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The Exploration of Gravity: Ancient Scholars' Understanding of the Force That Shapes Our Universe

Josh Parks*

Department of Physics and Astronomy, North-western University, Evanston, USA

Opinion Article

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***For Correspondence:**
Josh Parks, Department of Physics and Astronomy, North-western University, Evanston, USA
E-mail: Josh12@gmail.edu

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ABOUT THE STUDY

The nature and mechanism of gravity was explored by a wide range of ancient scholars. In Greece, Aristotle believed that objects fell towards the Earth because the Earth was the centre of the Universe and attracted all of the mass in the Universe towards it. He also thought that the speed of a falling object should increase with its weight, a conclusion which was later shown to be false. While Aristotle's view was widely accepted throughout Ancient Greece, there were other thinkers such as Plutarch who correctly predicted that the attraction of gravity was not unique to the Earth.

Although he didn't understand gravity as a force, the ancient Greek philosopher Archimedes discovered the center of gravity of a triangle. He also postulated that if two equal weights did not have the same center of gravity, the center of gravity of the two weights together would be in the middle of the line that joins their centers of gravity. Two centuries later, the Roman engineer and architect Vitruvius contended in his De architectura that gravity is not dependent on a substance's weight but rather on its "nature". In the 6th century CE, the Byzantine Alexandrian scholar John Philoponus proposed the theory of impetus, which modifies Aristotle's theory that "continuation of motion depends on continued action of a force" by incorporating a causative force which diminishes over time.

In India in the seventh century CE, Brahmagupta proposed the idea that gravity is an attractive force which draws objects to the Earth and used the term gurutvākarṣaṇ to describe it.

In the ancient Middle East, gravity was a topic of fierce debate. The Persian intellectual Al-Biruni believed that the force of gravity was not unique to the Earth, and he correctly assumed that other heavenly bodies should exert a

gravitational attraction as well. In contrast, Al-Khazini held the same position as Aristotle that all matter in the Universe is attracted to the center of the Earth. The Leaning Tower of Pisa, where according to legend Galileo performed an experiment about the speed of falling objects

In the mid-16th century, various European scientists experimentally disproved the Aristotelian notion that heavier objects fall at a faster rate. In particular, the Spanish Dominican priest Domingo de Soto wrote in 1551 that bodies in free fall uniformly accelerate. De Soto may have been influenced by earlier experiments conducted by other Dominican priests in Italy, including those by Benedetto Varchi, Francesco Beato, Luca Ghini, and Giovan Bellaso which contradicted Aristotle's teachings on the fall of bodies. The mid-16th century Italian physicist Giambattista Benedetti published papers claiming that, due to specific gravity, objects made of the same material but with different masses would fall at the same speed. With the 1586 Delft tower experiment, the Flemish physicist Simon Stevin observed that two cannonballs of differing sizes and weights fell at the same rate when dropped from a tower. Finally, in the late 16th century, Galileo Galilei's careful measurements of balls rolling down inclines allowed him to firmly establish that gravitational acceleration is the same for all objects. Galileo postulated that air resistance is the reason that objects with a low density and high surface area fall more slowly in an atmosphere.

In 1604, Galileo correctly hypothesized that the distance of a falling object is proportional to the square of the time elapsed. This was later confirmed by Italian scientists Jesuits Grimaldi and Riccioli between 1640 and 1650. They also calculated the magnitude of the Earth's gravity by measuring the oscillations of a pendulum.