

Time to Get the Science Right

While the Indiana time flap may “reflect the governor’s lack of leadership,” as suggested in a headline of the South Bend Tribune on December 1, 2005, the ensuing [commentary](#) reflects a common lack of scientific understanding.

The author stated, “If we want the sun to be overhead at noon, as nature intended, we need to be on Central time. That’s a fact, and it applies to the whole state, not just a few select counties. It’s a basic concept of natural law.” She further suggested this understanding reflects “good old Midwestern common sense.” Regardless of which zone is ultimately chosen, hopefully the time issue will be resolved by solid evidence, not by flawed common sense.

At no place in the continental United States is the sun *ever* overhead. The sun only reaches the zenith for people who live between the tropics, with 23 ½ degrees of northern latitude being the most northern location to experience an overhead sun. From South Bend, Indiana, (assuming a longitude of 86 degrees 15 minutes West and a latitude of 41 degrees 41 minutes North), the sun peaks at just over 70 degrees of altitude around the June solstice. In late December, the sun only gets about 25 degrees above the southern horizon at its highest point.



Why Isn't the Sun Ever Overhead Here?

Left: <http://www.solarnet.org/IndHome/Analemma.gif>.

Click to enlarge the diagram of North America. Notice how the sun is never overhead at the house, even at summer solstice.

Right:

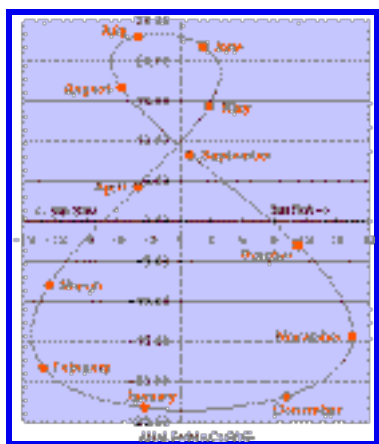


<http://analyzer.depaul.edu/paperplate/Altitude%20of%20Noon%20Sun%20II.htm>

From another perspective, try this paper plate demonstration. The observer's latitude at South Bend is indicated by the elevation of the North Star above the northern horizon, shown on the left half of the plate.

Polaris is about 42 degrees above the northern horizon because South Bend is at nearly 42 degrees of latitude. The celestial equator is perpendicular to the north pole, which is topped by Polaris. The sun appears to range north and south of the equator by about 23 1/2 degrees, between the Tropic of Cancer at 23 1/2 degrees in the north and the Tropic of Capricorn at 23 1/2 degrees in the south. The year-long range of the noon sun's height to the south is indicated by the scribble on the right half of the plate. Notice how the sun is never directly overhead in South Bend.

What I think the columnist *meant* to say in her commentary was, “If we want the sun to be at its highest point above the horizon at noon, as nature intended, we need to be on Central time. That’s a fact, and it applies to the whole state, not just a few select counties.” While that has been a notion upon which several Central time zone advocates have insisted, that assumption is also wrong.



If you were to track the sun’s noon position throughout the year, you would trace out the figure-eight shape called an **analemma**. You may recall seeing a thin analemma on an older globe, often depicted in the open space of the Pacific Ocean for clarity. (Unfortunately, many globe manufacturers have discontinued placing the figure-eight on their globes, another indication of the nation’s declining scientific ability and desire for science literacy.)

See <http://www.analemma.com/Pages/framesPage.html> for a tutorial on the analemma.

Earth’s rate of revolution around the sun is not constant throughout the year, as proven on a sundial. Some days the sun is a few minutes “fast” and other days the sun is a few minutes “slow” in reaching its highest southern altitude. The analemma reflects the Equation of Time, the combined effect of the eccentricity of the earth’s orbit and the obliquity (or tilt) of the earth’s axis. It might seem like technical mumbo jumbo, but the analemma--the annual sun path--has a very real bearing on the time zone discussion and the validity of many people's arguments.

In the diagram below, three analemmas show the sun's noon position throughout the year for three different hours of interest in the discussion. The far right analemma shows the noon sun from South Bend for Central Standard Time (CST), while the middle analemma shows the noon sun from South Bend for Eastern Standard Time (EST). For *neither* time zone is the sun due south at noon—it’s either a little to the right (west) or a little to the left (east) of due south. Admittedly, around late January and February (the lower left part of the loop) the sun does approach due south at noon with CST. However, in November (shown by the circular sun) the noon sun is nearly as far to the right of due south in CST as it is to the left of due south in EST.

