinary resistance to the harsh environment of space. An experiment strapped to the outside of the ISS aims to put such materials through their paces.



Comets & Meteors	<b>August 09: <u>Horse Flies and Meteors</u></b> - Like bugs streaking down the side  window of a moving car, long and colorful Perseid Earthgrazers could put on a remarkable show before midnight on August 11th.
Living in Space	<b>August 07: <u>Mixed Up in Space</u></b> - Humans can become confused and  disoriented (and even a little queasy) in an alien world where up and down have no meaning.
Moons of Jupiter	<b>August 03: <u>Another Daring Adventure for Galileo</u></b> - NASA's  durable Galileo space probe is heading for a close encounter with an alien volcano on Jupiter's moon Io. Galileo could fly right through a volcanic plume for the first time.
Living in Space	<b>August 02: <u>Gravity Hurts (So Good)</u></b> - Strange things happen to the body  when humans venture into space and the familiar pull of gravity vanishes. Scientists say exercise is the key to adapting to life in orbit -- and returning to Earth.

Subject	July Articles Date & Title
Comets & Meteors	<b>July 31: <u>Anticipating the Perseids</u></b> - The 2001 Perseid meteor shower  peaks on August 12th. Will it be an extraordinary sky show like last year -- or a moonlit disappointment? This story explains how to see for yourself.
Asteroids	<b>July 27: <u>Meteorites Don't Pop Corn</u></b> - A fireball that dazzled Americans  on July 23rd was a piece of a comet or an asteroid, scientists say. Contrary to reports, however, it probably didn't scorch any cornfields.
Space Station	<b>July 25: <u>Space Seeds Return to Earth</u></b> - Seed pods from a commercial  gardening experiment aboard the International Space Station are back on Earth. The far-out pods could hold the key to long-term habitation of space.
International Space Station	<b>July 23: <u>Building a 'Droid for the International Space Station</u></b>  - Inspired by science fiction classics, NASA scientists are building a talking, thinking and flying robot to help astronauts with their chores in space.
Mars Exploration	<b>July 20: <u>Happy Anniversary, Viking Lander</u></b> - On July 20, 1976,  NASA's Viking 1 lander descended safely to the surface of Mars, revealing an alien world that continues to puzzle scientists and tempt explorers.

Planetary Exploration	<b>July 19: <u><a href="#">A Propitious Alignment of Planets</a></u></b> - In ancient times many  people thought heavenly alignments influenced daily life on Earth. Nowadays they set the schedule for space exploration.
Mars Exploration	<b>July 16: <u><a href="#">Planet Gobbling Dust Storms</a></u></b> - An enormous dust storm has  erupted on Mars, shrouding the planet in haze and raising the temperature of its atmosphere by a whopping 30 degrees.
Astronomy	<b>July 11: <u><a href="#">Sizzling Comets Circle a Dying Star</a></u></b> - Astronomers have  detected a massive cloud of water vapor around an aging star. It could be the telltale sign of innumerable dying comets and a glimpse of things to come in our own solar system.
Looking Up	<b>July 10: <u><a href="#">Morning Coffee and Planets</a></u></b> - Beginning Friday the 13th -- a  lucky day for stargazers -- four planets, the Moon, and a giant red star will put on a dazzling show for early-rising sky watchers.
International Space Station	<b>July 06: <u><a href="#">Even Homes in Space Need a Door</a></u></b> - A new airlock soon to  be installed on the International Space Station is critical for assembly and maintenance of the orbiting outpost.
Earth Science	<b>July 03: <u><a href="#">Aphelion Away!</a></u></b> - On the 4th of July, Earth will lie at its greatest  distance from the Sun -- an annual event astronomers call "aphelion." But don't expect any sudden relief from the heat.










Subject	June Articles Date & Title
Astronomy	<b>June 29: <u><a href="#">Wandering Mystery Planets</a></u></b> - Scientists using the Hubble Space  Telescope have spotted mysterious planet-sized objects apparently running loose in a distant cluster of stars.
Earth Science	<b>June 28: <u><a href="#">El Niño Repellent?</a></u></b> - New satellite images of the Pacific Ocean hint  that El Niño will not return this winter. Instead, La Niña-like weather patterns will persist thanks to a "Pacific Decadal Oscillation" that might also repel strong El Niños.
Earth Science	<b>June 26: <u><a href="#">All the World's a Stage ... for Dust</a></u></b> - Tune in to a NASA  website and watch giant dust clouds as they ride global rivers of air, cross-pollinating continents with topsoil and microbes.




