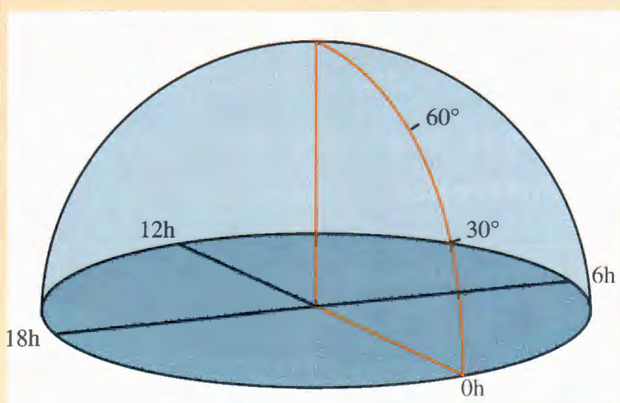
All things being equal?

On March 20, the Sun will reach the astronomical coordinates of 0 hours and 0 degrees. The Sun, in its apparent eastward motion, will be crossing the celestial equator heading toward the June solstice position north of the equator. This day will mark the end of the Northern Hemisphere winter and the Southern Hemisphere summer. On this day, referred to as an equinox, the length of daylight and night hours will be approximately the same, 12 hours, for everybody on the globe. What is interesting about the equinox day is that while the length of daylight and night are approximately the same for everybody at all latitudes, the apparent path the Sun follows from sunrise to sunset is not the same, nor will shadows look the same at midday. For example, at the equator the Sun passes straight overhead so that a shadow will move from west to east during the day and be its shortest at local midday time—in the case of the equator there is no shadow. At other latitudes, the Sun's apparent path also causes shadows to shift from west to east, but at midday there is a shorter shadow pointing north in the Northern Hemisphere and south in the Southern Hemisphere. The closer to the equator, the shorter the midday shadow.

The sky is divided into a grid-like pattern of intersecting lines that are an extension of the Earth's surface-based system of latitude and longitude. The hours are the celestial equivalent of meridians of longitude, without east or west, and are numbered from 0 to 23. The degrees are degrees of declination, the celestial equivalent of parallels of latitude, and are used to measure distances north or south from the celestial or sky equator.



At midday in Quito, Ecuador, the author had no shadow.

SunShIP

This past September, students and educators from locations in the Northern Hemisphere and on the equator took part in an investigation of shadows on the equinox called SunShIP. The goals of the Sun Shadow Investigation Project were to collect pictures of midday shadows from various latitude locations and to have the participants use their Sun altitude measurement to calculate the polar circumference of the Earth. (See *sunship.currentsky.com* for more details.)

Prior to the equinox day, students had to determine their latitude and distance from the equator as well as the local time of midday based on their longitude. At midday of the equinox day, students measured the altitude of the Sun and then combined their local measurements with those taken by middle and high school students at Colegio Menor San Francisco in Quito, Ecuador. From this, students were able to calculate the polar circumference of the Earth following a method developed many centuries ago by Eratosthenes of Cyrene (275 BC–195 BC), a mathematician and librarian in Alexandria, Egypt. Student calculations were collected and all participants received an official certificate from the Eratosthenes League.

At the equator on the equinox day, students measured the altitude of the Sun hourly throughout the day as they observed the changing length of shadows as shadows moved from west to east as the Earth rotates. At midday, with the Sun essentially directly overhead, the only shadows were directly below objects. There was virtually no length to any shadow, and as students discovered, without any length to a midday shadow it is difficult to determine which direction they are being cast. Technically the period of "no shadow" lasted an instant, but it seemed to last several minutes. On any other day at midday, all shadows would have length and would be pointing toward geographic north.

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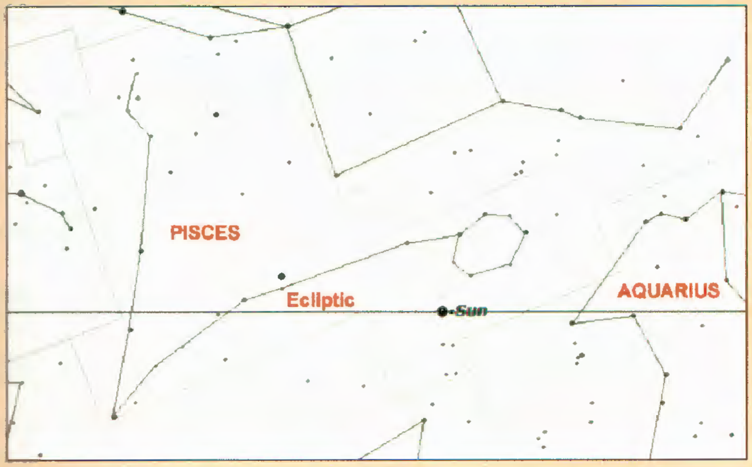
Tracking the Sun



Throughout the school year information and data will be provided through this column so that students may indirectly follow the Earth along its orbital path, the ecliptic, around the Sun. Because, from our perspective, it is the Sun that is "moving," students will actually be graphing the Sun's apparent motion caused by the Earth's real orbital and rotational motions. This graph-ready data will include celestial coordinate position and midday altitude of the mid-month Sun, its distance from the Earth, and the Sun's apparent size.

In addition to graphing the data provided each month, students can follow and plot the Sun's location along the ecliptic each month after downloading the free SFA star charts (see Resources).

March

During March the Sun's apparent eastward motion along the ecliptic takes it across the constellation Pisces, the Fishes.

On this date at midday EDT

Date	Time of midday Sun	Distance (in AU)	Altitude	Apparent size	Right ascension	Declination
4/20	12:15 p.m.	0.9960	31° 12'	32'	0h 0m	-0° 0'

Visit the SunShIP website to learn more about the 2004 project and how to participate in the project this month (see Internet resources).

Visible planets

- Mercury will set about an hour after sunset and for the first two weeks of the month will be at its best apparition (visibility) for the Northern Hemisphere.
- Mars will rise about an hour before the Sun and will be visible just to the east, left, of the handle of the teapot-shaped constellation *Sagittarius, the Archer*.
- Saturn will be visible over the southern horizon at sunset and will set a few hours before sunrise.
- The waxing gibbous Moon will rise near Saturn and the Gemini Twin stars, Pollux and Castor, on the evening of March 19. The Cassini Spacecraft makes several trajectory course maneuvers (TCMs) this month as it heads toward a flyby of Saturn's moon, Enceladus, on March 29 and another flyby of the large moon Titan on March 31.
- Jupiter will rise about two hours after sunset and will be visible all night. On the evening of March 26 the waning gibbous Moon will rise with Jupiter.

Celestial events

3/20 March Equinox, 7:33 a.m. EST—First day of Northern Hemisphere spring

3/23 Martian Equinox—First day of northern hemisphere autumn

Moon phases

March

Last quarter	3/3
New Moon	3/10
First quarter	3/17
Full Moon	3/26

Internet resources

2004 SunShIP—*sunship.currentsky.com*
SFA star charts—*observe.phy.sfasu.edu*
March equinox—*www.equinox-and-solstice.com/html/vernal_equinox.html*
Ephemeris generator—*ssd.jpl.nasa.gov/cgi-bin/eph*
Daylight saving time—*www.timeanddate.com/time/aboutdst.html*
Custom sunrise/sunset calendar—*sunrisesunset.com/custom_srss_calendar.asp*
Print your own solar noon calendars—*www.solar-noon.com*
Cassini mission—*saturn.jpl.nasa.gov*