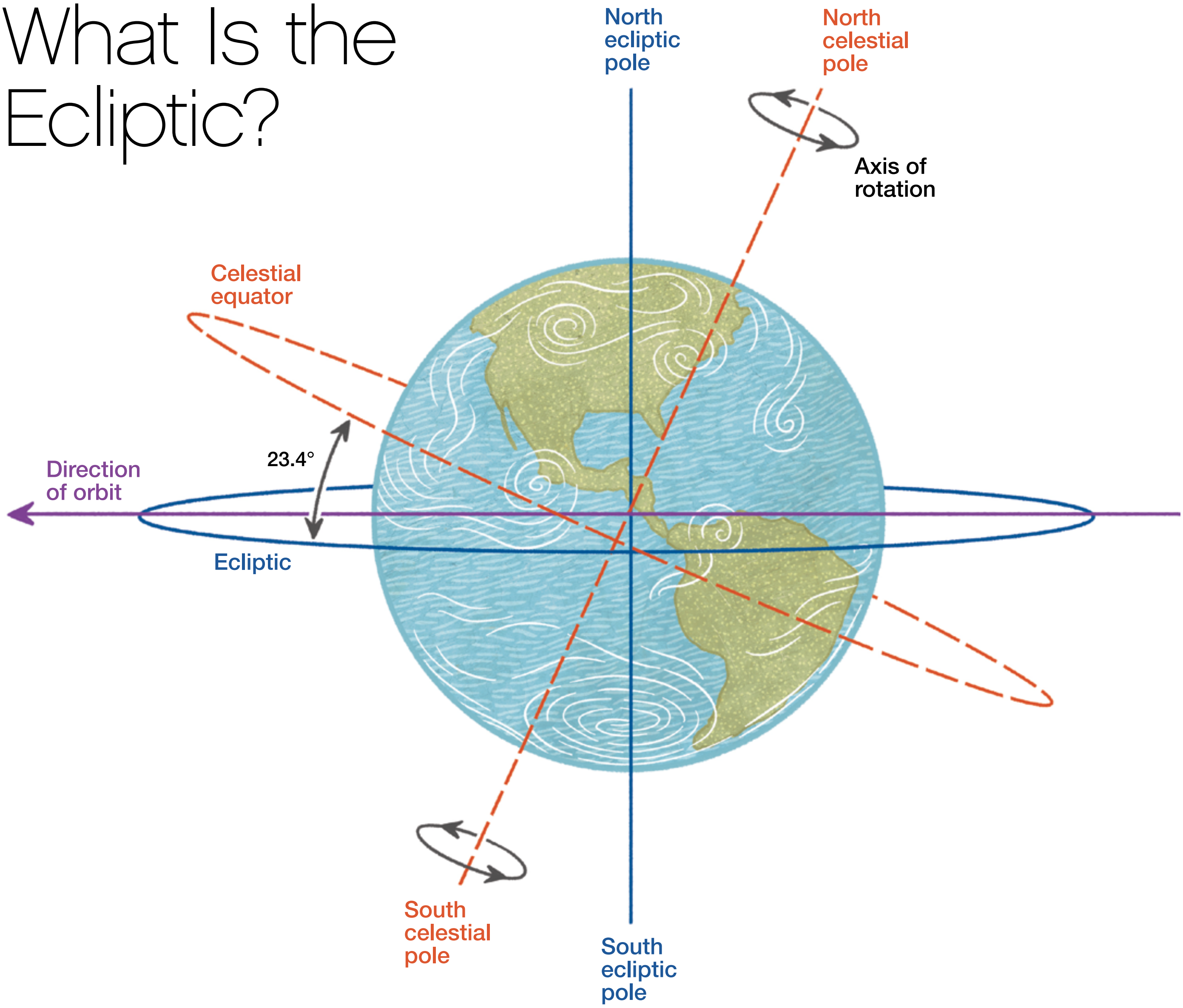
What Is the Ecliptic?