Looking Up	<b>June 21: <u><a href="#">A Close Encounter with Mars</a></u></b> - Today Earth and Mars will  experience their closest encounter in a dozen years. Stargazers won't want to miss the Red Planet blazing bright in the midnight sky.
Looking Up	<b>June 19: <u><a href="#">Eclipse Safari</a></u></b> - On Thursday, June 21st, the Moon's shadow will race  across southern Africa for the only total solar eclipse of 2001. The display will delight some creatures and put others to sleep.
Earth Science	<b>June 18: <u><a href="#">Mobile Homes for Microbes</a></u></b> - African dust that crosses the  Atlantic Ocean and brings beautiful sunsets to Florida also carries potentially harmful bacteria and fungi, a new study shows.
Space Weather	<b>June 12: <u><a href="#">The Biggest Explosions in the Solar System</a></u></b> - Scientists  hope NASA's HESSI spacecraft will unravel an explosive mystery: the origin of solar flares.
Astrophysics	<b>June 07: <u><a href="#">Where No Telescope Has Gone Before</a></u></b> - Astronomers at  NASA's Marshall Space Flight Center have captured the first focused hard x-ray images of the cosmos, opening a new window of the electromagnetic spectrum for practical exploration.
Planetary Exploration	<b>June 06: <u><a href="#">Bracing for an Interplanetary Traffic Jam</a></u></b> - NASA is  improving its already-extraordinary traffic control system for interplanetary spacecraft, the Deep Space Network, in preparation for a flurry of activity in deep space.
Living in Space	<b>June 01: <u><a href="#">Jellyplants on Mars</a></u></b> - Scientists are creating a new breed of glowing  plants --part mustard and part jellyfish-- to help humans explore the Red Planet.






Subject	May Articles Date & Title
Living in Space	<b>May 30: <u><a href="#">What Space Needs: The Human Touch</a></u></b> - NASA's Human  Exploration and Development of Space enterprise tackles one of the toughest and most redeeming problems of all: sending humans into space.
Robots	<b>May 29: <u><a href="#">Brainy 'Bots</a></u></b> - NASA's own 'Bionic Woman' is applying artificial  intelligence to teach robots how to behave a little more like human explorers.












Mars Exploration	<b>May 24: <u>Unmasking the Face on Mars</u></b> - New high-resolution images  and 3D altimetry from NASA's Mars Global Surveyor spacecraft reveal the Face on Mars for what it really is: a mesa.
Earth Science	<b>May 23: <u>Water-Witching From Space</u></b> - Farmers will soon have a new  tool for getting the most out of their fields. NASA's Aqua satellite will provide crucial information about the water in the ground and the weather on the horizon.
Earth Science	<b>May 22: <u>Dust Begets Dust</u></b> - Everyone knows that dry weather leads to dusty  soils, but new research suggests that dust might in turn lead to dry weather.
Comets	<b>May 18: <u>A Taste for Comet Water</u></b> - When Comet LINEAR broke apart  last year it revealed what many scientists thought all along: Water in Earth's oceans could have come from outer space.
Earth Science	<b>May 17: <u>The Pacific Dust Express</u></b> - North America has been sprinkled  with a dash of Asia! A dust cloud from China crossed the Pacific Ocean recently and rained Asian dust from Alaska to Florida.
Looking Up	<b>May 15: <u>The Great Mars Rush</u></b> - Hurtling toward Mars at 22,000 mph, Earth  is heading for its closest encounter with the Red Planet in a dozen years. Mars is already a brilliant morning star and it will soon become a dazzling all-night spectacle.
Living in Space	<b>May 10: <u>Teaming Up on Space Plants</u></b> - This week students, scientists,  and astronauts will join forces to learn more about how plants grow on the International Space Station.
Mars Exploration	<b>May 08: <u>Roses for the Red Planet</u></b> - What makes the Red Planet red? Right  now the answer is iron oxide, but one day it could be roses say NASA scientists debating the prospects for plant life on Mars.
International Space Station	<b>May 04: <u>The Phantom Torso</u></b> - An unusual space traveler named Fred is  orbiting Earth on board the International Space Station. His job? To keep astronauts safe from space radiation.
Pioneer 10	<b>May 03: <u>Seven Billion Miles and Counting</u></b> - Last week NASA  received a weak signal from Pioneer 10, twice as far from the Sun as Pluto and speeding toward the constellation Taurus.
Mars Exploration	<b>May 01: <u>Space Weather on Mars</u></b> - Future human explorers of Mars can  leave their umbrellas back on Earth, but perhaps they shouldn't forget their Geiger counters! A NASA experiment en route to the Red Planet aims to find out.

