

## Plato (c. 428 BCE–c. 348 BCE)



Ancient Greek writer, philosopher Plato was a student of Socrates and a teacher of Aristotle. As a philosopher who believed that explanations could be deduced, through reason, Plato believed that the entire cosmos was constructed with precision and that circles and spheres, as the most perfect objects, were the key to understanding the universe. His contribution to ancient astronomy was the idea that the stars, sun, and moon were fixed to concentric crystalline spheres, rotating inside one another. Plato proposed that the stars formed the outermost crystal sphere, followed by the planets, the sun, the moon, and the spherical earth at the center. These rotated and gave rise to the motion of the heavens around the fixed earth. However, records and observations soon showed that this model could not fully explain the complicated movement of the planets, sun, and moon. These move across the sky at varying rates, often appearing to move backwards relative to the sky in a retrograde direction. Plato, ever one to complicate matters, decided that this movement was still circular, but his model needed a slightly more sophisticated explanation.

Estimates of a Perfect Year's length are a few hundred thousand years.

Though some of Plato's ideas concerning the solar system are now known to be incorrect, the Earth does complete one long cycle on timescales comparable to the (non-existent) Perfect Year. Because of the precession of the Earth's spin, the direction along which the Earth's axis of rotation is aligned drifts among the stars, completing one round in about thirty thousand years. This cycle has been named the Platonic year in honor of Plato's revolutionary ideas.

## Eudoxus of Cnidus (408 BC to 355 BC)

- First geocentric model of solar system explaining retrograde motion.
- Retrograde motion explained with multiple concentric spheres.

Eudoxus of Cnidus was an ancient Greek astronomer, mathematician, scholar, and student of Archytas and Plato. All of his works are lost, though some fragments are preserved in Hipparchus' commentary on Aratus's poem on astronomy. Eudoxus traveled and study widely - studying mathematics in Italy with the Pythagoreans, medicine and philosophy in Athens at Plato's newly founded Academy, and astronomy in Egypt. He formed his own successful school in Cyzicus, and eventually went back home to Cnidus where he was given a job in the legislature. He actually made his own observatory in Cnidus.

### Importance to Astronomy

In mathematical astronomy, his fame is due to the introduction of the astronomical globe, and his early contributions to understanding the movement of the planets. Eudoxus was the first person to devise a model that could explain the retrograde motion



of the planets in the sky. (Keep in mind that there was not a great deal of real accurate data regarding the positions of the planets at the time.) Eudoxus was a gifted mathematician and was able to show that using three concentric spheres, one could arrange the spheres in such a way that a planet attached to one of the spheres could be made to travel around the common center, making periodic retrograde motions. Because the spheres are all concentric, this is often called the "homocentric" model of planetary motion.

### ***Eudoxan planetary models***

*In most modern reconstructions of the Eudoxan model, the Moon is assigned three spheres:*

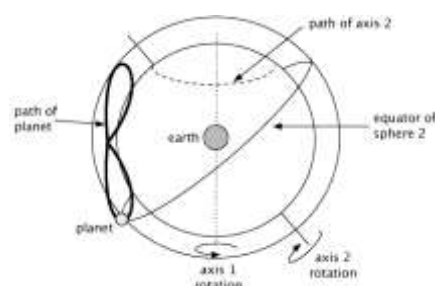
- The outermost rotates westward once in 24 hours, explaining rising and setting.
- The second rotates eastward once in a month, explaining the monthly motion of the Moon through the zodiac
- The third also completes its revolution in a month, but its axis is tilted at a slightly different angle, explaining motion in latitude (deviation from the ecliptic), and the motion of the lunar nodes.

Craters on Mars and the Moon are named in his honor. In ancient Greece, astronomy was a branch of mathematics; astronomers sought to create geometrical models that could

imitate the appearances of celestial motions. Identifying the astronomical work of Eudoxus as a separate category is therefore a modern convenience.

Some of Eudoxus' astronomical texts whose names have survived include:

- Disappearances of the Sun, possibly on eclipses
- Oktaeteris (Ὀκταετηρίς), on an eight-year lunisolar cycle of the calendar-
- Phaenomena (Φαινόμενα) and Entropon (Ἔντροπον), on spherical astronomy, probably based on observations made by Eudoxus in Egypt and Cnidus
- On Speeds, on planetary motions



**This was created by students taking part in the programme "Four Seasons in the Sky"**