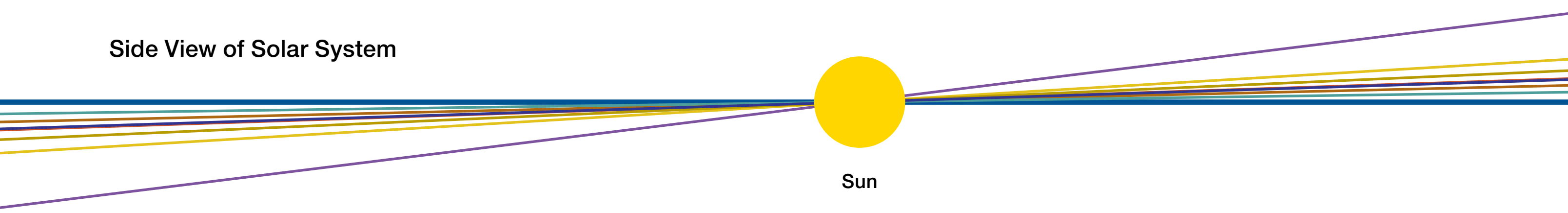
THE ECLIPTIC, SIMPLY PUT, is the plane of Earth's orbit around the Sun. It extends beyond that to include the seven other planets — and, because it's imaginary, actually beyond that into infinity. But for our purposes, picture a flat, round disk with the Sun at the center and all the planets, from Mercury out through Neptune, circling it in roughly the same plane.

I say roughly because the planets don't circle our star on precisely the same orbital plane as Earth (see diagram below). They vary a bit, though only slightly. Uranus varies the least, deviating from the ecliptic by less than a degree. Mercury has the greatest inclination, about 7°. (Pluto's is 17°, but it's officially a dwarf planet so is not included here.) Essentially, all the planets, as well as the asteroid belt between Mars and Jupiter, lie in the same plane.

They do so, astronomers think, because they all coalesced from the

EARTH AND ECLIPTIC: LEAH TISCIONE / S&T; PLANET ORBITS: TERRI DUBÉ / S&T; INCLINATIONS SOURCE: NASA

Side View of Solar System



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same *accretion disk* of debris that formed the Sun about 4½ billion years ago.

So why is this plane called the ecliptic? The word comes from the Greek for "fail to appear," and ancient astronomers named it such because it's the place where eclipses happen. A solar eclipse occurs when the Moon passes between Earth and the Sun; a lunar eclipse happens when Earth slips between Sun and Moon. Both only take place when the Moon is on or near that plane of Earth's orbit around the Sun, at two points in the lunar orbit known as *nodes*. When it's off that plane, its shadow misses Earth, and there's no solar eclipse — or Earth's shadow misses the Moon and there's no lunar eclipse.

The Moon isn't always on the plane, and that's because its orbit is inclined about 5° from the ecliptic (see diagram below right). Twice a month on average, the Moon crosses the ecliptic at either an *ascending* or *descending* node. That's when eclipses can occur.

Against the Stars

While the ecliptic is technically the plane of Earth's orbit around the Sun, it might be easier to think of it as the *apparent* path of the Sun and planets around Earth. That's because our senses tell us, even if it isn't in fact true, that our planet is motionless in space while those other bodies revolve around it.

From our earthbound perspective, the Sun arcs overhead from east to west over the course of a day (because of Earth's 24-hour rotation) and slowly creeps from west to east over the course of a year (because of Earth's 365¼-day annual orbit).

The Sun takes one year to (apparently) complete a circuit of the ecliptic, because that's how long it takes Earth to finish one orbit of our star. Each day in that year, the Sun moves eastward slightly less than 1°, a reflection of how far our planet has progressed in its orbit in that 24-hour period.

The other planets, too, travel along the ecliptic. Using an ephemeris or smartphone sky app will help you locate their positions throughout the year.

