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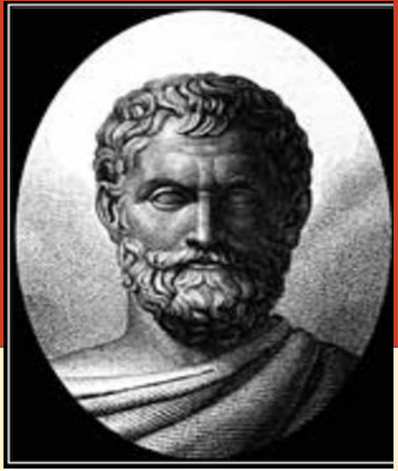
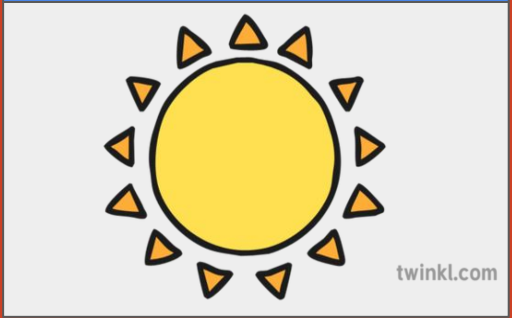
why is the solar noon time different every day ?

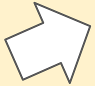


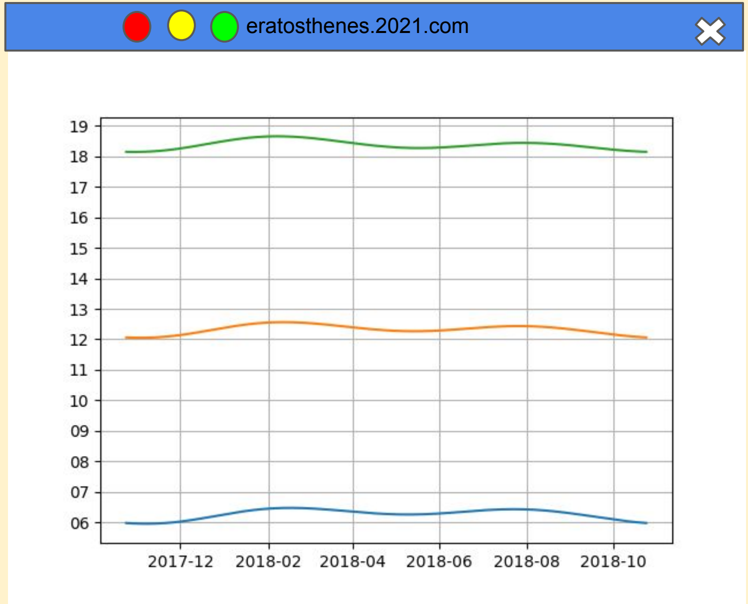


by dimitris Ilion

the question

If you check the local time for solar noon is different every day. Why is it so? Is it because Earth doesn't make a complete rotation in exactly 24 hours?
The following is an example of the solar noon differences (also sunrise and sunset), computed by the Python Astral module for the city of Guayaquil





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what a teacher on the internet has to tell us, let's call him Mr A.(1/4)

Here's how I explain this to my students. There are actually two suns in the sky. One is responsible for causing objects to cast shadows and is the daytime star we're all accustomed to observing. Let's call it the "true Sun" or the "apparent Sun." It, in effect, governs our lives. However, it has one main problem relevant to timekeeping, and that is that its speed along the ecliptic throughout the year varies. It's average (angular) speed is about

