Lunar Librarian Newsletter
February & March 2009

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LRO News

The Orbiter is on its way to Florida! We loaded it on the truck and sent it on its way early this morning after successfully completing our Pre-Ship Review (PSR). The PSR started on Monday (February 9, 2009) - exactly 3 years to the day after our Preliminary Design Review, a short time for a mission of this complexity. We spent the last few weeks cleaning up paperwork, packing up our ground support equipment, and practicing the Lunar Orbit Insertion and other early operations. The solar arrays are already in Florida, inspected, and ready for testing with the Orbiter.

"This is the culmination of four years of hard work by everyone on the LRO Project," said Cathy Peddie, LRO deputy project manager at NASA's Goddard Space Flight Center in Greenbelt, Md. "LRO now begins its launch site processing, where it will be prepped for integration with our sister mission LCROSS, and eventually encapsulated in the Atlas V for its journey to the Moon."

LRO shipping
The Orbiter is wrapped up in bagging, attached to the transporter.
In the background, the lid to the shipping container is suspended from a crane.

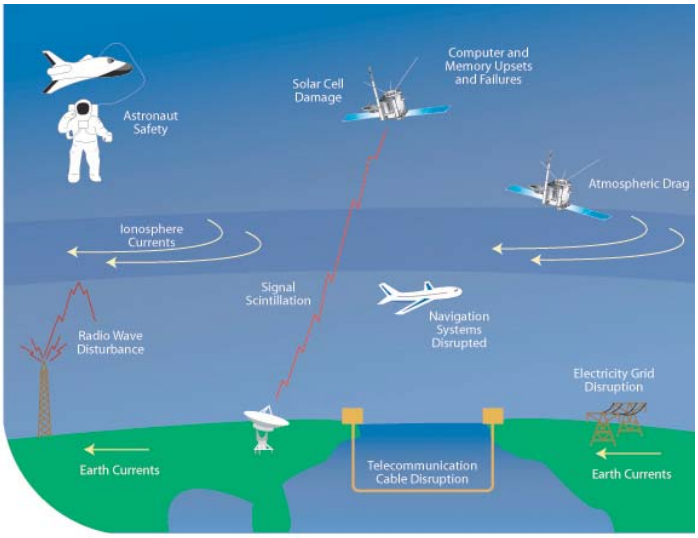
LRO shipping
Here is the LRO truck leaving for Florida.

Check out the cool new video, on YouTube, about the LRO Mission!
http://www.youtube.com/watch?v=UDrJFRr-KHo

NASA News

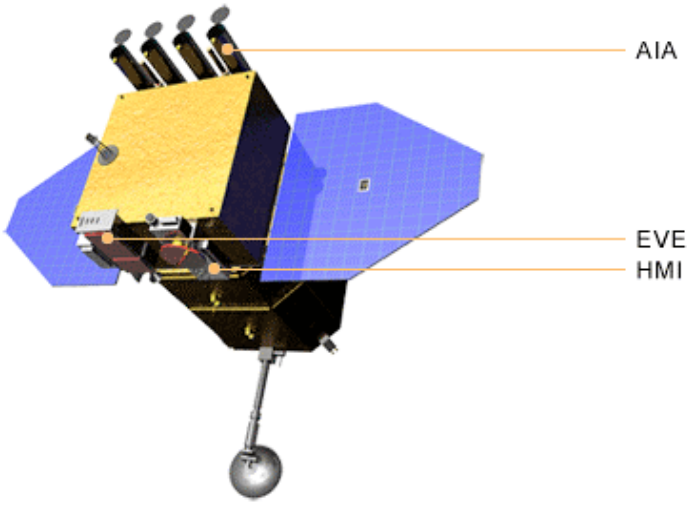
Checking Out the Sun with the Solar Dynamics Observatory **By Emilie Drobnes**

The Solar Dynamics Observatory (SDO) will be taking a closer look at the Sun, the source of all Space Weather. Set to launch this fall from the Kennedy Space Center, SDO will help us understand where the Sun's energy comes from, how the inside of the Sun works, and how energy is stored and released in the Sun's atmosphere.



