

Analemma Program Introduction

Analemma Program Chair

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Introduction

Just about everyone knows that the Sun's altitude at culmination, the highest point above the observer's horizon, varies through the year – high in the summer, and low in the winter. However, outside of navigators, cartographers and astronomers, it is not commonly realized that the Sun's apparent angular velocity also varies – sometimes “fast” (west of the meridian at Local Noon), and sometimes “slow” (east of the Meridian at Local Noon).

Participants in the Analemma Program will monitor the Sun's motion throughout the year and note changes in the Sun's position, both in altitude and azimuth.

They will then, with reference only to their analemma and observing apparatus:

- Calculate their observing latitude and the tilt of the Earth's axis
- Sketch or plot the path of the Sun on the Celestial Sphere
- Calculate the Equation of Time
- Calculate the eccentricity of the Earth's orbit

Rules and Regulations

To qualify for the AL's Analemma Certificate and pin, you need only be a member of the Astronomical League, either through an affiliated Club or as a Member at Large, generate an analemma, and analyze the data of the analemma. The analemma should be formed by a minimum of 100 observations spread approximately evenly throughout the year (i.e., about two per week).

Though not necessary to observe on specific days, both the Vernal and Autumnal Equinox, both the Summer and Winter Solstice, and the days of perihelion and aphelion should be noted on the analemma. The Observer's Latitude, Longitude, and Local Observing Time should also be noted.

Some pre-observing activity is required:

- Select your observing site. The site must allow full-year observation of the Sun – either a ray through a hole in an obstruction, or a shadow. You will need to determine the site's Latitude, Longitude, and Magnetic Variation (if you use a magnetic compass to identify true north/south).

- Specify your Observing Time: Most observers will find it least complicated to record their observations at Local Noon; it can be calculated from the Observing Site's Longitude, and should be calculated to the second. A source for accurate times (e.g., W W V) is required to assure that the observations are taken at the same clock time (even when using a small enclosure, being off by 15-20 seconds makes a small but noticeable change in the observed position of the Sun). Be sure to add 1 hour when Daylight Savings Time is in effect.
- Specify your observing apparatus: If using a transmitted light ray for your observations, a box containing an 8½" x 11" sheet of paper can be constructed – for a procedure to build such a box, see Appendix A (there are many ways to cast a light beam or shadow; this is only one of them). If following a shadow, the points can be marked during the year and photographed at the end of the project, with the points of Solstices, Equinoxes, and aphelion and perihelion identified on the image.

When the Analemma is complete, a number of parameters about the Earth and its journey around the Sun are to be calculated; they are:

- **Activity #1:** with reference only to your analemma and measured dimensions of your observing apparatus, calculate (1) the tilt of the Earth's axis relative to its orbital plane, and (2) your observing Latitude.
- **Activity #2:** with reference only to your analemma and measured dimensions of your observing apparatus, calculate the Sun's path in the sky and produce a sketch or plot to depict that path.
- **Activity #3:** with reference only to your analemma and measured dimensions of your observing apparatus, calculate the Equation of Time curve across the year.
- **Activity #4:** with reference only to your analemma and measured dimensions of your observing apparatus, calculate the eccentricity of the Earth's orbit.

To receive your Analemma Program certificate and award pin, mail the following to the Club Coordinator (do not mail originals):

- a description of your observing setup (with dimensions). This includes a description of your observing location (Latitude, Longitude, Magnetic Variation, if used) and Local Observing Time.
- a copy of your analemma, with the points of Solstices, Equinoxes, and aphelion and perihelion identified
- a description of how you derived the tilt of the Earth's axis and your observing Latitude (Activity #1)

- a copy of your sketch or plot of the Sun's path in the sky, and a brief description of how you derived it (Activity #2)
- a copy of your Equation of Time curve, and a brief description of how you derived it (Activity #3)
- your estimate of the eccentricity of Earth's orbit, and a brief description of how you derived it (Activity #4)

Include with your submission, your name as you want it to appear on the Certificate, address, phone number, email, and society affiliation. Upon verification of your observations, your certificate and pin will be forwarded to you or your club's Awards Coordinator, whomever you choose.