360/365

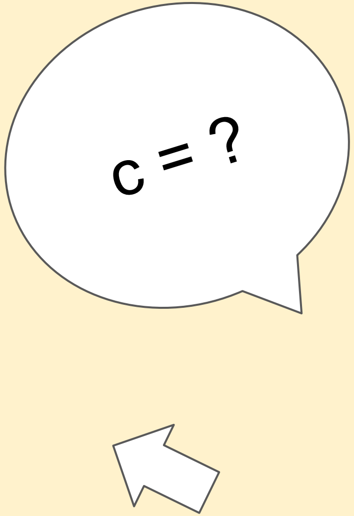
360/365 deg/day or about 0.986 deg/day. Now, this variation is important because if we want to use this Sun as a prime mover for timekeeping, we have to be aware of the variation. It means that an hour, which is defined as one twenty-fourth of the time it takes this Sun to go from the celestial meridian around to the celestial meridian again, varies in duration throughout the year when compared to the same interval measured with a timekeeping device that does NOT vary in rate. As for the cause of the variation, there are several factors at work here. One is the shape of Earth's orbit, which causes Earth to move at different speeds at different places in its orbit. Of course, we see this as differences in true Sun's speed along the ecliptic because we're on the moving Earth. Another is the fact that true Sun's path, the ecliptic, makes a 23.5° angle with the celestial equator, which also causes seasonal variations in true Sun's speed along the celestial equator.

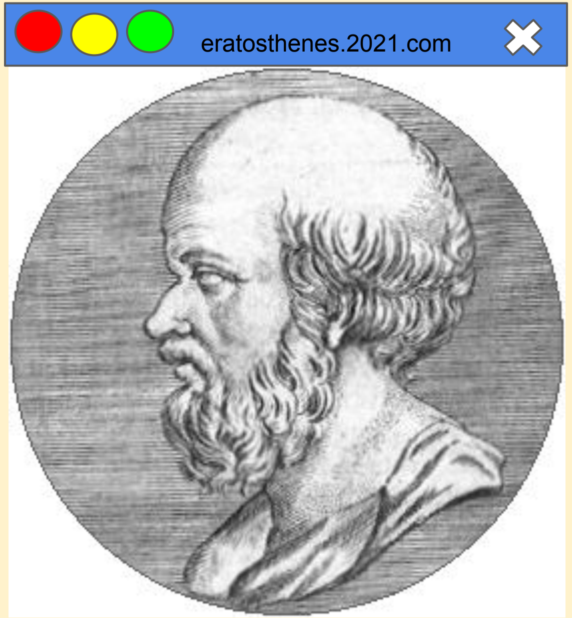
what a teacher on the internet has to tell us (2/4)

To get around these problems, astronomers invented the "mean Sun" for timekeeping, and it moves at a uniform rate (not a variable rate) along the celestial equator (not the ecliptic). Both it and the true Sun have the same **average** angular speed, taking one year to complete one trip around the sky (in different planes, however). Being fictitious, one can't actually observe mean Sun. Nevertheless, mean Sun is the prime mover that we use for all civil timekeeping. We can track its motion relative to the celestial meridian with a mechanical (or nowadays, digital) device called a "clock."

what a teacher on the internet has to tell us (3/4)

Now, the variations in the true Sun's motion causes it to sometimes be ahead of, sometimes lag behind, and sometimes be neck and neck with the mean Sun. This variation is called the **equation of time** and can be tabulated for any date.