Space weather not only affects astronauts, satellites, and planets out in space (http://sdo.gsfc.nasa.gov/epo/101/spaceweather/spaceweather.php), but it also affects the Earth and our lives here on Earth. It can cause GPS and communication satellites to malfunction, power grid outages, and pipeline corrosion just to name a few (http://www.swpc.noaa.gov/primer/Primer3.htm).

By better understanding the Sun and how it works, we will be able to better predict and better forecast the "weather out in space" providing earlier warnings to protect all of our assets out in space and here on Earth. SDO will fly three instruments (http://sdo.gsfc.nasa.gov/epo/101/mission/mission_spacecraft.php) to help us in our never-ending quest to know more. Those instruments are: Atmospheric Imaging Assembly (AIA), EUV Variability Experiment (EVE), and Helioseismic and Magnetic Imager (HMI). AIA will image the outer layer of the Sun's atmosphere, much like EIT on SOHO (http://sohowww.nascom.nasa.gov) does with the red, blue, green, and yellow photos. EVE will keep track of the amount of energy or light the Sun sends towards us, sort of like tracking the heartbeat of the Sun. HMI will look at the Surface of the Sun, much like MDI on SOHO does.



Although SDO is taking similar images to some of its predecessors, SDO is unlike any other satellite. SDO will be taking A LOT of extremely large photos, of the whole Sun, in extremely short periods of time. Our principle is, the more details and the more information you have, the better big picture understanding you can build. But what exactly do we mean? Let's just take the instruments that photograph the atmosphere of the Sun. EIT on SOHO takes a fairly small (1,000,000 pixels) full-sun image every 10 minutes. AIA on SDO will take 4 large (16,000,000 pixels) full-sun image every 10 seconds. Another way to think about it is to say that SOHO is like a 1 megapixel camera while SDO is like a 16 megapixel camera. No matter which way you look at it, it's a lot of pixels!

OK, so it will produce a lot of data, but what else makes it special?

Many satellites share a ground system (place on the ground where they send data and photographs) and have recording systems to save the data collected until they can talk to their ground station. Because SDO has no recording system and will be collecting so much data (1.5 terabytes of data daily… that's like downloading half a million songs a day!), the SDO mission had to build its very OWN ground station out in the desert of New Mexico. For this to be possible, SDO has to be placed in a geosynchronous orbit (GEO). This means that it will rotate at the same speed as the Earth and will always be directly above and in constant communication with its ground station in New Mexico.
For more information on the SDO mission please feel free to browse through our mission website (http://sdo.gsfc.nasa.gov/) and stay tuned as we gear up for launch!

Kepler Launches:

The Kepler Mission, which launched on March 6, 2009, is a spacecraft that was designed to examine our region of the Milky Way galaxy to look for Earth-size and smaller planets in or near the habitable zone of their star. The 'habitable zone' defined by scientists "as the distance from a star where liquid water can exist on a planet's surface." (http://discovery.nasa.gov/kepler.html) Kepler will help scientists determine how many of the billions of stars in our galaxy might have these types of planets. The results of the Kepler mission will also provide scientists with a better understanding of planetary formation, the frequency of formation, the structure of individual planetary systems, and the generic characteristics of stars with terrestrial planets.

On Launch Pad 17-B at Cape Canaveral Air Force Station in Florida, the first half of the fairing is moved into place around NASA's Kepler spacecraft, atop the United Launch Alliance Delta II rocket. The fairing is a molded structure that fits flush with the outside surface of the rocket and forms an aerodynamically smooth nose cone, protecting the spacecraft during launch and ascent.

Kepler is NASA 10th Discovery class mission. Some of the other Discovery class missions include MESSENGER, DAWN, Deep Impact, and Lunar Prospector. To learn more about this class of missions, please visit: http://discovery.nasa.gov .

