PYTHAGORAS *(pi-THAG-uh-rus)* **of Samos** (*c.* 560–*c.* 480 B.C.) was a Greek philosopher and religious leader, responsible for important developments in the history of mathematics, astronomy, and the theory of music. Pythagoras is most famous for the theorem on right triangles that bears his name.

The Teacher Who Paid His Student

"Psst! Young man! Over here!"

The ragged Greek boy stopped in his tracks. Had he really heard someone calling him from behind that vegetable cart?

"Here! Here I am! Come here. I have an offer for you."

The boy, whose name was Philocrates, bent over to look around the wagon. The eyes he saw peering back at him looked a bit wild, but kind.

"What do you want with me?" answered Philocrates. "Surely you can see that I have no money to buy your wares! I'm just a poor street boy, trying to make a living doing odd jobs for anyone who will hire me."

"I have no wares to sell, except the truth," the stranger said. "Wouldn't you like to learn it?"

Philocrates scratched his head. He had met some unusual people, but this fellow seemed really different. The man's eyes

parkled, and his manner seemed friendly enough. But truth? How could truth fill one's stomach?

"Sorry, friend," he replied. "I have to keep working the streets so that my mother and sisters and I can eat each day. Perhaps you can sell your truth to someone more wealthy than I."

He picked up his roughly woven sack of tools and waved a quick farewell.

"Wait! Please wait," the stranger called. "Let me introduce myself. My name is Pythagoras and I was born here on the island of Samos. But I have traveled to Miletus and Egypt and was even captured and taken to Babylon for seven years. The things I have learned in these travels—oh, my son, you would be thrilled to learn them!"

"I'm sure I would, sir, but you don't understand my problem. I have no money, so I must work. It's that simple."

"All right," Pythagoras offered. "I'll make you a deal. If you will let me teach you, I will pay you what you would normally earn at your other work." He paused to let his unusual proposition sink in. "Well, what do you say? Shall we start tomorrow morning? You can meet me here by this bench."

Something drew Philocrates towards this odd teacher, but his practical nature made him resist. Finally he decided he would give it a try. If the stranger didn't really have any money to pay him for tutoring student, he could always quit and go back to his odd jobs. What did he have to lose?

"All right. We'll start tomorrow. But remember, I need daily wages."

The next day the strange pair began their first lesson in the alley where they had met, amidst the cries of merchants and the min-

gled smells of fish, freshly baked honey cakes, and sweating donkeys carrying goods to sell. While the townspeople shopped and gossiped, Pythagoras and his student squatted in the dirt. The eager teacher drew shapes and figures on the ground. To Philocrates, it was all new but intriguing. And, just as he promised, at the end of the day Pythagoras paid.

Day after day it was the same. Each time Philocrates learned a new lesson Pythagoras paid him three oboli, about a penny. Soon he was making far more money than he could have made doing errands and odd jobs. He was an excellent student and quickly built up quite a savings account.

Pythagoras loved the arrangement, too. It was exhilarating to have an eager young mind absorb his ideas. Unfortunately, Philocrates learned so quickly and well that Pythagoras was soon out of money.

"I'm sorry to tell you this, Philocrates, but today will be our last lesson. I have no more money to pay your wages, so you will have to find other ways to support yourself."

"But Pythagoras, you can't quit teaching me now," the boy protested. "I'm just starting to understand arithmetic and you were going to teach me astronomy and geometry, too."

"I'm sorry, young man, but I see no other choice."

Philocrates hung his head and thought. In a moment he came up with an idea.

"I know! You have been paying me to learn; now I will pay you to teach."

So for the next several months the two continued to meet, but this time the student paid the teacher. By the time the lessons were completed, Pythagoras had become an experienced teacher, and

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Philocrates had gained an excellent education!

Pythagoras's first "school" with Philocrates may have had only one student. But several years later he founded a real school at Croton, a Greek colony in southern Italy. This school became so influential it changed even the way people thought about knowledge. During his many travels, Pythagoras had gained quite a reputation. Some people even thought he was divine, or the son of their god Apollo. When he called together a group of wealthy scholars to form a school, no wonder many responded enthusiastically.

The students in Pythagoras's school were all adults. He divided them into two grades depending on their knowledge. The first grade was called the *acoustici*, or the listeners. They were invited to listen to Pythagoras lecture but were not allowed to see him—they had not yet proven themselves worthy. He stood behind a curtain, where only the second grade, the *mathematici*, could see him.

After three years of listening to their teacher's voice, the *acoustici* were admitted into the inner circle of learners. Seeing Pythagoras must have been worth waiting for. He had a flair for the dramatic and dressed like a stage performer. While the students waited for Pythagoras's entrance, musicians played popular music. Finally the curtain was drawn back and Pythagoras, stately in his white robe, appeared before the learners. His feet were strapped with gold sandals, and his head was crowned with a golden wreath. No wonder people suspected him of having gods for ancestors.