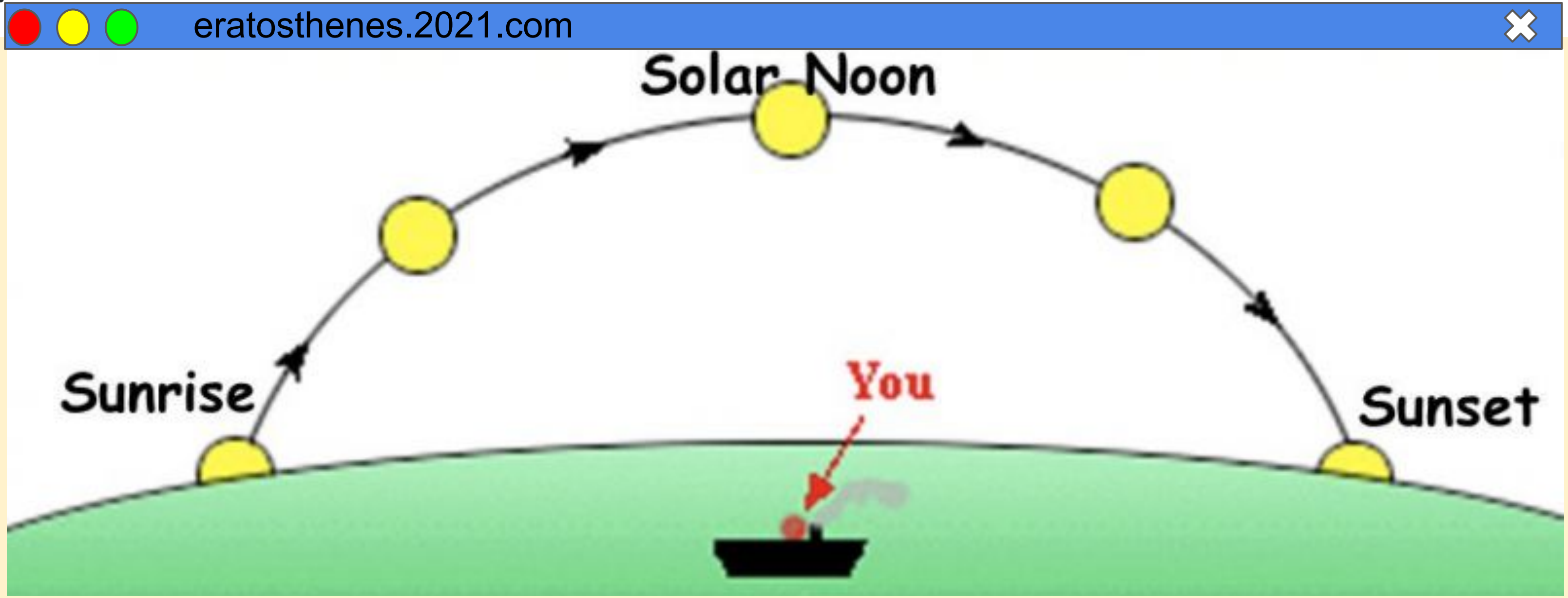


what a teacher on the internet has to tell us (4/4)

When we say "noon" most people think of Sun being at its highest point in the sky, which need not be the zenith, but will ALWAYS be somewhere on the celestial meridian (yes, things get weird in the arctic and antarctic regions). However, "noon" really only applies to true Sun's motions. We keep time by mean Sun's motions, and a mean solar clock ALWAYS reads 12:00 when mean Sun is on the meridian. This moment, except for four days of the year, does not coincide with "noon" as embodied by true Sun's motions.

what another person thinks, let's call this person Mr B.

The main cause is that the length of a day changes during the year. For example the Earth moves faster relative to the Sun at perihelion than it does at aphelion. This means the period from noon to noon measured by a sundial is not the same as the period measured using one of the standard time schemes like universal time.
The other significant cause of changes in the day length is the the tilting of the Earth's orbit.



AND ... another person, lets say Mr C. disagrees with the previous one, Mr B.

“the answer is much simpler - the earth's orbit is an ellipse, not a circle . . so it is traveling faster when closer to the sun (january) and slower when farthest from the sun (july). The time from solar noon to solar noon is a sidereal day (23h56m, fixed to the stars) PLUS the time it takes to "compensate" for how far it has moved in its orbit. This is about 4 minutes, but it is a bit MORE when the earth is moving fast (january) and a bit LESS when the earth is moving slowly - thus the time from solar noon is a bit longer than 24 hours in january, and a bit shorter in july. This is why the solar noon time "wobbles" throughout the year.”

