

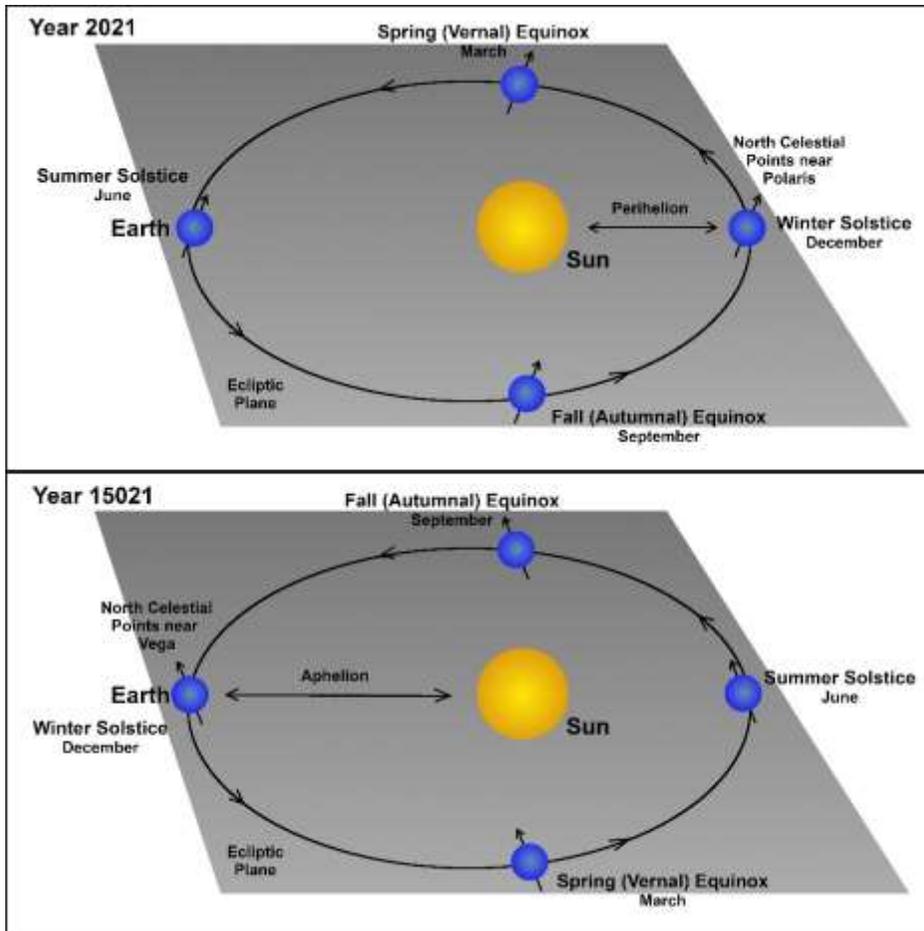
Dec 17, 2021

## Chippewa Valley Astronomy Update

### “Solstices, Precession, and the North Star”

By Mike Brown

**Figure caption.** The Earth’s axis is tilted compared to its orbit around the sun. Now, at winter solstice when the axis is pointing away the sun, Earth is closer to the sun as seen in the top panel. The second panel shows the tilt in the opposite direction, as it will be 13 thousand years in the future. At that time, winter solstice (axis tilted away from the sun) will be at a different place in Earth’s orbit.



The winter solstice, or the first day of winter, occurs next week on Tuesday. The winter solstice ushers in winter and marks the day the Earth’s axis is tilted away from the sun, giving days in the northern hemisphere the least amount of sunlight of the year.

The Earth’s axis, the imaginary line that runs through the Earth from the north pole to the south pole, is tipped 23.5 degrees relative to the plane of the Earth’s orbit around the sun, called the ecliptic plane.

The tilt causes the Earth to have seasons as it makes its yearly course around the sun. Around June 21st, the Earth’s axis is pointed towards the sun, giving the northern hemisphere longer days and shorter nights.

The spring and fall equinoxes, around the 21st of March and September, mark the days where both hemispheres experience equal amounts of day and night.

There is another nuance to the earth's axis.

The position of the north celestial pole (NCP), the direction into the sky at which the north end of the axis points, seems to stay the same as the years go by but it precesses in a circle against the backdrop of the stars over a period of about 26,000 years. Ditto for the south celestial pole.

A Greek astronomer, Hipparchus of Nicea (190-120 BCE), is credited with first noticing precession. Hipparchus compared observations more than a century apart and suggested that the NCP position very slowly shifted.

At this point in the 26,000-year cycle, the NCP points to a position in the sky very close to the star known as Polaris, which some also call the "North Star."

Precession will cause the celestial poles to move about 1 degree around the circle every 72 years. In about 13,000 years the NCP will be near the star Vega, the new "North Star."

Precession also changes the position in the Earth's orbit at which the equinoxes and solstices occur.

Earth's orbit around the Sun is elliptical and currently the winter solstice occurs a few weeks before perihelion, the point at which the earth is closest to the sun. Aphelion, the point at which the Earth is furthest from the sun, occurs a few weeks after the summer solstice.

In 13,000 years the winter solstice will still occur around the 21st of December, thanks to the accuracy of the Gregorian calendar established in 1582 by Pope Gregory XIII. However, in 15021, the Earth will be near aphelion, the point at which the Earth is furthest from the sun.

So for now the Earth is closest to the sun in January, but winter in the northern hemisphere might be a little cooler in 13,000 years when the Earth is farthest from the sun in January.

-- Mike Brown is a member of the Chippewa Valley Astronomical Society