The Kepler Mission Scientific Objective, as stated on the Kepler webpage (http://kepler.nasa.gov/about/):

The scientific objective of the *Kepler Mission* is to explore the structure and diversity of planetary systems. This is achieved by surveying a large sample of stars to:

1. Determine the percentage of terrestrial and larger planets there are in or near the habitable zone of a wide variety of stars;
2. Determine the distribution of sizes and shapes of the orbits of these planets;
3. Estimate how many planets there are in multiple-star systems;
4. Determine the variety of orbit sizes and planet reflectivities, sizes, masses and densities of short-period giant planets;

5. Identify additional members of each discovered planetary system using other techniques; and
6. Determine the properties of those stars that harbor planetary systems.
7.

The *Kepler Mission* also supports the objectives of future NASA Origins theme missions Space Interferometry Mission (SIM) and Terrestrial Planet Finder (TPF),

- By identifying the common stellar characteristics of host stars for future planet searches,
- By defining the volume of space needed for the search and
- By allowing SIM to target systems already known to have terrestrial planets.

Science News

NASA Science News has published several articles last month. Please follow the links to read the full stories. Check out our RSS feed at http://science.nasa.gov/rss.xml!

Mars Technology Helps Create Inauguration Mega-Picture
A private photographer has used NASA's Mars technology to create a 1,474 megapixel panoramic photo of President Obama's inauguration. The interactive mega-snapshot has become an international sensation, viewed by more than two million people in 186 countries. Today's story from Science@NASA presents the photo and tells how it was made. http://science.nasa.gov/headlines/y2009/02feb_gigapan.htm?list907815

Green Comet Approaches Earth
A green comet of rare beauty is approaching Earth and may become visible to the naked eye later this month. http://science.nasa.gov/headlines/y2009/04feb_greencomet.htm?list907815

Astronauts Swab the Deck
Even in space, someone has to clean the bathroom. ISS astronauts are using a tricorder-like device to help them 'swab the decks.' http://science.nasa.gov/headlines/y2009/06feb_locad.htm?list907815

Remarkable Flare Star Attracts Attention
A gamma-ray flare star 30,000 light years from Earth is putting on a remarkable show for NASA spacecraft. Highlights include ghostly x-ray "light halos" and eruptions packing more total energy than the Sun puts out in 20 years. http://science.nasa.gov/headlines/y2009/10feb_sgr.htm?list907815

Spectacular Photo-op on Saturn
Something is about to happen on Saturn that is so pretty, even Hubble will pause to take a look. Backyard astronomers can see it, too. Four of Saturn's moons will transit Saturn and cast their shadows on the planet's cloudtops at the same time. http://science.nasa.gov/headlines/y2009/19feb_quadrupletransit.htm?list907815

Record-setting Gamma-ray Burst Detected
NASA's Fermi Gamma-ray Space Telescope has detected a record-setting gamma-ray burst with the greatest total energy and fastest motions ever seen.
http://science.nasa.gov/headlines/y2009/20feb_extremegrb.htm?list907815

Kepler Mission to Hunt for Earth-like Planets
Are there other worlds like ours? Are we alone? NASA's Kepler spacecraft is about to begin an unprecedented journey that could ultimately answer these ancient questions.
http://science.nasa.gov/headlines/y2009/20feb_kepler.htm?list907815

Otherworldly Solar Eclipse
For the first time, a spacecraft from Earth has captured high-resolution video of a solar eclipse while orbiting another world. http://science.nasa.gov/headlines/y2009/25feb_kaguyaeclipse.htm?list907815

Pretty Sky Alert
The crescent Moon and Venus are converging for a conjunction of rare beauty on Friday evening, Feb. 27th.
http://science.nasa.gov/headlines/y2009/26feb_prettysky.htm?list907815

Kepler Mission Rockets to Space in Search of Other Earths
In a night launch of stunning beauty, NASA's Kepler spacecraft lifted off from Cape Canaveral on Friday night, March 6th, on a mission to find Earth-like planets circling other stars.
http://science.nasa.gov/headlines/y2009/06mar_keplerlaunch.htm?list907815