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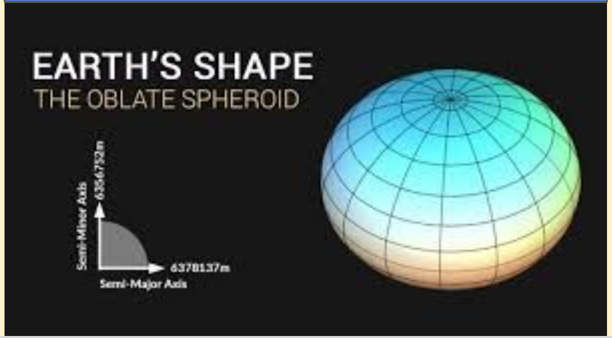
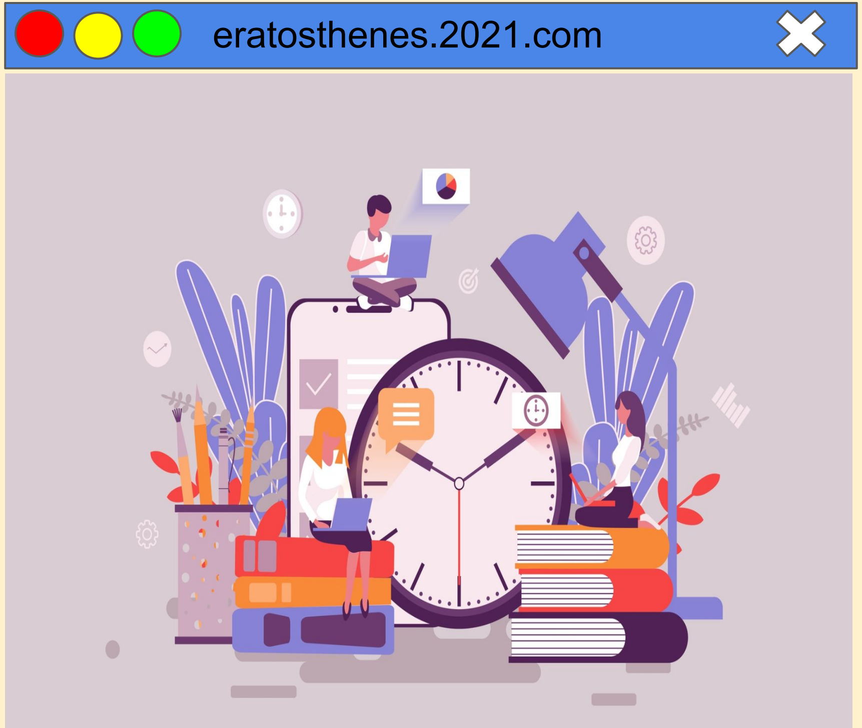
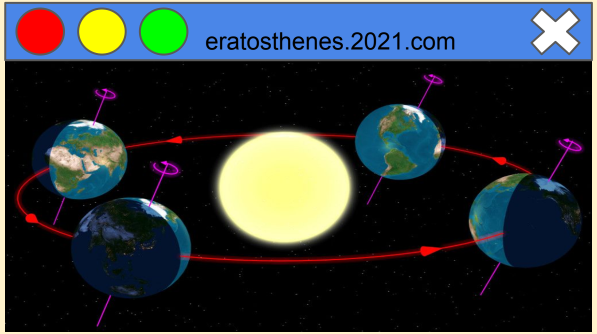
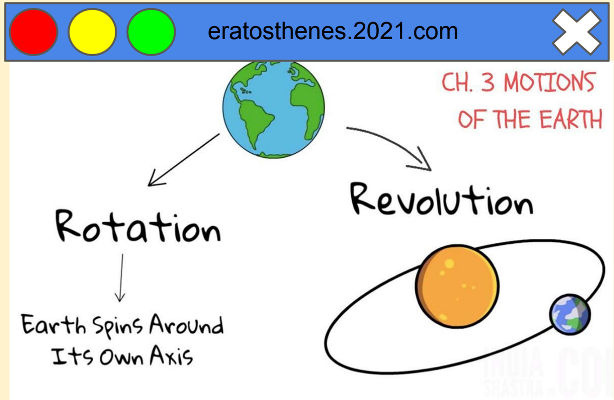


and Mr B replied with: “It's not quite this simple. You must account for Earth's obliquity and not just Earth's orbital eccentricity. – user11266 Jan 14 '13 at 16:54”

