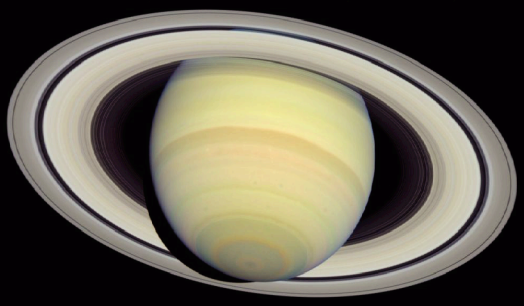
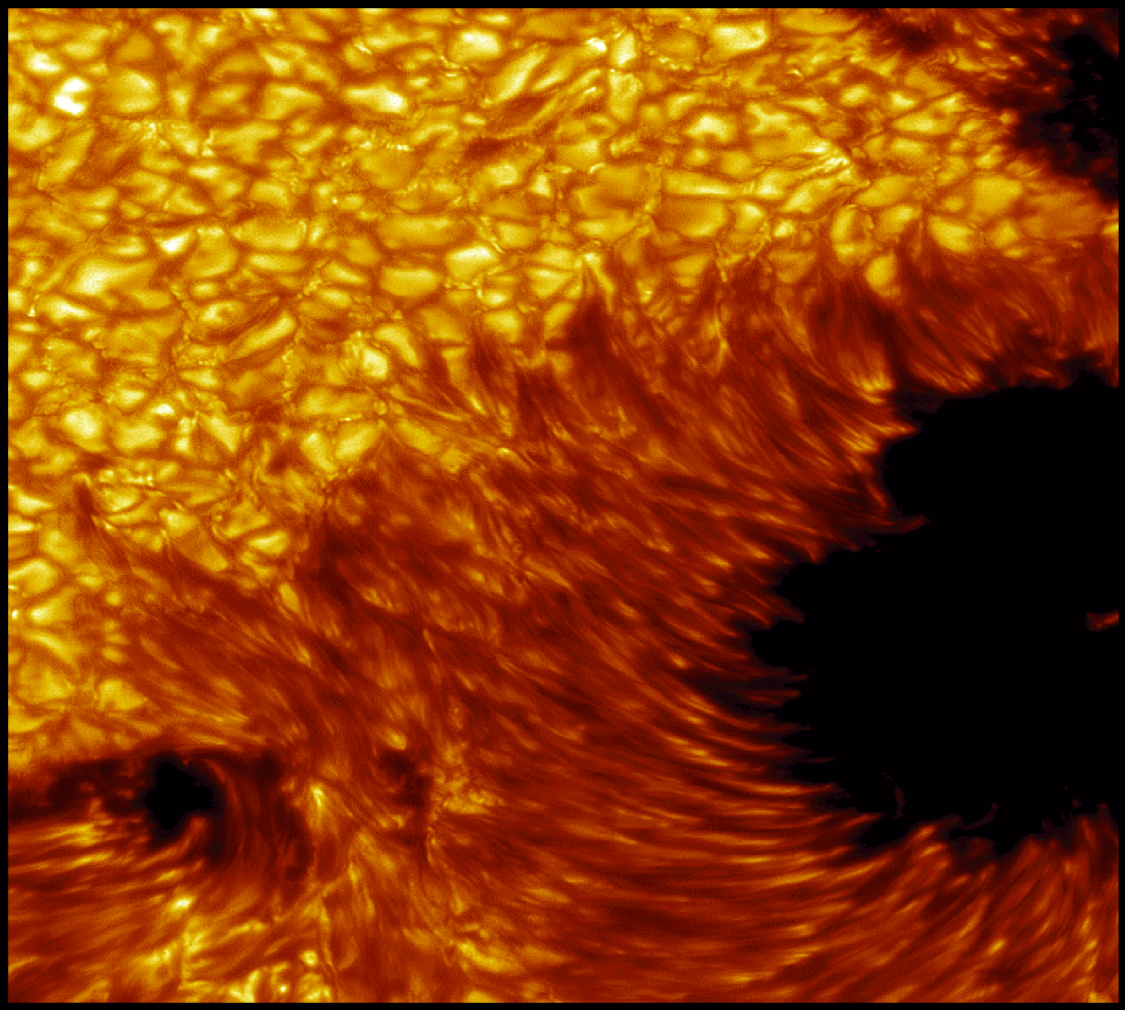
National Aeronautics and Space Administration





Space Math - II

This collection of activities is based on a weekly series of space science problems distributed to thousands of teachers during 2005-2006 school year. They were intended as extra-credit problems for students looking for additional challenges in the math and physical science curriculum in grades 7 through 9. The problems were designed to be authentic glimpses of modern engineering issues that come up in designing satellites to work in space, and to provide insight into the basic phenomena of the Sun-Earth system, specifically 'Space Weather'. The problems were designed to be 'one-pagers' with the student work sheet (with the top line for the student's name) and a Teacher's Guide and Answer Key as a second page. This compact form was deemed very popular by participating teachers.

