

PYTHAGORAS

The details of the life of **Pythagoras** (c. 569 BCE – 500 BCE) are sketchy and the accuracy of the accounts provided by later commentators centuries after his death are doubtful. What is known is that he was born at Samos on the western coast of what is now Turkey, the son of a prominent citizen, Mnesarchus. He studied with Pherecydes of Syros and later with Anaximander. Thereafter he supposedly went to Egypt, where he spent several years studying at Thebes and Memphis. He returned to Samos to set up a school, but it was not successful.



About 529 BCE he moved to Sicily, then on to Tarentum, and at last to Croton in Southern Italy, where he developed most of his important ideas and theories. At Croton, the schools he opened were crowded with people from all walks of life, and although law forbade it, even women attended.

From the vast numbers of his students, Pythagoras chose especially talented and like-thinking disciples who earned the name Pythagoreans. The latter formed a society, in which men and women were treated equally. All property was held in common and members were bounded by an oath not to reveal the teaching or secrets of the school. Some of the Pythagorean rules seem strange, especially those that were clearly taboos, such as the following:

1. To eat no beans.
2. Not to pick up what has fallen.
3. Not to touch a white cock.
4. Not to break bread.
5. Not to step over a crowbar.
6. Not to stir a fire with iron.

7. Not to walk on highways.
8. Not to let swallows share one's roof.
9. Not to look into a mirror beside a light.

Tradition has it that Pythagoras published no books, nor did he wish to spread the word of the society's philosophical and mathematical findings to the general public. The wisdom of the Pythagoreans was held in common and kept from the outside world. At least for a time, even after Pythagoras' death, any discovery by members of the society was credited to its founder. Legend has it that Hippasus was drowned for violating his oath when he publicly took credit for adding the dodecahedron to the number of regular solids enumerated by Pythagoras. Pythagoras was primarily a moral reformer and philosopher, but his system of morality and philosophy was built on a mathematical foundation. He gave the basis of his philosophy as follows:

“There are three kinds of men and three sorts of people that attend the Olympic Games. The lowest class is made up of those who come to buy and sell, the next above them are those who compete. Best of all, however, are those who come simply to look on. The greatest purification of all is, therefore, disinterested science, and it is the man who devotes himself to that, the true philosopher, who has most effectually released himself from the wheel of birth.”

Pythagoreans partitioned mathematics into four divisions: numbers absolute (arithmetic, what is now known as number theory), numbers applied (music), magnitudes at rest (geometry), and magnitudes in motion (astronomy). For centuries this *quadrivium* constituted the necessary and sufficient course of study for a liberal education. Though it is impossible to separate precisely the discoveries of Pythagoras and those of his followers, Proclus' writings inform us that it was Pythagoras who gave geometry its rigorous character of deduction. There is reason to believe that Pythagoras was the first to arrange the

propositions of geometry in a logical sequence. He probably knew and taught the ideas contained in the first two books of Euclid's *Elements*. Pythagoras also made contributions in the theory of numbers. He was mostly concerned with problems dealing with polygonal numbers, ratio and proportion, factoring numbers, and numerical series. Most of these arithmetical pursuits were treated geometrically.

The strict discipline and secrecy of the Pythagorean order gave the society a temporary supremacy in the Achaean cities, but it also brought them many enemies. It has been asserted, that instigated by political rivals, a mob attacked and murdered Pythagoras and many of his followers. Although there seems to be some evidence that many Pythagoreans died in a fire set by their enemies, this appears to have happened after Pythagoras retired to Metapontum and after his death, possibly by his own hand. Pythagoras' teaching was carried on by Epicharmus and Hippasus, and eventually by Philolaus, Archippus, and Lysis. The society was still thriving a century after Pythagoras' death, with Archytas heading the school.

Pythagoras made important discoveries in musical theory and musical progressions. He observed that when a blacksmith struck his anvil, different notes were produced, according to the weight of the hammer. From this he established the relationship between music and number. He taught that each of the seven planets produced a particular note by its orbit according to its distance from the Earth, which is at the center of the universe. This is what is commonly called the "Music of the Spheres," sounds so exquisite and rarified that ordinary ears can't hear the sounds produced. Pythagoras' influence, which found an important expression in the visual art and music of the renaissance and baroque periods, is all the more remarkable because he did not leave any original writings. Pythagoras apparently preferred oral instruction to the dissemination of his ideas by writing. Later, in the Alexandrian times, forgeries ascribed to Pythagoras and the early Pythagoreans appeared. Thus, the early history of Pythagorean philosophy is conjectural, with all that is known of his teachings coming down to us from later

generations of philosophers and historiographers.

The theorem named for Pythagoras was most certainly known to the Egyptians and perhaps other early civilizations, but probably only in special cases that were used in surveying and building. It was Pythagoras and the Pythagoreans who gave a formal proof of the proposition, which may be stated as follows: “The square of the hypotenuse of a right triangle is equal to the sum of the squares of the remaining two sides.” This is probably the best-known mathematical theorem of all time. Even those who do not understand it or its significance or can even correctly state it have heard of it. In the 1939 film *The Wizard of Oz*, the scarecrow risks everything so that the wizard will give him a brain. When the wizard proves to be a phony, the scarecrow is crushed, but the old con man has a trick or two in his bag. He tells the scarecrow that what he needs instead of a brain is a diploma, and forthwith presents the straw-filled man with one. Immediately the scarecrow proves his newfound brilliance by reciting the Pythagorean Theorem – unfortunately incorrectly, but few outside mathematical circles noticed. There are many different proofs of the Pythagorean Theorem, including an original one by James A. Garfield, the 20th President of the United States.

Quotation of the Day: “The so-called Pythagoreans, who were the first to take up mathematics, not only advanced the subject, but saturated with it, they fancied that the principles of mathematics were the principles of all things.” – Aristotle