Ares Super-chute
NASA and U.S. Air Force test pilots have dropped a 50,000-pound "dummy" rocket booster on the Arizona desert--and stopped it before it crashed. It's all part of NASA's plan to return to the Moon.
http://science.nasa.gov/headlines/y2009/13mar_superchute.htm?list907815

Space Station Construction Visible Through Backyard Telescopes
Space shuttle Discovery launched Sunday, March 15th, on a construction mission to the International Space Station. Perfect timing for sky watchers! The mission coincides with a series of ISS flybys over North American towns and cities. People who go outside after sunset can see the shuttle-station combo with their naked eyes and view the changing outlines of the ISS through backyard telescopes.
http://science.nasa.gov/headlines/y2009/17mar_bigconstruction.htm?list907815

Spacewalkers Test Planetary Protection Concept
Yesterday, astronauts onboard the International Space Station checked themselves for microbes before stepping outside on a space walk. It was a first-ever test of planetary protection technology that, one day, could keep humans from contaminating the sands of Mars.
http://science.nasa.gov/headlines/y2009/20mar_locadexploration.htm?list907815

Librarian News

The LRO launch has been shifted again. As of right now, launch is set for May 21, 2009. Key an eye on how the launch date might change. Please check out: http://www.nasa.gov/missions/highlights/schedule.html periodically.

Links of the Month…

- Sun-Earth Day Image gallery: http://sunearthday.nasa.gov/2009/multimedia/gallery.php
- The Galileoscope – Make a telescope like Galileo did: http://www.galileoscope.org/
- CAUSE OF THE SEASONS, Gallaudet University, Discover animations, and illustrations that relate to the cause of the seasons. http://csc.gallaudet.edu/soarhigh/SHMASeason.HTM
- SATELLITE TRACKER, Spaceweather.com US and Canadian readers, enter your zip code below, hit Go!, and you will find out what is going to fly over your area in the nights ahead. There are hundreds of satellites in Earth orbit; we cut through the confusion by narrowing the list to a half-dozen or so of the most interesting. At the moment we are monitoring spy satellites Lacrosse 3 and NOSS 2-1, the International Space Station, the ISS Toolbag, and the Hubble Space Telescope. http://spaceweather.com/flybys/index.php?

Monthly Activity

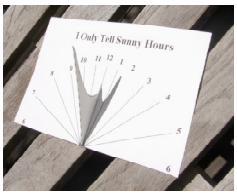
Making a Sun Clock
http://sunearthday.nasa.gov/2008eclipse/materials/Solar_Clock.pdf

National Aeronautics and Space Administration

www.sunearthday.nasa.gov

Public Outreach:
Make and Take Activities

Solar Clock



About this Activity

Build your own paper sundial and tell the time of day by using the Sun.

Right: A photo of a completed Solar Clock in the sunlight.

Preparation

This activity works best when the handout is printed on thick cardstock. Another option is to have the handouts on regular paper, and have the participant paste it to a manila folder before cutting and assembling.

To Do and Notice

1) Read the instructions to familiarize yourself with the process.

2) Have the participant begin by cutting off the half sheet where indicated on the handout.

3) On the base (the half sheet with "I Tell Only Sunny Hours"), carefully cut a slit up the middle line ("12") only up to the notch about 2/3 of the way up. Do not cut more than that!

4) On the gnomon half sheet, have the participant cut off and discard the corners. Then fold the gnomon in the middle along the dotted line so the curved lines are on the outside. Keep it folded and cut along the solid curved line and continue to cut to the edge of the sheet of paper. Do not cut along the dotted lines!

5) Fold along the dotted lines in the opposite direction than the original middle fold, like wings of a paper airplane. The "wings" should be flat on the table and the gnomon should rise above them like a shark fin.

6) Slide the gnomon into the slit on the base, with the tall, skinny tip of the gnomon pointing towards "12," until they are flush. Flip it over and tape the gnomon securely to the base.