Subject	April Articles Date & Title
Space Weather	<b>April 27: <a href="#">The Transparent Sun</a></b> - Giant sunspot 9393 is making a rare second  transit across the face of the Sun. Its unusual reappearance came as no surprise to scientists who tracked the behemoth by peering right through our star.
The Moon	<b>April 26: <a href="#">The Mysterious Case of Crater Giordano Bruno</a></b> - A  band of 12th century sky watchers saw something big hit the Moon 800 years ago. Or did they? A new study suggests the event was a meteoritic trick of the eye.
Astrobiology	<b>April 25: <a href="#">20,000 Leagues Under the Sea: The Webcast</a></b> -  Astrobiologists are visiting the Indian Ocean to explore a bizarre undersea ecosystem that doesn't need sunlight to flourish. You can join them via a live webcast on April 26th!
Materials Science	<b>April 23: <a href="#">Look Ma -- No Hands!</a></b> - Using a force field to float molten test  samples precisely in mid-air, NASA's Electrostatic Levitator creates a unique environment for space-age materials processing.
Looking Up	<b>April 19: <a href="#">Look, Listen, Lyrids!</a></b> - The Lyrid meteor shower peaks on  Sunday, April 22nd. Looking at the Lyrids can be fun, but now you can listen to them, too, using NASA's online meteor radar.
International Space Station	<b>April 18: <a href="#">The Amazing Canadarm2</a></b> - Crawling around the International  Space Station like an agile worm, the newest Canadian robotic arm will be essential for building and maintaining the ISS.
Astrobiology	<b>April 17: <a href="#">Solving Charles Darwin's 'Abominable Mystery'</a></b> -  About 130 million years ago the first flowering plants suddenly appeared -- an event Charles Darwin described as an 'abominable mystery.' Now, scientists using chemical fossils are unraveling this ancient puzzle.
Astrobiology	<b>April 13: <a href="#">Life as We Didn't Know It</a></b> - Biologists always thought life  required the Sun's energy, until they found an ecosystem that thrives in complete darkness.
International Space Station	<b>April 09: <a href="#">Leafy Green Astronauts</a></b> - NASA scientists are learning how to  grow plants in space. Such far-out crops will eventually take their place alongside people, microbes and machines in self-contained habitats for astronauts.

Astrobiology	<b>April 05:</b> <u><a href="#">Was Johnny Appleseed a Comet?</a></u> - A new experiment  suggests that comet impacts could have sowed the seeds of life on Earth billions of years ago.
Science Education	<b>April 04:</b> <u><a href="#">Tireless Science Communication Pays Off</a></u> - Last night, the Science@NASA family of web sites received the 2000 Pirelli INTERNETional, a prestigious international award for science communications.
Space Station	<b>April 03:</b> <u><a href="#">Plumbing the Space Station</a></u> - Nothing goes to waste on the  International Space Station where nearly everything is recycled. What makes this ecologist's dream world work? Some of the fanciest plumbing in the solar system!
Cosmology	<b>April 03:</b> <u><a href="#">A Supernova Sheds Light on Dark Energy</a></u> - A  discovery by astronomers using the Hubble Space Telescope supports the notion that the Universe is filled with a mysterious form of energy pushing galaxies apart at an ever-increasing rate.