This booklet was created by the NASA, IMAGE satellite program's Education and Public Outreach Project (POETRY).

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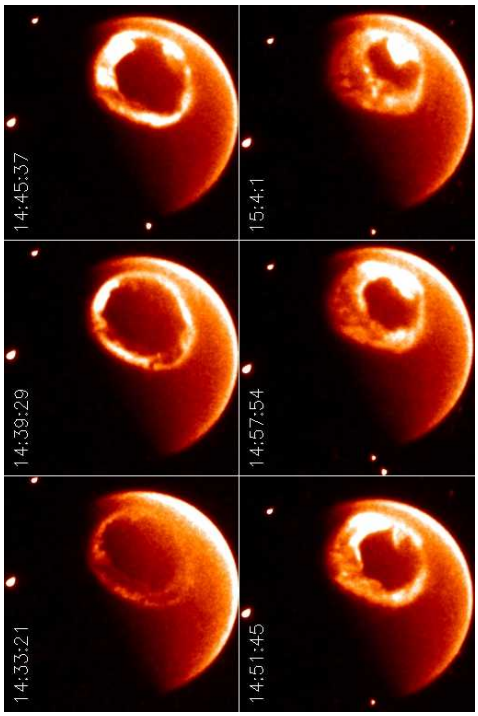

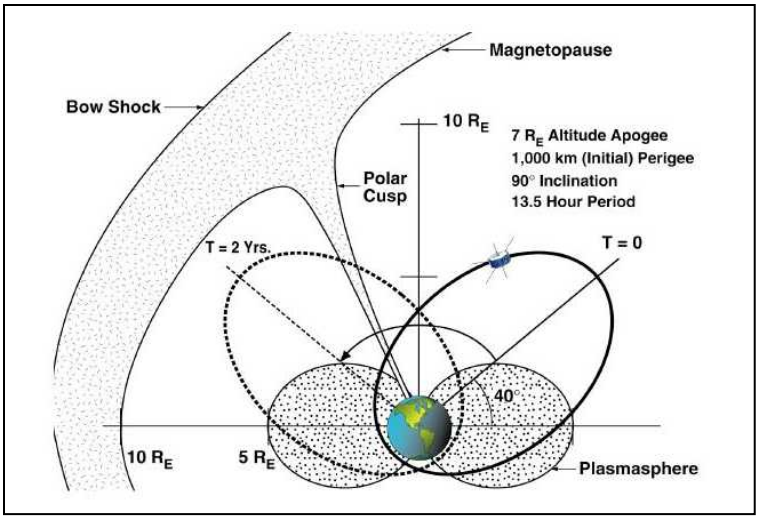

A series of images (left) of the Northern Lights from space taken by the IMAGE satellite. The satellite orbits Earth in an elliptical path (above), which takes it into many different regions of Earth's environment in space.

For more weekly classroom activities about the Sun-Earth system visit the IMAGE website,

http://image.gsfc.nasa.gov/poetry/weekly/weekly.html

Add your email address to our mailing list by contacting Dr. Sten Odenwald at

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***Cover Credits**: Saturn (NASA/HST); Hinode (JAXA); Sunspot (Swedish Vacuum Telescope); Hoag's Object (NASA/HST). **Inside figures**: 4) CME (NASA/SOHO Earth Aurora (NASA/IMAGE) Saturn Aurora (NASA/HST); 80 Supernova 1987A ring (NASA/HST), CME (NASA/ESA/SOHO); solar shock wave (NASA/ESA/SOHO); 10) NGC-1232 (ESA/VLT); 12) Pleiades (Lick Observatory); 13) Galaxy redshifts (ESA/VLT); 14) sunspot detail (Swedish Vacuum Telescope); 150 Sombrero galaxy (NASA/Spitzer); 16) asteroid orbits (IAU/Minor Planets Center); 18) Butterfly (www unattributed); 20) satellite images (NASA); 24) aurora (The Morrisons, Alaska);*

The following table connects the activities in this booklet to topics commonly covered in Grade 7, 8 and 9 pre-algebra and algebra textbooks. The specific national math and science education standards (NSF 'Project 2061') targeted by this product are:

Grade 6-8

Most of what goes on in the universe involves some form of energy being transformed into another form
Graphs can show a variety of possible relationships between two variables
A system can include processes as well as things
Locate information in reference books, and computer data bases
Understand writing that incorporates circle charts, bar graphs line graphs, tables, diagrams and symbols

Grade 9-12

Find answers to problems by substituting numerical values in simple algebraic formulas.
Use tables, charts and graphs in making arguments and claims in oral and written presentations.
Distances and angles inconvenient to measure directly can be found by using scale drawings.