What You'll Need

- White or light-colored Cardstock
- Copies of the Solar Clock hand-out (see next page) printed on cardstock
- Scissors
- Scotch Tape
- (optional) Manila Folders
- (optional) Glue sticks or paste

Activity Notes

It is important to keep the gnomon perpendicular to the base, and to make the folds as crisp and neat as possible to create the best shadow for telling the time. It is also helpful to know where north is in your location. When the sundial is complete, orient the tip of the gnomon (or the top of the base) to the north, keeping the base parallel to the ground. Compare with your wristwatch to see how accurate your sundial is! Or better yet, use the sundial throughout the day to tell the time.

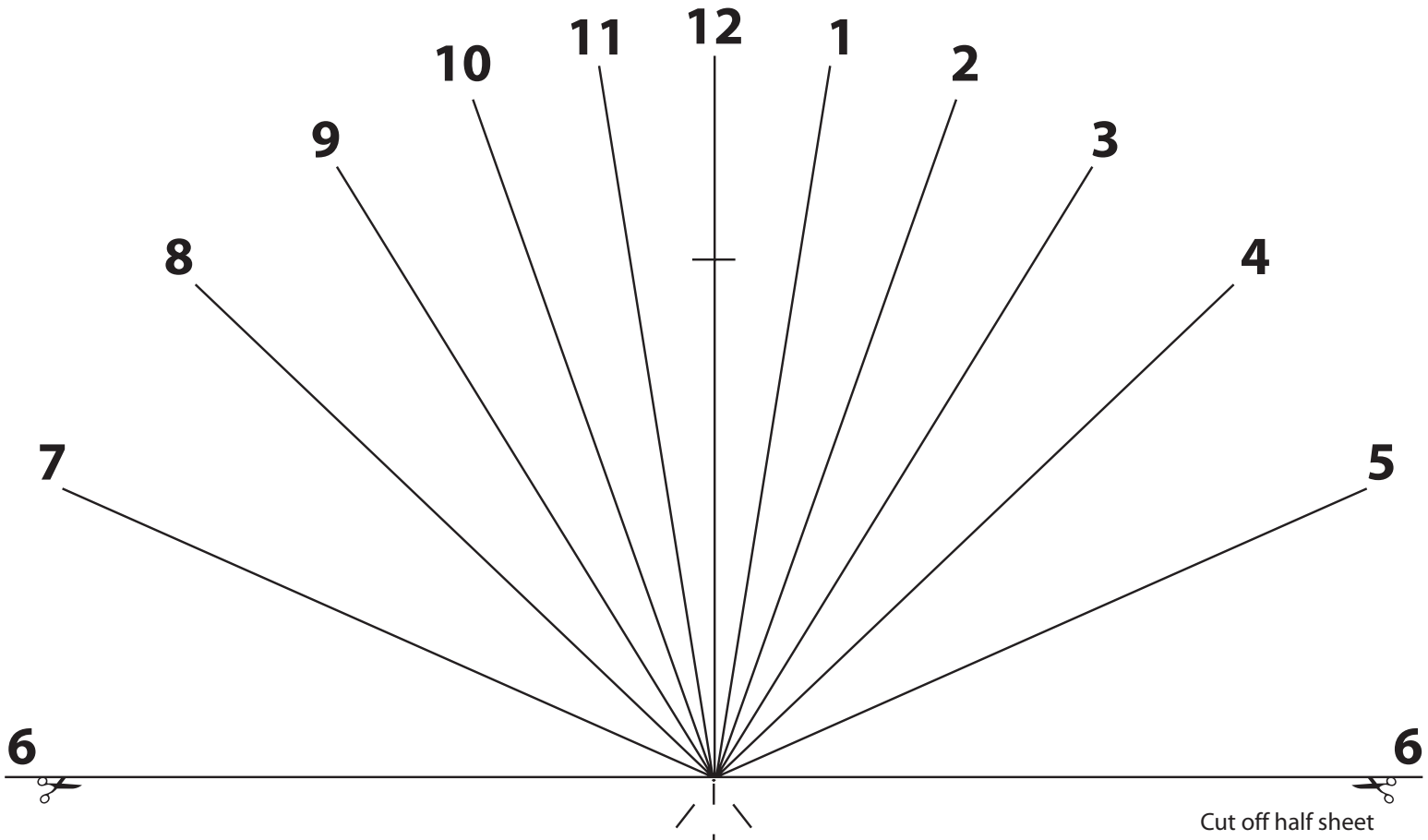
This activity is adapted from "From Stargazers to Starships" Educational Exposition. To learn more about sundials, follow the link under "Related Websites" below.