Pythagoras worked most of his problems in the sand. His classroom always had a good supply of sand on the floor, and his

attendants stood by with a selection of differently-colored sand in containers. When Pythagoras wanted to show one part of a geometric shape, for instance, the attendants would fill that part with blue or green sand so that students could see it more easily.

Pythagoras gave lectures on "mathemata," which in his language meant studies of all kinds. Because Pythagoras emphasized arithmetic and geometry, the word came to mean mathematics as we know it today. He also taught astronomy and music, but he believed that everything in the universe depended on numbers. Pythagoras and his followers chose the motto "All is Number." They were convinced that if they understood numbers, they would hold the key to life itself.

Because Pythagoras and his students believed that knowledge was powerful, they wanted to control it. They became secretive about what they knew. The school was a "Secret Brotherhood," and everyone who joined had to promise never to tell outsiders about their discoveries. If anyone did tell, the results could be disastrous for him or her.

"Have you heard about Hippasus?"

The question hummed throughout Croton.

"Yes. Isn't it horrible? Just because he broke the code of the Brotherhood. It doesn't seem fair."

"But the gods are always fair. He knew better than to tell about the discovery of irrational numbers."

"He must have known he would be expelled from Pythagoras's Secret Brotherhood. Do you suppose he thought that would be his only punishment?"

"I don't know. But there's something suspicious about the way he drowned, falling off that boat in such calm weather."

People were always talking about the Secret Brotherhood, also known as the Pythagorean School. Schools of adults were common, but this group had some unusual ideas. They became a kind of religious order with their own set of initiations and rites.

The 300 members of the Brotherhood shared whatever they had with each other. They were unusually kind to animals because they believed that human souls might come back after death for another life in an animal body. They were vegetarian and would not even wear wool because it came from sheep. If they could choose, they always took a low road instead of a high road, to show their humility. They would not poke a fire with iron because fire was the symbol of truth. They would not touch white roosters

or eat beans, because both roosters and beans symbolized perfection. On their clothing they each wore their sacred symbol—the pentagram, a five-pointed star.

In one way the Brotherhood was unusually progressive. During Pythagoras's day, women were forbidden to attend public meetings of any kind, but Pythagoras welcomed them to his school. Of course, they had to prove themselves just as the male students did. Nevertheless, at one time the select *mathematici* class included at least 28 women.

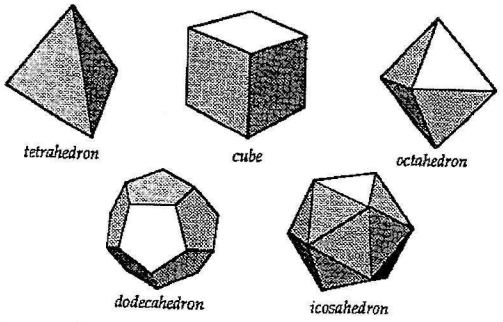
Because the Pythagoreans shared everything, it is hard to separate Pythagoras's discoveries from those of his followers. Much of modern mathematics is based on their work. Like Thales before him, Pythagoras insisted on mathematical proof. It was not enough to say that two angles were equal because they looked equal. One had to prove it. Pythagoras is most famous for providing the first logical proof of this theorem:

> *In a right triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.*

The common formula for this theorem, if c is the length of the hypotenuse and a and b the lengths of the other two sides, is

$$a^2 + b^2 = c^2.$$

The Pythagoreans were also the first to divide all numbers into even and odd. They learned to construct the five regular solids, the only solids whose faces are all the same shape and size: the tetrahedron (four sides), the cube (six sides), the octahedron (eight sides), the dodecahedron (twelve sides), and the icosahedron (twenty sides). The first two had been known from ancient times, but the others had never been constructed.



The Pythagoreans learned to construct the five regular solids.

Great thinkers are not always appreciated in their own times. The Pythagoreans were often misunderstood. Many of their ideas and practices seemed strange to their countrymen. Some townspeople suspected the Pythagoreans would try to take over the local government. They blamed the Pythagoreans, who were quite wealthy, for trying to keep them poor. One day in about 500 B.C., an angry mob set the Pythagoreans' meetinghouse on fire during a lecture. Only a few members survived, and Pythagoras himself was killed. Some say that his students formed a human bridge over the fire so that he could escape—but when he reached a field of beans, he surrendered to his enemies rather than trample the sacred bean plants.

By this time chapters of the Brotherhood had spread throughout Sicily and southern Italy. For many years men and women continued to discuss the ideas Pythagoras had introduced. Today, all students of geometry and higher mathematics work with concepts

that Pythagoras discovered. The search for knowledge and truth continued long after Pythagoras's death and the end of the Brotherhood. It continues today wherever people are willing to pursue it.