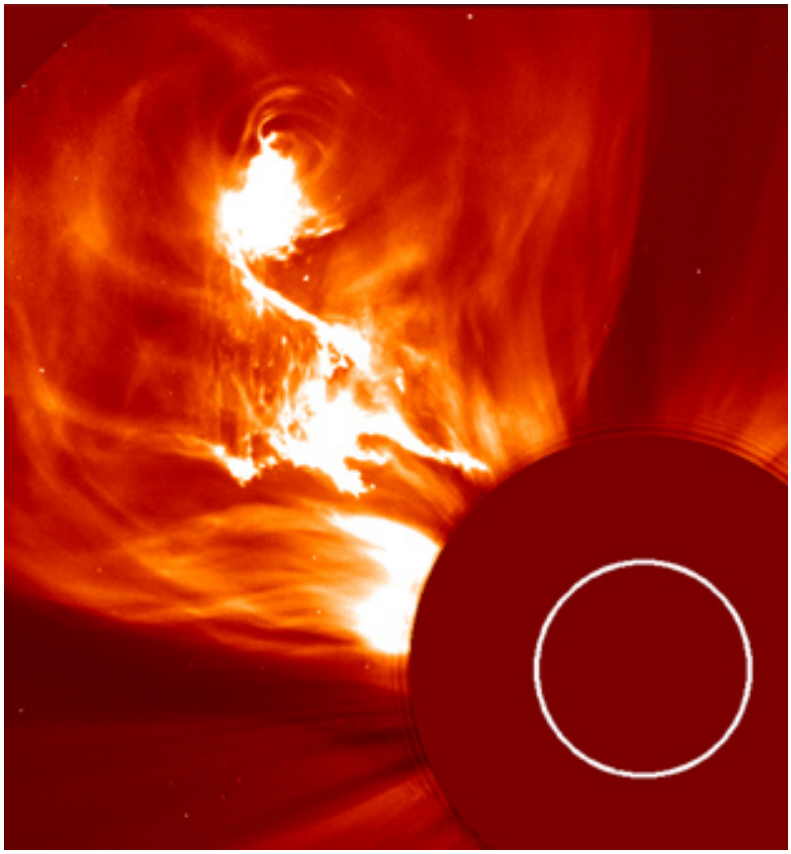
Topic	Problem Number in the Book																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Reading to be Informed	x			x						x		x	x	x	x	x	x	x	x	x	x	x	x	x
Scale drawings		x						x		x		x		x	x	x				x				
Triangle Properties			x			x																		
Speed Distance, time				x																				
Solving for X											x													
Equations and substitution					x						x							x						
Calculating Areas of polygons		x					x																	
Positive & negative numbers																					x			
Decimal math.					x		x	x	x	x		x	x		x	x		x			x			
Time calculations	x																					x		
Percentages																						x		
Unit Conversions								x	x															
WWW Research													x				x				x			x
Graphing																				x				
Open Inquiry													x				x				x	x		
Histograms																			x					
Geometry			x			x																		
Scientific Notation									x															

Name _____

The sun is an active star that produces explosions of matter and energy. The space between the planets is filled with invisible clouds of gas that sometimes collide with Earth. Scientists call them Coronal Mass Ejections. They can travel at millions of miles per hour and carry several billion tons of gas called a plasma. When 'CMEs' collide with Earth, they produce the Northern Lights and magnetic storms.

In this exercise, you will examine one of these 'solar storm' events by examining a timeline of events that it caused.

The picture to the right was taken by the SOHO spacecraft showing a spectacular CME. The white circle is the size of the sun.



Solar Storm Timeline

Day	*Time*	*What Happened*
Tuesday	4:50 PM	Gas eruption on Sun
Thursday	3:36 AM	Plasma storm reaches Earth.
Thursday	5:20 AM	Storm at maximum intensity.
Thursday	5:35 AM	Auroral power at maximum.
Thursday	11:29 AM	Aurora power at minimum.
Thursday	2:45 PM	Space conditions normal

1) How much time passed between the solar gas eruption and its detection near Earth?

2) How long after the plasma storm reached Earth did the aurora reach their maximum power?

3) How long did the storm last near Earth from the time the plasma was detected, to the time when space conditions returned to normal?

<u>Extra for Experts!</u>
If the Earth is 150 million kilometers from the sun, how fast did the storm travel from the Sun in kilometers per hour? How long will the trip to Pluto take is Pluto is 40 times farther away from the sun than Earth?

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