Subject	March Articles Date & Title
Astrobiology	<b>March 30:</b> <u><a href="#">Back-to-School Time for Astrobiologists</a></u> - NATO and  NASA are joining forces to host an Advanced Study Institute for students and practitioners of astrobiology.
The Red Planet	<b>March 28:</b> <u><a href="#">The Lure of Hematite</a></u> - On rusty-red Mars, a curious deposit of  gray-colored hematite (a mineral cousin of common household rust) could hold the key to the mystery of elusive Martian water.
Space Weather	<b>March 27:</b> <u><a href="#">Cannibal Coronal Mass Ejections</a></u> - Fast-moving solar  eruptions that overtake and devour their slower-moving kin can trigger long-lasting geomagnetic storms when they strike Earth's magnetosphere.
Solar Power	<b>March 23:</b> <u><a href="#">Beam it Down, Scotty!</a></u> - Solar power collected in space and  beamed to Earth could be an environmentally friendly solution to our planet's growing energy problems.
Space Station	<b>March 21:</b> <u><a href="#">Staying Cool on the ISS</a></u> - The International Space Station's  thermal control systems maintain a delicate balance between the deep-freeze of space and the Sun's blazing heat.





Mars 2001	<b>March 19:</b> <a href="#"><u>2001 Mars Odyssey</u></a> - NASA's latest mission to Mars, an orbiter  scheduled for launch on April 7th, will seek out underground water-ice and explore space weather around the Red Planet.
Astronomy	<b>March 15:</b> <a href="#"><u>Welcome Interference</u></a> - NASA scientists have combined  starlight from two of the largest telescopes on Earth to form an extraordinary new tool in the search for planets outside the solar system.
International Space Station	<b>March 14:</b> <a href="#"><u>Home, Space Home</u></a> - On the ground, the International Space  Station would be an odd looking building -- but space is an odd place to live! Find out how space weather, orbital free fall, and the Space Shuttle's payload bay shapes the architecture of the ISS.
Space Station	<b>March 10:</b> <a href="#"><u>The End is Mir</u></a> - On March 22, 2001, the Russian Space Agency  will ignite the engines of a Progress rocket attached to Mir and send the 135-ton space station to a watery grave in the remote south Pacific. The space station will join a surprising parade of Mir-sized objects that hit Earth every year.
Earth Science	<b>March 09:</b> <a href="#"><u>Science Out of Africa</u></a> - Not all NASA adventures happen in  space. In this story a scientist describes his down-to-Earth encounters with poisonous snakes, charging elephants and more!
Climate Science	<b>March 06:</b> <a href="#"><u>After Three Strikes, Is La Niña Out?</u></a> - La Niña-like  conditions that have persisted in the Pacific Ocean for three years might finally subside this Fall.
The Cutting Edge	<b>March 01:</b> <a href="#"><u>Buck Rogers, Watch Out!</u></a> - NASA researchers are studying  insects and birds, and using smart materials with uncanny properties to develop mindboggling new aircraft designs.

Subject	February Articles Date & Title
Astrobiology	<b>February 28:</b> <a href="#"><u>Magnetic Chains from Mars</u></a> - Curious chains of magnetic  crystals have turned up in a meteorite from Mars. Scientists say ancient martian microbes may have kept them in line.
Asteroid Eros	<b>February 27:</b> <a href="#"><u>Gamma-rays from an Asteroid</u></a> - Perched on the surface  of asteroid 433 Eros, NASA's NEAR spacecraft is beaming back measurements of gamma-rays leaking from the space rock's dusty soil.