One more, Mr D. theorized that



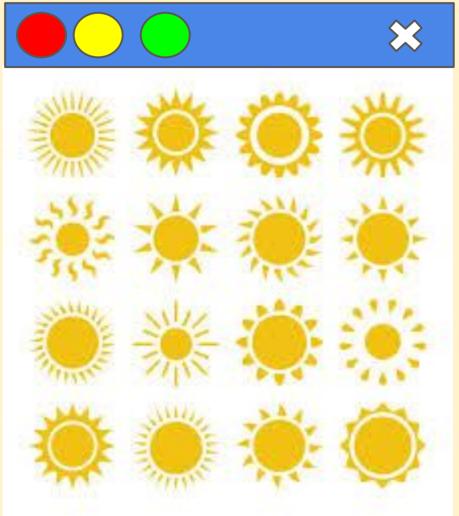


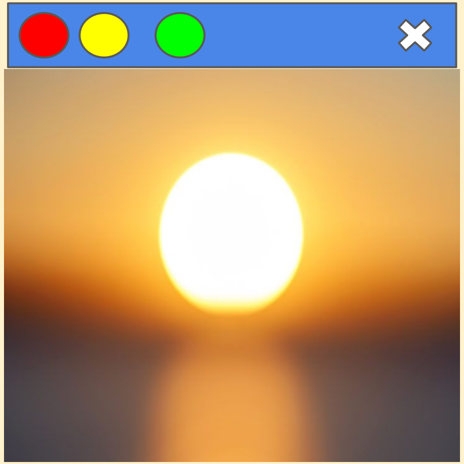


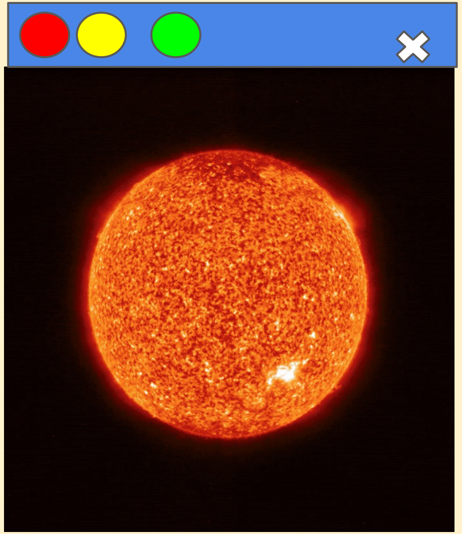
"A solar noon is defined when the Sun is at the zenith (directly above). Since the Earth revolves around the Sun, the point that is directly above would have changed because Earth is in a different point from the previous noon."

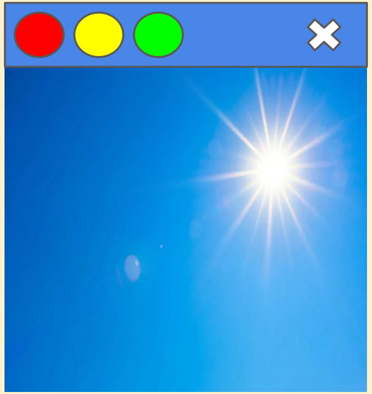
but this person disagreed with the last one

“NO! Solar noon, more correctly 12:00 Local Apparent Solar Time (LAST), is NOT defined in terms of the zenith. If it were, it would never occur for the majority of the observers on the planet! Only observers within 23.5 degrees of the equator would experience noon. Instead, the concept of "noon" is related to meridian passage. Noon is when Sun (either true or apparent) is on the meridian. – user11266 Sep 25 '12 at 10:52”









but in the end….

Who is right?

The answer as you can see is not clear to me at the moment . I will probably make another presentation in the future . I'll study the subject and talk about it with my teacher altho I would appreciate some help from the eratosthenes project if you can give it ! write your answers or theory in the comments of this presentation to learn more about this together

keep on the great job , contentiou measuring and have a nice day !

Dimitris Ilion