

## THE PYTHAGOREAN THEOREM: ANCIENT ROOTS AND MODERN SIGNIFICANCE

*Mirzakimova Dilnavoz Rashid qizi*

*University of chemistry in Tashkent*

**Abstract:** This article explores the historical origins and development of the Pythagorean Theorem, its early conceptions, and Pythagoras's contribution to this theorem. It also discusses the theorem's importance in mathematics and beyond, its applications, and its role in modern education.

**Keywords:** Pythagorean Theorem, Pythagoras, right-angled triangle, Babylonian mathematics, Egyptian mathematics, geometry, history of mathematics.

**Introduction.** The Pythagorean Theorem is one of the fundamental concepts of geometry, expressing the relationship between the sides of a right-angled triangle. Although the theorem is commonly associated with Pythagoras, evidence of its use has been found in various cultures prior to Pythagoras. The article examines the theorem's origins, development, significance, and role in modern education.

**Main Body.** 1. Pre-Pythagorean Era: Evidence of Practical Knowledge The Pythagorean Theorem, while named after the Greek mathematician Pythagoras, wasn't a completely new discovery. Evidence suggests that various civilizations before Pythagoras possessed practical knowledge of the relationship between the sides of a right-angled triangle.

- Babylonians (1800-1600 BCE): The Babylonian clay tablet known as "Plimpton 322" is a crucial piece of evidence. It contains a list of Pythagorean triples – sets of three positive integers (a, b, c) that satisfy the equation  $a^2 + b^2 = c^2$ . This suggests that the Babylonians were aware of the fundamental relationship between the sides of right triangles and may have used this knowledge in construction, surveying, and land division. Their approach was likely empirical, derived from practical experience and observation, rather than based on formal mathematical proofs.

- Egyptians (3000-300 BCE): Ancient Egyptian "rope stretchers" (harpedonaptai) used ropes with knots tied at specific intervals (e.g., 3, 4, and 5 units) to create right angles for constructing buildings and laying out land boundaries. Using a 3-4-5 triangle ensures a perfect right angle. While they might not have explicitly formulated the theorem in abstract terms, their method clearly demonstrates a practical understanding of the principle underlying the Pythagorean Theorem. The Egyptians' expertise in geometry was essential for constructing monumental structures like the pyramids.

- Chinese (200 BCE): The ancient Chinese mathematical text, "Zhoubi Suanjing", contains a diagram and discussion related to the Pythagorean Theorem, known in China as the "Gougu Theorem". This text illustrates the relationship between the sides of a right triangle and provides geometrical arguments to support it. It shows that the Chinese also recognized and utilized this relationship, likely for surveying and astronomical calculations.

## 2. Pythagoras and the Pythagorean School: Formalizing Knowledge

Pythagoras (c. 570 – c. 495 BCE), a Greek philosopher and mathematician, is credited with providing a formal proof of the theorem, solidifying its place in mathematical theory. He founded a school of thought, known as the Pythagoreans, which emphasized the importance of mathematics and its role in understanding the natural world.

- Theoretical Justification: While Pythagoras likely didn't "discover" the theorem in the sense of being the first to recognize the relationship, his contribution lay in providing a theoretical framework and proof for it. The Pythagoreans sought to elevate mathematics beyond mere practical application, establishing it as a deductive science based on rigorous logical reasoning.

- Integration into the Mathematical System: The Pythagoreans were fascinated by the connection between numbers and geometry, believing that numbers were the fundamental building blocks of the universe. They integrated the Pythagorean Theorem into their broader philosophical and mathematical system, exploring its implications for other areas of knowledge.

- Dissemination and Popularization: The Pythagorean school played a significant role in disseminating and popularizing the theorem throughout the Greek world and beyond. Their commitment to education and scholarship helped to ensure that the Pythagorean Theorem became a cornerstone of mathematical knowledge.

## 3. Statement and Formula of the Theorem: A Concise Expression

The Pythagorean Theorem states that in any right-angled triangle, the area of the square whose side is the hypotenuse (the side opposite the right angle) is equal to the sum of the areas of the squares whose sides are the two legs (the two sides that meet at the right angle).

- Formulaic Representation: This relationship is succinctly expressed by the formula:  $a^2 + b^2 = c^2$ , where 'a' and 'b' represent the lengths of

**Conclusion.** The Pythagorean Theorem stands as a cornerstone of mathematical knowledge, bridging the gap between ancient practical know-how and modern theoretical applications. While its origins can be traced back to pre-Pythagorean civilizations like the Babylonians, Egyptians, and Chinese, it was Pythagoras and his school who formalized the theorem, providing a rigorous proof and integrating it into

the broader framework of Greek mathematics. This achievement transformed the theorem from a practical tool into a fundamental principle of geometry.

The beauty of the Pythagorean Theorem lies not only in its simple statement ( $a^2 + b^2 = c^2$ ) but also in its far-reaching implications. Its multiple proofs demonstrate its inherent validity, while its wide-ranging applications across geodesy, construction, navigation, and computer graphics underscore its practical utility. It is a testament to the power of mathematics to provide a concise and elegant way to understand and model the world around us. Moreover, the Pythagorean Theorem continues to play a vital role in modern education. It serves as an entry point into the world of deductive reasoning, allowing students to develop logical thinking skills and appreciate the beauty of mathematical proof. By connecting abstract concepts to real-world applications, the theorem helps to make mathematics more accessible and relevant to learners of all ages.

In conclusion, the Pythagorean Theorem is more than just a mathematical formula; it is a symbol of the enduring power of human curiosity and ingenuity. From its humble beginnings in practical applications to its elevated status as a foundational principle, the theorem's journey through history reflects the evolution of mathematical thought and its profound impact on our understanding of the universe. As long as humans continue to explore and seek to understand the world around them, the Pythagorean Theorem will undoubtedly remain a fundamental tool and a source of inspiration.

#### References:

- Berggren, J. L., Borwein, J., & Zhai, L. (2010). *Pi: A Source Book* (2nd ed.). Springer. (While this is about Pi, it often contains contextual info on related mathematical history)
- Boyer, C. B., & Merzbach, U. C. (2011). *A History of Mathematics* (3rd ed.). John Wiley & Sons. (A classic text for the history of mathematics)
- Maor, E. (2007). *The Pythagorean Theorem: A 4,000-Year History*. Princeton University Press. (A comprehensive look at the theorem's history)
- Joyce, D. E. (1996). *Euclid's Elements*. Retrieved from <http://aleph0.clarku.edu/~djoyce/java/elements/elements.html> (Access to Euclid's original work)
- O'Connor, J. J., & Robertson, E. F. (2000). *Pythagoras of Samos*. Retrieved from <https://mathshistory.st-andrews.ac.uk/Biographies/Pythagoras/> (A good source for biographical information)