

Nicolaus Copernicus and Theories of the Solar System

Read the article and answer the questions that follow on the back of this sheet.

"We revolve about the sun like any other planet." —Copernicus, A Commentary on the Theories of the Motions of Heavenly Objects (1514)

Watching the sun travel through the sky each day and seeing the stars and planets glide across the sky each night, Europeans concluded that these heavenly bodies revolved around the earth. As a result, they made the logical conclusion that the earth was the center of the universe and did not move. This view also became part of the teaching of the Catholic Church. Nicolaus Copernicus changed all this.

Born in 1473, Copernicus became a learned man. He was trained in Church law, medicine, and mathematics. His main interest, though, was astronomy. After more than 25 years of observations, he reached a startling conclusion: the earth itself moved and revolved around the sun.

In 1514, Copernicus wrote a pamphlet outlining his ideas and passed it around to friends, but he delayed making it widespread. In the 1530s, his views were presented to Pope Clement VII, who had no objection to this new theory. Finally, a former student of Copernicus's persuaded him to publish his ideas. As a result, *On the Revolutions of Heavenly Bodies* became available in 1543, the year its author died.

Copernicus argued that the earth moved in three ways. It spun on its axis every day, it rotated around the sun over the course of a year, and it moved up and down on its axis to cause the change of seasons. His new system put the planets in their proper order: sun, Mercury, Venus, Earth and moon, Mars, Jupiter, and Saturn.

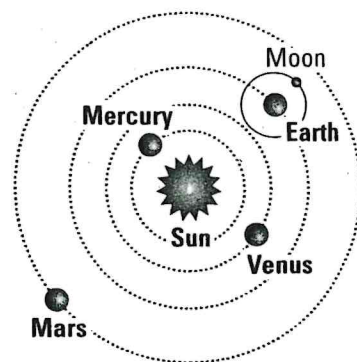
Copernicus's bold idea solved several problems. The order of Mercury and Venus had always been disputed, and his new system settled that. His idea also gave a simpler explanation of the motion of the planets. Because the planets sometimes seem to stop and move backward, the old theory had required a complex structure of circles within circles. Copernicus reasoned that these movements occurred because the earth also orbits the sun. Furthermore, the earth and the other planets orbit at different speeds. His view was not perfect, though. He believed the planets moved in circles around the sun, but it was later proven that they

move in ellipses, or ovals.

Copernicus's theory raised two questions. If the earth moves, why do the stars not appear in different positions? The stars, he said, were so far away that their changes in position could not be noticed. In other words, he suggested that the universe was vast. Copernicus was right, although his argument could not be proven for three centuries. Only then did scientists have telescopes powerful enough to detect that the stars did indeed move.

The second question asked why objects in the air tend to fall to the ground. When the universe was seen as moving around the earth, it was logical to think that objects would fall to the center of the universe. Now that the earth moved, it was no longer the center. However, Copernicus believed that an object tended to fall to the center of its home. Thus, articles on Earth would be pulled to Earth, and those on the moon would be pulled to the moon. He suggested the basics of gravity about 100 years before Isaac Newton.

Copernicus's views did not cause much of a stir at first. Although his idea challenged Catholic teaching about the universe, the Church did not object to the new theory. However, Martin Luther and John Calvin, leaders of the Reformation, both objected strongly. Calvin asked, "Who will venture to place the authority of Copernicus above that of the Holy Spirit?" Over time, though, Catholics objected as well. By 1616, the Church officially called his idea false. The work of later astronomers, however, showed that Copernicus drew an accurate picture of the solar system.



COPERNICUS

In the second century A.D., Claudius Ptolemy, an astronomer who lived in Egypt, claimed that the sun, stars, and other planets revolved around the earth. These ideas were unchallenged nearly 1,300 years until Nicolaus Copernicus, a Polish astronomer, discovered his revolutionary theory about the sun.

Ptolemy had believed in his geocentric or earth-centered view for several reasons. First, because of gravity all objects were attracted to the earth, which suggested to him that the earth must be the center. Second, he thought that the earth did not move.

He showed how an object is thrown in the air and falls in practically the same place. If the earth moved, he theorized, that object should fall in a different place. Even today, these arguments would be difficult to disprove by observation. As a result, Ptolemy's views remained undisputed for centuries.

During the 1500s, Copernicus did not accept the Ptolemaic view. He became convinced that a different explanation of the solar system existed. After 25 years of observation, Copernicus concluded that the sun was the center of the solar system and that the planets, including the earth, revolved around the sun in "perfect divine circles."

Copernicus's conclusion at first went practically unnoticed. However, in the 1600s a German astronomer, Johannes Kepler, supported Copernicus's belief with mathematics. He also proved that the planets travel in ellipses (ovals), not perfect circles, around the sun. Both Copernicus's and Kepler's breakthroughs laid the foundation of modern day knowledge of the solar system.

1. According to Copernicus, what were the ways in which the earth moved?
2. What was Copernicus's explanation of why objects in the air fell to the ground?
3. What object is farthest from the center in systems of Ptolemy, Copernicus and Kepler?
4. What object is closest to the earth in all three systems?
5. What is the main difference between Kepler's system and the Copernican system?

