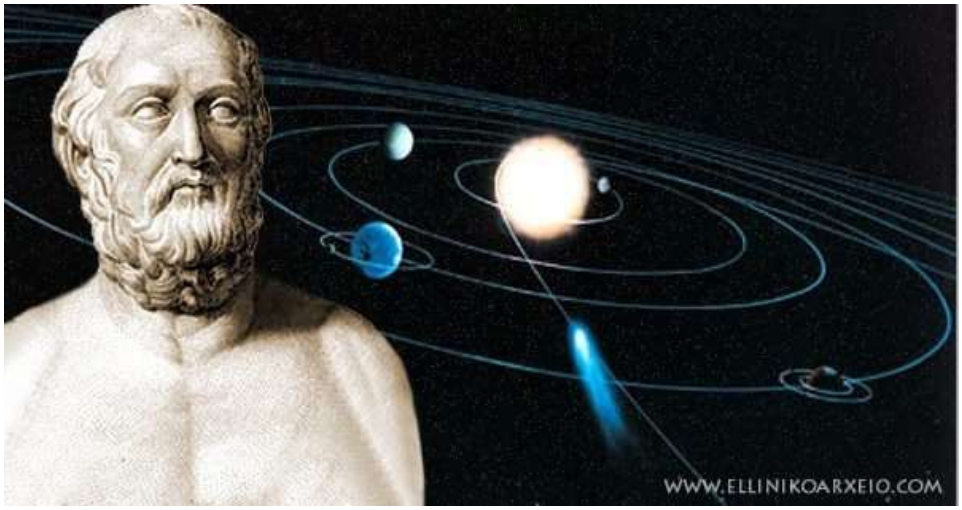
Aristarchus of Samos

Aristarchus of Samos (c. 310 - c. 230 BC) was an ancient Greek mathematician and astronomer from Ionia who came up with a revolutionary astronomical hypothesis. He claimed the Sun, not the Earth, was the fixed centre of the universe, and that the Earth, along with the rest of the planets, revolved around the Sun. He also said that the stars were distant suns that remained unmoved and that the size of the universe was much larger than his contemporaries believed. Also, he determined the relative distance of the sun and moon from the earth and he estimated the relative sizes of sun and moon.



LIFE

Aristarchus was born in Samos island. He probably studied in Alaxandria, Egypt, under Strato of Lampsacus. We know very little about Aristarchus's life, but we know enough to be astounded by his science. We know that he lived at about the same time as two of our other scientific heroes, Archimedes and Eratosthenes he was 20 to 30 years older than them. His greatest work has been lost in the mists of time; we know about it because Archimedes mentions it in *The Sand Reckoner*. His only surviving work is entitled On the Sizes and Distances of the Sun and Moon.

THE WORK

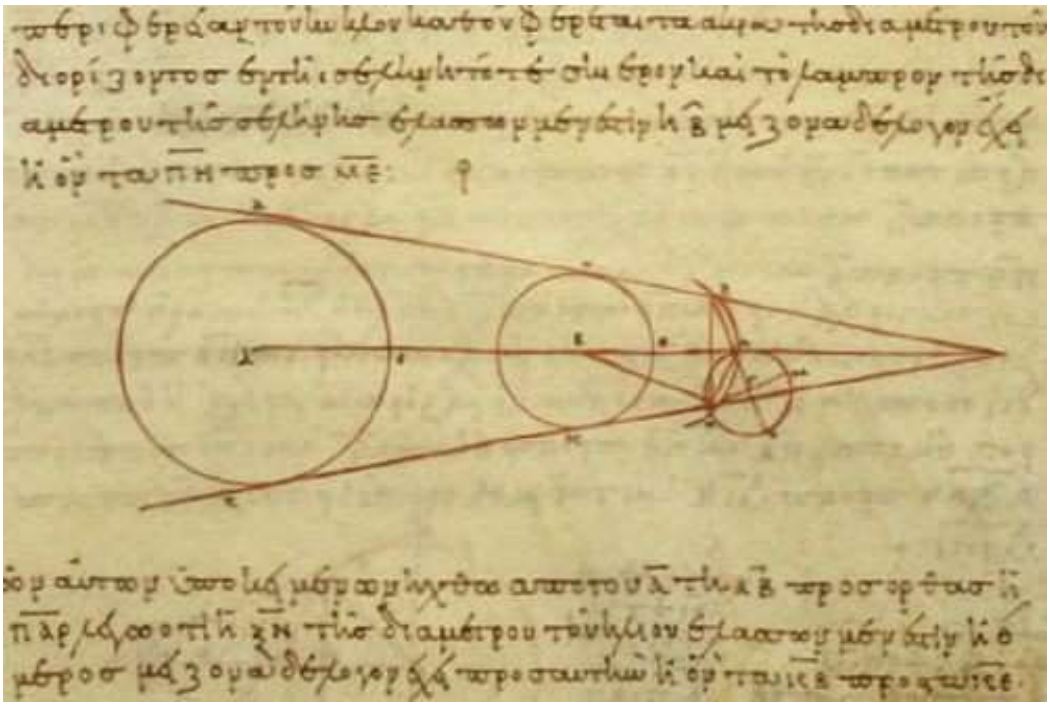
Aristarchus was influenced by Philolaus of Croton, but Aristarchus identified the "central fire" with the sun, and he put the other planets in their correct order of *distance* around the sun.

Aristarchus takes as premises that

- (1) as observed during a lunar eclipse, the diameter of Earth's shadow is twice the diameter of the Moon;
- (2) the Moon and Sun are each 2 degrees in angular diameter; and
- (3) at the time of quarter Moon, the angular distance between the Moon and the Sun is 87 degrees.

Using premise 3, Aristarchus showed that the Sun is between 18 and 20 times farther away from Earth than the Moon is. (The actual ratio is about 390.) Using this result and premises 1 and 2 in a clever geometric construction based on lunar eclipses, he obtained values for the sizes of the Sun and Moon. He found the Moon's diameter to be between 0.32 and 0.40 times the diameter of Earth and the Sun's diameter to be between 6.3 and 7.2 times the diameter of Earth. (The diameters of the Moon and the Sun compared with that of Earth are actually 0.27 and 109, respectively.)

In Aristarchus's day the geometric method was considered more important than numerical measurements. His premise 1 is reasonably accurate. Premise 2 overestimates the Moon's angular diameter by a factor of four, which is puzzling, since this is an easy measurement to make. (In a later publication, Aristarchus gave the angular size of the Moon as half a degree, which is about right, but he apparently did not modify his earlier work.) Premise 3 was probably not based on measurement but rather on an estimate; it is equivalent to assuming that the time from first quarter Moon to third quarter Moon is one day longer



than the time from third quarter to first quarter. The true angle between Sun and Moon at the time of quarter Moon is less than 90 degrees by only 9 minutes of arc—a quantity impossible to measure in antiquity.

Rejection of Aristarchus' View

Some historians have suggested that Aristarchus himself may have abandoned his theory as a result of failing to reconcile it with the supposedly circular movements of the heavenly bodies, since all Greek astronomers took for granted that the orbit of all heavenly bodies had to be circular. Whether Aristarchus himself ended up rejecting his own hypothesis is not totally clear. The only way that Aristarchus' view could stand mathematical analysis was by supposing an elliptical orbit of the Earth, and this supposition was almost a blasphemy to Greek thought. On top of this, this new model expanded the size of the universe far beyond the accepted size, which was also difficult to accept.

Aristarchus planetary model was discarded only to be rediscovered almost two millennia later during the years prior to the rise of modern science that took place during the Renaissance.

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