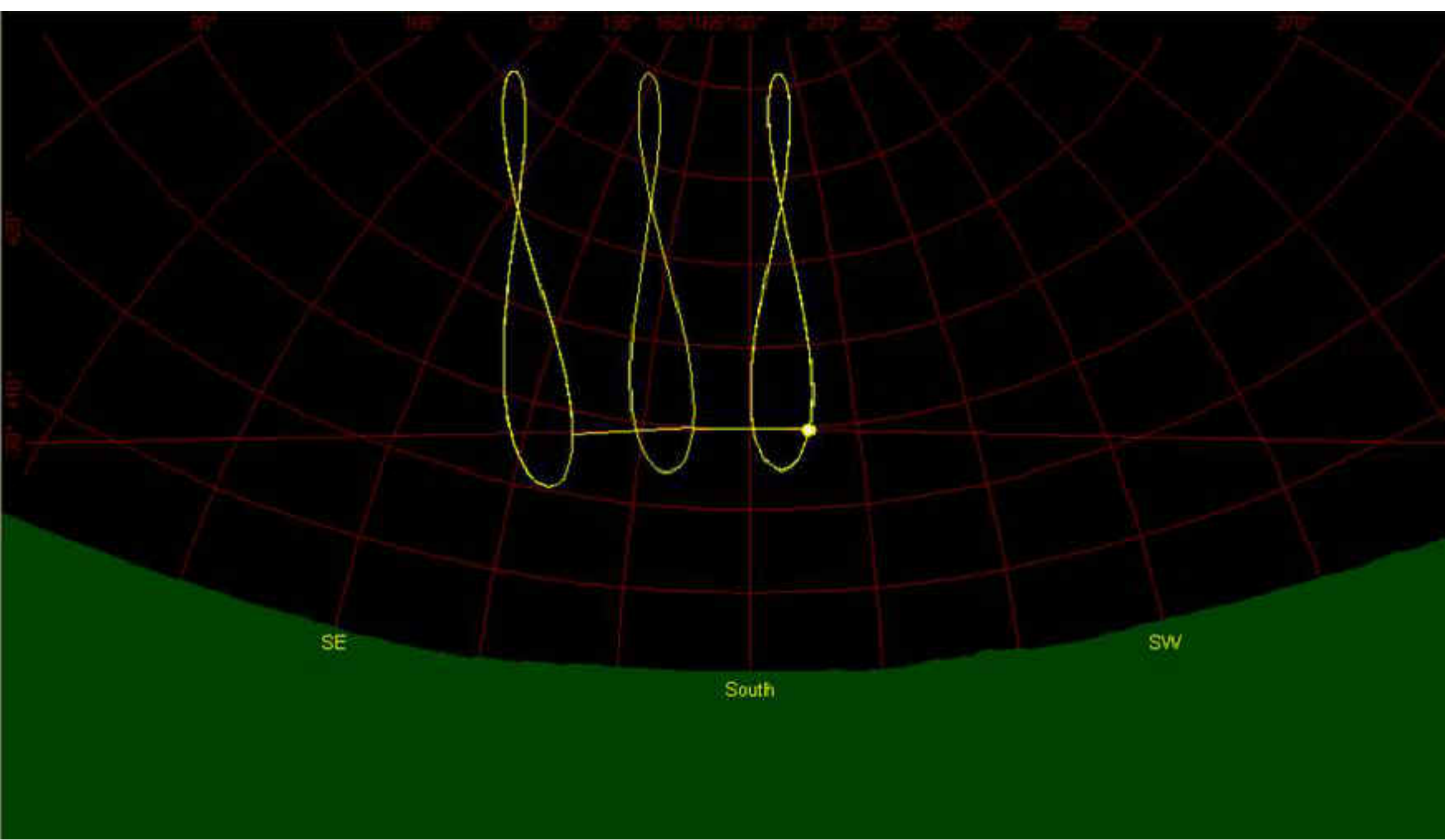


Diagram in Coordinated Universal Time (UTC) depicts the noon analemma for UTC-4, UTC-5, and UTC-6 (from left to right) as seen from South Bend, Indiana.

The effect of Daylight Saving Time (DST) is to shift the analemma left (east) one hour. If South Bend were on Central time (shown below in blue rows), the noon analemma would shift eastward from the right analemma to the middle analemma. Again, in South Bend the sun would be due south at noon for *neither* Standard nor Daylight time. If South Bend were on Eastern time (shown below in the bottom two rows), the noon analemma would shift eastward from the middle analemma to the left analemma. In that case, the noon sun in South Bend shifts from east of due south to *well* east of due south.

	Left Analemma	Center Analemma	Right Analemma
	Sun is well left (east) of south	Sun is left (east) of south	Sun is right (west) of south
Central Time	10:00 CST	11:00 CST	Noon CST
Central Time	11:00 CDT	Noon CDT	1:00 CDT
Eastern Time	11:00 EST	Noon EST	1:00 EST
Eastern Time	Noon EDT	1:00 EDT	2:00 EDT

On Central time, South Bend gains the purported benefits of Daylight time by shifting the analemma left (east) of due south for about seven months. However, if South Bend started with Eastern time as the baseline (i.e., our standard), the region would automatically gain the purported benefits of DST simply by having its noontime analemma left (east) of due south to begin with. During Eastern Daylight Time (EDT), the benefit is further extended as the analemma shifts left (east) even more. Of course, this benefit is dependent on whether one acknowledges, say, the energy savings gained from DST, of which the columnist was not convinced. More insight into Daylight Saving Time is at <http://webexhibits.org/daylightsaving/k.html>.

Contrary to the columnist's insistence that, in essence, the position of the analemma “applies to the whole state, not just a few select counties,” the analemma varies with one's location. The annual path of the noontime sun, “a basic concept of natural law ” in her words, is easy to plot, even if one doesn’t have the “Princeton degree” that the columnist decried. See <http://analyzer.depaul.edu/paperplate/analemma.htm> for an example of plotting a local analemma.

Finally, if your location straddles the primary meridian of longitude for your time zone, your analemma is closer to the ideal “that nature intended.” For the Eastern time zone, the 75 degree meridian, shown below, is slightly west of New York. For the Central time zone, the 90 degree meridian is well west of Chicago, not a mere 100 miles from South Bend as several people have suggested. Yes, 86 degrees of longitude at South Bend is closer to 90 degrees than to 75 degrees, but 86 degrees coincides with *neither* primary longitude.



From <http://upload.wikimedia.org/wikipedia/commons/4/4b/Timezones.png>.

While I have enjoyed the public discussion about time zones and DST, the newspaper columnist has the advantage of the pulpit. She may preach her commentary at will, but I ask her and others not to propagate erroneous information. Please do not declare your "common sense" to be scientific fact. It gives Midwesterners a bad name.

Chuck Bueter

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