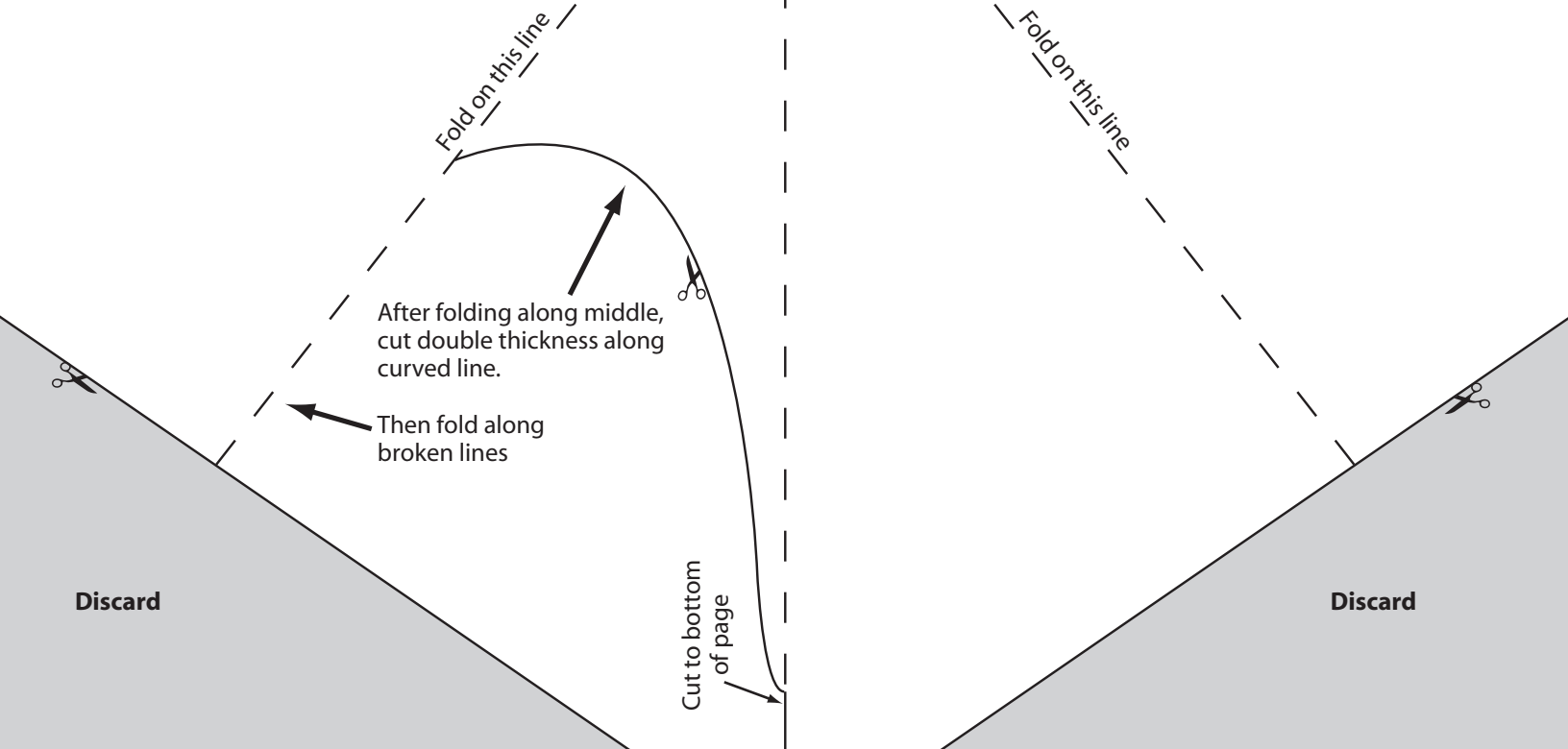
Related Websites

"From Stargazers to Starships" – More Information on Sundials:

http://www-spof.gsfc.nasa.gov/stargaze/Sundial.htm

I Tell Only Sunny Hours





Instructions (from **http://www-spof.gsfc.nasa.gov/stargaze/Sundial.htm**; more there.)

