

Learning about Solar Angles from the Shadow Analemma

by
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Abstract

The analemma is the figure eight shape followed by the location of the Sun at a specific time of day throughout the year. Commonly a camera is set up with a carefully calibrated position and the shutter opened at that specific time of day throughout the year. The difficulty of this procedure limits its application to professionals. What is presented here is a simple way of determining the analemma in a grade school classroom.

The shadow analemma can be captured through a window facing the noonday Sun, with an orientation plus or minus at most about 20° . A target is affixed to the glass, and a white foamboard placed on the floor such that at a specified time, usually close to noon, when a clear shadow of the target appears on the foamboard this position is marked. Exact timing is important; within a minute. The position of the board must be accurately noted since after every marking it is stored so it will not be damaged.

Markings are made throughout the year, not every clear day, but a three or four times a month will suffice. When the year is complete the dots are connected and the shape produced is the figure eight, shadow analemma.

What can be deduced from this shadow analemma? The answer is a lot. The latitude and longitude can be calculated, as well as the angle that the glass is away from facing the noontime Sun. Additionally, solar elevation and azimuth for each of these dots on the board can be calculated, and by noting some of the days on which markings are made, the seasons of the year make sense to students.

The only instruments needed are an accurate clock with a second hand, a tape measure, a builders square available in most hardware stores, and a foamboard available at most hobby stores.

For better understanding of the calculations made from the shadow analemma, high school students who have taken algebra and trigonometry will benefit the most. But grade school students of all ages can learn from this simple experiment. They can all become invested in the process, they all see the result at the end, and it encourages even the youngest amongst them to embrace science.