Optical Computing	<b>February 27: <u>Fire Photon Torpedoes!</u></b> - A NASA alliance with minority  colleges and universities is working to create futuristic computers that operate using particles of light.
Earth and Moon	<b>February 23: <u>The Great Moon Hoax</u></b> - Yes, there really is a Moon hoax,  but the prankster isn't NASA. Moon rocks and common sense prove Apollo astronauts really did visit the Moon.
Asteroids	<b>February 23: <u>Apocalypse Then</u></b> - A violent collision with a space rock, like  the one that doomed the dinosaurs, may have also caused our planet's greatest mass extinction 250 million years ago.
Space Weather	<b>February 21: <u>Nature's Tiniest Space Junk</u></b> - NASA scientists are using  an experimental radar to monitor a swarm of tiny meteoroids surrounding our planet. Listen to the echoes, live!
Looking Up	<b>February 20: <u>Blazing Venus</u></b> - This is a good time to keep an eye on the fiery  second planet from the Sun as it approaches Earth and delivers a dazzling sky show.
Space Weather	<b>February 15: <u>The Sun Does a Flip</u></b> - NASA scientists who monitor the Sun  say that our star's awesome magnetic field is flipping -- a sure sign that solar maximum is here.
Asteroid Eros	<b>February 14: <u>It's Not Over Yet!</u></b> - Following one of the softest planetary  landings ever, ground controllers have decided to extend the NEAR mission and gather unique data from the very surface of asteroid Eros.
The Red Planet	<b>February 09: <u>Global Warming on Mars</u></b> - Artificial greenhouse gases that  are bad news on Earth could provide the means to make Mars a more comfortable place for humans to live.
Earth Science	<b>February 07: <u>What Next, Galapagos?</u></b> - The worst of the recent fuel spill  in the Galapagos has passed ... or has it? Researchers plan to use NASA satellite data to keep an eye on the islands' unique ecosystem.
The Red Planet	<b>February 05: <u>Carbonated Mars</u></b> - Here on Earth the only way to make  carbonate rocks is with the aid of liquid water. Finding such rocks on Mars might prove, once and for all, that the barren Red Planet was once warm and wet.



Subject	January Articles Date & Title
The Red Planet	<b>January 31: <a href="#">The Solar Wind at Mars</a></b> - Scientists think Mars once had a  thicker atmosphere than it does today, perhaps even comparable to Earth's. But where did all that Martian air go? New evidence from NASA's Mars Global Surveyor spacecraft supports a long-held suspicion that much of the Red Planet's atmosphere was simply blown away -- by the solar wind.
International Space Station	<b>January 30: <a href="#">Students make First Contact with the ISS</a></b> - Last  month a group of Chicago students talked to astronauts on the International Space Station via amateur radio.
Astrobiology	<b>January 26: <a href="#">Greening of the Red Planet</a></b> - A hardy microbe from Earth  that thrives where others perish might one day transform the barren ground of Mars into arable soil.
Space Weather	<b>January 25: <a href="#">Earth's Invisible Magnetic Tail</a></b> - The first global views of  our planet's magnetosphere, captured by NASA's IMAGE spacecraft, reveal a curious plasma tail that stretches toward the Sun.
Water on Mars	<b>January 23: <a href="#">Layers of Mars</a></b> - If layered regions on Mars are sedimentary  deposits that formed underwater, as some scientists suspect, they could be the best places to hunt for elusive Martian fossils.
Planet Earth	<b>January 19: <a href="#">Earth Songs</a></b> - If humans had radio antennas instead of ears, we  would hear a remarkable symphony of strange noises coming from our own planet.
Planet Earth	<b>January 18: <a href="#">The Eastern U.S. Keeps Its Cool</a></b> - While surface  temperatures across most of the globe are on the rise, the eastern U.S. appears to be slowly cooling.
Astrobiology	<b>January 17: <a href="#">Precocious Earth</a></b> - Tiny zircon crystals found in ancient stream  deposits suggest that Earth harbored continents and liquid water remarkably soon after our planet formed.
Black Holes	<b>January 12: <a href="#">New Evidence for Black Holes</a></b> - By seeing almost  nothing, astronomers say they've discovered something extraordinary: the event horizons of black holes in space.
Cosmic Rays	<b>January 12: <a href="#">Ballooning for Cosmic Rays</a></b> - Astronomers have long  thought that supernovas are the source of cosmic rays, but there's a troubling discrepancy between theory and data. A balloon flight could shed new light on the mystery.