1. Cut the paper along the marked line: one half will serve as **base**, the other will be used to construct the **gnomon**.
2. In the gnomon part, cut away the two marked corners.
3. **Fold** that part at the broken line at its **middle, to get paper of double thickness**. The two other broken lines (leading to the cut-off corners) should remain visible. The line of the fold is the gnomon.

   Note: In stiff paper, straight folds are helped by first scoring the paper: draw the line with a black ballpoint, guided by a ruler and pressed down hard.
4. With the gnomon sheet folded at its middle, **cut out along the curved line**, cutting a double thickness of paper in one cut. The cut begins near the top of the gnomon-fold and ends on the secondary (broken) line. **Do not cut along the broken line** but connect the cut with the edge ("Cut to bottom of page"). No pieces come off.
5. **Fold** the gnomon sheet at the other two broken lines, in directions **opposite** to the one of the earlier fold. These folds should form 90-degree angles, not produce a double thickness.

   If the two pieces on the outer side of the fold are placed flat on the table, the gnomon should rise above them.
6. In cut (4), the fin of the gnomon was separated from two pieces with curved outlines. **Fold** those pieces so that they, too, are flat with the table. One goes above the other, then fit the fin to fit into slots they form near the broken lines.
7. You are almost done. Take the **base** sheet, and note the **apex** where the hour-lines all meet (that is where the bottom corner of the fin will go). Carefully cut the sheet from this point along its middle line, up to the small cross-line marked on it. Do not cut any further!
8. **Slide the fin** into the cut you made, all horizontal parts of the first sheet **below** the base sheet; only the fin sticks out. Its bottom corner should be at the apex. **Very important:** the fin must be **exactly perpendicular** to the base (you may have to widen the slot with a second sn otherwise, the sundial's time is wro g.

   The sundial is now ready, but you might use tape on the bottom of the base-sheet to hold the two pieces together firmly. For further stability, and to prevent the sundial from being blown away, you may attach its base with thumbtacks, tape or glue) to a section of a wooden board or a piece of plywood.
9. Finally, **orient the fin** to point north. The shadow of the tip of the fin now tells the time.

A sundial should work equally well at any time of the year. Equinox is special because

(1) The Sun rises exactly in the east and sets exactly in the west, both directions perpendicular to north; north could be defined as the direction of a flagpole's shadow when it is shortest. You may not get students to observe at sunrise but maybe they could do so at sunset. They could in any case use the shadow of a flagpole to determine north.

(2) The length of the shadow at noon changes most rapidly at equinox. Draw a northward line from the flagpole on the ground, and mark on it the tip of the shadow. If students make 2 marks per week, they probably will see changes.

(3) The location on the horizon of sunset (and sunrise) changes fastest at equinox.

The outlines of this sundial can also be downloaded from the world-wide web, at the above URL http://www-spof.gsfc.nasa.gov/stargaze/Sundial.htm The site is part of an extensive educational exposition on **astronomy, space, spaceflight, the Sun** and **Newtonian mechanics,** titled "From Stargazers to Starships." It contains 90 main sections, plus a math course, glossary, timeline, lesson plans and more.

"From Stargazers to Starships" found at URL http://www-spof.gsfc.nasa.gov/stargaze/Sintro.htm was written by Dr. David Stern, a scientist working in space research, at roughly the high school level. It follows the historical thread of humanity's quest into space, from the early Greek astronomers to NASA and Sputnik, and to ideas still on the drawing boards.