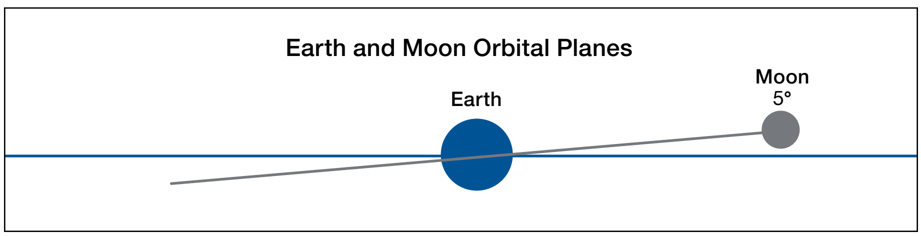
With each passing day, the Sun's position against the background stars changes. Over the course of a year, our star journeys in front of the 12 classic constellations of the ancient zodiac. From January to December, they are Capricornus, Aquarius, Pisces, Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpius, and Sagittarius. (The ecliptic actually crosses the modern boundary of one more constellation — Ophiuchus — making the Serpent Bearer the zodiac's unofficial 13th constellation.)

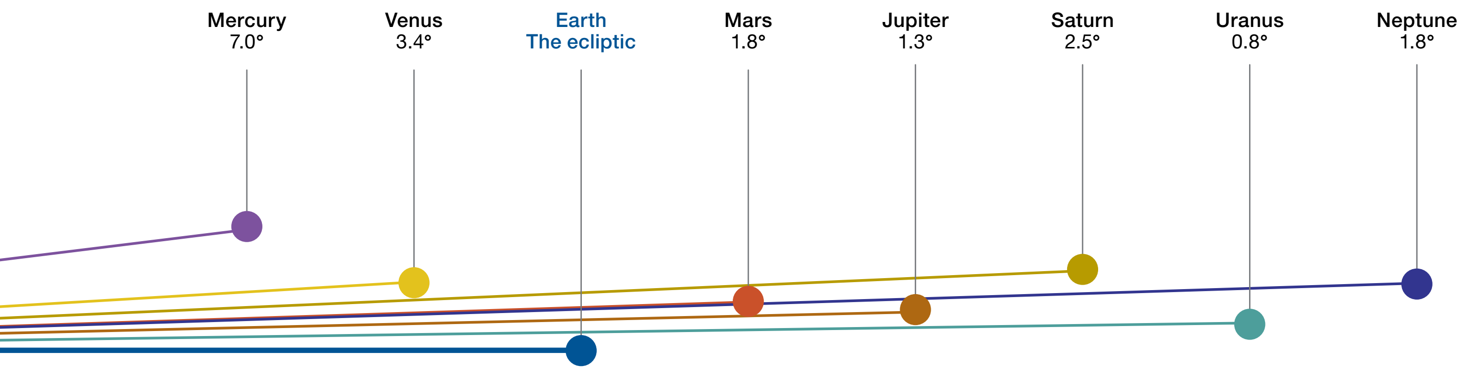
Ecliptic vs Celestial Equator

It's useful to distinguish between the ecliptic and the *celestial equator*. As schoolchildren learn, Earth is tilted on its axis. That is, our planet's rotational axis is not perpendicular to the ecliptic plane but rather inclined to it by about 23.4°. Just as the ecliptic plane extends out in an infinite circle from Earth's orbit around the Sun, the celestial equator extends out in an infinite circle from Earth's equator, which is tilted 23.4° from our planet's orbital plane (see the diagram on the previous page).

This distinction is helpful to keep in mind because most astronomers today use a coordinate system based on so-called equatorial coordinates rather than on ecliptical coordinates to precisely locate stars and other objects in the sky. That coordinate system uses "right ascension (RA)" and "declination (DEC)" to indicate the location of an object on the celestial sphere. ■

▼▶ *Below:* Each planet's line represents its orbit around the Sun. It appears here as a line rather than a circle or oval because we're seeing it edge-on. This allows us to see the degree to which all non-Earth planetary orbits deviate from the ecliptic, or Earth's orbital plane, which appears horizontal below. *Right:* The Moon's orbit inclines from the ecliptic by about 5°.





Orbits not to scale