X-ray Astronomy	<b>January 11:</b> <a href="#"><u>Chandra Links Pulsar to Historic Supernova</u></a> - New  evidence from NASA's Chandra X-ray Observatory suggests that a known pulsar is the present-day counterpart to a stellar explosion witnessed by Chinese astronomers in 386 AD.
Looking Up	<b>January 08:</b> <a href="#"><u>A Total Eclipse of the Sun -- on the Moon!</u></a> - This  Tuesday, January 9th, sky watchers across some parts of Earth will enjoy a total lunar eclipse. But what would they see if they lived, instead, on the Moon?
Water on Mars	<b>January 05:</b> <a href="#"><u>The Case of the Missing Mars Water</u></a> - Plenty of clues  suggest that liquid water once flowed on Mars --raising hopes that life could have arisen there-- but the evidence remains inconclusive and sometimes contradictory.
Planet Earth	<b>January 04:</b> <a href="#"><u>Earth at Perihelion</u></a> - This morning at 5 o'clock Eastern Standard  time Earth made its annual closest approach to the Sun -- an event astronomers call perihelion.
Science Education	<b>January 03:</b> <a href="#"><u>A New Look for the New Year</u></a> - The Science@NASA home page has a new look and we're pleased to offer a host of new services as well, including Spanish-language science stories ... and more!

**YEAR 2000 NEWS ARCHIVE**

**YEAR 1999 NEWS ARCHIVE**

**YEAR 1998 NEWS ARCHIVE**

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**YEAR 1996 NEWS ARCHIVE**

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Curator: [Bryan Walls](#)

NASA Official: [Ron Koczor](#)

Science@NASA presents

# Thursday's Classroom

**Teachers & Parents:** The aim of Thursday's Classroom is to provide a connection between NASA research and the classroom. And we don't mean *old* research! Our weekly lessons --prepared by professional educators and scientists-- are based on breaking [Science@NASA](#) news reports. Thursday's Classroom activities are as timely as the news itself. [Feedback](#) is welcomed. -- Dr. Tony Phillips, Editor

## Feature Episodes

Tricksters say NASA never went to the Moon. Find out for yourself!

### The Great Moon Hoax



[Lessons & Activities!](#)

Who takes out the trash in Earth orbit?

### Far-out Chores in Space

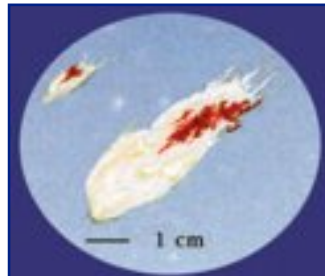
## Lesson Plans

### SPACEY MATERIALS

**August 15:** [Samples of the Future](#) - The advanced space ships of tomorrow will be crafted from far-out materials that can handle the harsh environment of space. An experiment strapped to the outside of the ISS aims to put such materials through their paces. **Lesson Plans:** [\[html\]](#) [\[pdf\]](#)



### SHOOTING STARS



**August 9:** [Horse Flies and Meteors](#) - Splat! There goes another bug on the windshield. But wait, before you scrape off that disgusting mess, look carefully -- there's an astronomy lesson in there!

Learn more about what bugs and meteors have in common: **Lesson Plans & Kids Stories:** [\[html\]](#) [\[pdf\]](#)

### MOONS OF JUPITER

**August 3:** [Alien Volcanoes](#) - NASA's durable Galileo space probe is heading for a close encounter with an alien volcano on August 6th. It's Galileo's latest daring flyby of Jupiter's moon Io -- the hottest spot in the solar system! Learn more about volcanoes on Io and around the solar system from the safety of your



## More

**Aug. 02:** [Gravity Hurts \(So Good\)](#) - Strange things happen to the body when humans venture into space and the familiar pull of gravity vanishes.

**July 31:** [The Perseid Meteor Shower](#) - The 2001 Perseid meteor shower peaks on August 12th. Will it be an extraordinary sky show like last year -- or a moonlit disappointment? Wake up early and see for yourself!

### [SUBSCRIBE TO THURSDAY'S CLASSROOM!](#)

**July 27:** [Meteorites Don't Pop Corn](#) - A fireball that dazzled Americans on July 23rd was a piece of a comet or an asteroid, scientists say. Contrary to reports, however, it probably didn't scorch any cornfields.

**July 25:** [Space Seeds Return to Earth](#) - Seed pods from a gardening experiment on board the International Space Station are back on Earth. The far-out pods could hold the key to long-term habitation of space.



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THE END