

Paper Plate Education

"Serving the Universe on a Paper Plate"

Activity: Analemma Project



With the [Sub-Solar Cup activity](#) you can determine the position on the earth where an observer would see the sun directly overhead. Plotting the sub-solar point at the same time each day should yield an analemma, the figure-eight shape on a globe that expresses the sun's declination and the equation of time.

In this ongoing project, we hope to track the sub-solar point for one year, provided the weather and personal commitments permit regular observations at noon. See the [Analemma Project](#) (same name, different project) for multiple exposure photographs that produce terrific visual image of analemmas. Paper Plate Education, being a very casual pursuit, will likely undertake this Sub-Solar Cup endeavor with less exactness. Enjoy.

The results are in and appear at the bottom of this page...



From the Sun Clock home page at

<http://www.mapmaker.com/sunclock.htm> see the Sun Path diagram for depictions of analemmas. It is a nice addition to this activity.



For continuity, we secure our globe in a base so our location (see figurine at left) is atop the globe. Then we align our globe base with cracks in a driveway that are nearly north-south. Any minor offset from north-south will cause a slanted figure-eight.



Another way to check the north-south alignment is to track the path of the sun through several hours. If the globe is properly aligned, the sun should move along one latitude for the entire day.

At the end of 12 months we will mark the globe to clarify the path of the analemma.



December 25, 2002
Noon (Standard Time)

The sun appears just slightly above the Tropic of Cancer two days after the December solstice. Please recognize the sub-solar image is an approximate position, dependent on the accuracy of the globe's alignment relative to the real earth.



January 6, 2003
Noon

For the first image, the base was wobbly on ice. The zoomed image is with the base steady. Weather is mostly cloudy.



January 9, 2003
Noon



January 12, 2003

Noon



Hands shaky from bitter cold. Intermittent snow, windy, temperature 10 degrees F.

January 22, 2003

Noon



January 30, 2003

Noon



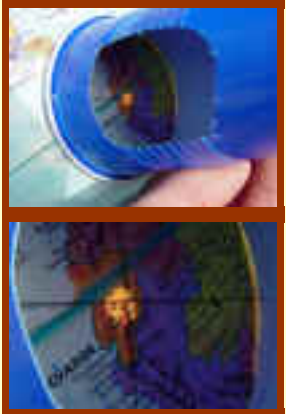
February 11, 2003

Noon



Lesson learned: Do not align globe with intersection of four slabs of concrete running along cardinal points, for when the slabs heave in the winter the globe is not automatically level anymore.

February 27, 2003
Noon



March 13, 2003
12:10 p.m.



March 21, 2003
12:10 p.m.



March 30, 2003
Noon



April 15, 2003
Noon (Standard Time)

An upside not to move the clock forward to daylight time (DT): the time remains *noon*, Standard Time (ST).



April 24, 2003
Noon



April 29, 2003
Noon



May 21, 2003
Noon



June 17, 2003
Noon

Has been a large gap since last observation.



June 22, 2003

By tracking the summer solstice sun across the length of the day, we can see the globe is slightly skewed from ideal. In the morning the sub-solar point is slightly under the globe's Tropic of Cancer line; in the afternoon the solar dot is well above the line.



June 24, 2003
approx. noon



July 9, 2003
Noon



July 16, 2003
Noon



July 25, 2003
Noon



August 12, 2003
Noon



August 19, 2003
12:05 p.m.

Meanwhile, Mars at opposition is making its closest approach to earth

in nearly 60,000 years.



August 28, 2003
Noon



September 10, 2003
Noon



September 15, 2003
Noon



September 23, 2003
Noon

September Equinox. The sun's position just above the equator hints that the globe is slightly out of alignment. As long as that error is kept nearly constant, we should still be able to plot a figure-8 (albeit misaligned) onto the globe at the end of one year.



October 12, 2003
Noon



October 27, 2003
11:55 a.m. EST



November 6, 2003
12:05 p.m. EST



November 26, 2003
Noon



Meanwhile, the big sunspot groups of 2003 come round again--a bonus while tracking the sun.

Image courtesy of [SOHO \(ESA & NASA\)](#).



December 2, 2003
Noon



December 21, 2003
Noon



We're done! We have tracked the sun for 12 months. Now we just have to plot the points on the globe. To be more scientific about this, we could continue tracking the sub-solar point to see if its path is repeatable. You may notice that the sun does not exactly coincide with the tropic of Capricorn. In the past year, the globe has settled into the padded base and repeated handling has affected the positioning of the base, globe, and cup.

THE OUTCOME

The results are in, with mixed success. We first plotted the sub-solar point with yellow circles on the Tropic of Capricorn and moved up to the Tropic of Cancer. From there the red circles descend back to the Tropic of Capricorn. If the three points immediately after the vernal equinox were better positioned, then the figure-8 of the analemma would be more apparent. Again, the globe was repositioned after each observation, so plenty of error is introduced.



[globe-plot.jpg](#) (286 KB)



[globe-plot2.jpg](#) (50 K)



globe-plotzoom.jpg (275



globe-plotzoom2.jpg (34 KB)

KB)

[Note: The [Sub-Solar Cup activity](#) is [detailed](#) in the [Paper Plate Astronomy video](#).]

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