The Solar System: A Changing Model

Have you ever gazed up at the sky on a starry night? If you watch for several hours, the stars seem to move across the sky. Now think about what you see every day. During the day, the sun appears to move across the sky, too. Here on Earth, it seems as if the Earth is stationary and that the sun, moon, and the stars are moving. But is that really true? Centuries ago, before there were space shuttles or tools like telescopes, there was no easy way to find out.

Greek Observations

When the ancient Greeks watched the sky, they noticed that although the stars seemed to move, they stayed in the same position relative to one another. These patterns of stars, called constellations, kept the same shape from night to night and year to year. The Greeks also noticed that several points of light seemed to wander slowly among the stars. They called these object “planets”, from the Greek word meaning “wanderers”. Most Greek astronomers believed the universe to be perfect, with Earth at its center. Since “Geo” is the Greek word for “Earth”, an Earth-centered model of the universe is known as a “geo-centric” system. In a geocentric system, the Earth is at the center of the universe, with all of the planets, stars, and the moon revolving around the Earth in perfect circles.

Ptolemy’s Model

About A.D. 140, the Greek astronomer Ptolemy further developed the geocentric model. Like the earlier Greeks, he thought the Earth was at the center of a system of planets and stars. Ptolemy’s model added something called “epicycles” to the movement of the planets. In an epicycle, the planets moved in smaller circles as they revolved around the Earth. Even though his model was wrong, it allowed astronomers to predict the motions of objects in the sky fairly accurately. It was widely accepted for over 1000 years.

The Copernican Revolution

There were problems with the geocentric system. While it did allow astronomers to predict the movement of objects with a good amount of accuracy, errors were common. In 1543, the polish astronomer Nicolaus Copernicus developed the heliocentric model of the universe**.** In a heliocentric system, Earth and the other planets revolve around the sun. He found that this system was more accurate for predicting the motions of objects in the heavens, but because he was afraid that his ideas would not be accepted, they were not published until he was on his deathbed. Once they were published, most people did not accept the idea that the Earth was moving. One reason for their disbelief involved the moon: If the Earth was moving, why did the moon move with it? Copernicus could not answer that question.

Brahe and Kepler

In the late 1500s, the Danish astronomer Tycho Brahe spent over 20 years carefully observing and recording the positions of the planets. When he died in 1601, his assistant, Johannes Kepler, went to work analyzing the observations. After years of work, Kepler found that the orbit of each planet is an ellipse, which is a slightly flattened circle. He published an article that used data to disprove the long-held belief that the planets move in perfect circles. Today, we call his approach “The Scientific Method”.

Galileo

Around the same time that Kepler was working on his theories, Galileo Galilei, an Italian astronomer, mathematician, physicist, and philosopher, used the newly invented telescope to make discoveries that supported the heliocentric model. In 1610, Galileo discovered four moons revolving around the planet Jupiter. The motions of these moons proved that not everything in the sky revolves around Earth. While he could not explain *why* moons and planets moved through space together, he was able to show such movement *was* occurring. This was proof that people could see for themselves, and it convinced Galileo that the heliocentric theory proposed by Copernicus was correct.

Newton

Sir Isaac Newton was the scientist who finally explained why moons and planets can move through space together. In 1664, after schools in England were closed for two years due to the Great Plague, Newton returned home but continued to study on his own. One day he saw an apple fall from a tree, leading him to wonder why it fell straight down and not at an angle. As a result, he developed three basic laws of motion as well as what has become known as the Law of Universal Gravitation. His work helped explain not only how the moon revolves around Earth and the moons of Jupiter revolve around it but also explained nearly every other motion in the universe, including how the planets are kept in orbit by the pull of the sun’s gravity, why planetary orbits are elliptical, and how comets revolve in elliptical orbits around the sun. As a result, most people began to accept the heliocentric model as being correct.

Modern Discoveries

Since Newton’s time, scientists have continued to add to our understanding of space and the Earth’s place in the universe. For example, the physicist Albert Einstein developed a theory that explained what gravity was for the first time; he described it as a dip in the space/time fabric that makes up the universe. As technology improved, other scientists discovered new planets, galaxies, black holes, dark matter, and much more. As time moves on, one has to wonder, what we will learn next?