

# Pythagorean geometry in Vedic-era texts

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**In news**– A position paper by the Karnataka government on the National Education Policy (NEP) 2020, uploaded recently, has revived discussion that the Pythagoras theorem was already known to Indians from the Vedic times.

## **Controversy over the theorem-**

- As per Karnataka government paper, the Pythagoras theorem is disputed in many international forums. Not the content, but Pythagoras claiming it as his own.
- It added that there are theories that say there was nobody called Pythagoras.
- The paper referred to a text called the Baudhayana Sulbasutra, in which a specific shloka refers to the theorem.

## **Pythagoras & the theorem**

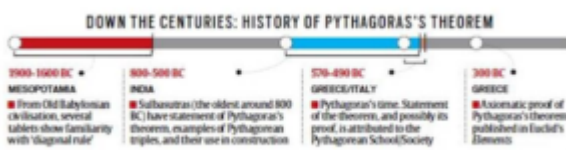
- Some evidence suggests that **Pythagoras, the Greek philosopher (around 570–490 BC) did exist.**
- However, there is an **element of mystery around him, largely because of the secretive nature of the school/society he founded in Italy.**
- Relatively **little is known about his mathematical achievements,** because there is nothing today of his own writings (History of Mathematics Archive, University of St Andrews, Scotland).
- **The Pythagoras theorem describes the relationship connecting the three sides of a right triangle** (one in which one of the angles is  $90^\circ$ ):  $a^2 + b^2 = c^2$  where a and b are the two perpendicular sides, and c is the length of the diagonal side.
- **If any two sides of a right triangle are known, the**

**theorem allows you to calculate the third side.**

- Extended to the sides of squares and rectangles and their diagonals, **the equation is of immense importance in construction, navigation and astronomy.**

### How did knowledge of the equation evolve?

- The **earliest evidence is from the Old Babylonian civilisation** (1900-1600 BCE).
- They were well aware of Pythagoras's theorem: but since that was more than a thousand years before Pythagoras, they did not call it that: **they referred to it as the 'Diagonal rule'**.
- There are probably at least half a dozen tablets that establish that they knew this rule. **The earliest evidence of a proof comes from a period after the sulbasutras.**
- The **oldest surviving axiomatic proof of the theorem is in the Elements of Euclid** from around 300 BCE.
- But again, it seems extremely likely that many more-or-less formal geometric rationales for the 'Pythagorean' relation were understood by many of its users long before Euclid recorded his rigorous-demonstration version.



### The theorem in Indian History-

- There are **references in the sulbasutras**, which are **texts pertaining to fire rituals** (yajanas) performed by Vedic Indians. **The oldest of these is the Baudhayana Sulbasutra.**
- **The period of Baudhayana Sulbasutra is uncertain** (as with other sulbasutras), there being no direct internal evidence useful in this respect.

- By and large, in recent literature, **Baudhayana Sulbasutra is taken to be from around 800 BCE** .
- It has been known for quite long in academic circles that **Baudhayana Sulbasutra contains a statement of what is called Pythagoras theorem** (it was known rather as a **geometric fact**, and not as a 'theorem').
- **The yajna rituals involved construction of altars (vedi) and fireplaces (agni) in a variety of shapes such as isosceles triangles**, symmetric trapezia, and rectangles. **The sulbasutras describe steps towards construction of these figures with prescribed sizes.**
- The Pythagorean equation comes into play in these procedures, which involve drawing perpendiculars.
- However, **there is no evidence that the Indians had a proof, nor even that Pythagoras did.**
- The idea of a mathematical proof based on an axiomatic structure is unique to the Greeks – thus in respect of the other cultures, 'proof' of a geometrical statement only meant some means of carrying conviction, which would have been there in various cultures.
- An Associate Professor from New York, who specialises in the history of Indian mathematics, cited two of the sutras in the first chapter in the Baudhayana Sulbasutra: "The areas [of the squares] produced separately by the length and the breadth of a rectangle together equal the area [of the square] produced by the diagonal. This is observed in rectangles having sides 3 and 4, 12 and 5, 15 and 8, 7 and 24, 12 and 35, 15 and 36."

### **The Baudhāyana sūtras–**

- They are a group of **Vedic Sanskrit texts which cover dharma, daily ritual, mathematics** and is one of the oldest Dharma-related texts of Hinduism that have survived into the modern age from the 1st-millennium BCE.

▪ They **belong to the *Taittiriya* branch of the Krishna Yajurveda school** and are among the earliest texts of the genre.

▪ **The Baudhayana sūtras consist of six texts:**

1. The *Śrautasūtra*, probably in 19 *Praśnas* (questions).
2. The *Karmāntasūtra* in 20 *Adhyāyas* (chapters).
3. The *Dwaidhasūtra* in 4 *Praśnas*.
4. The *Grihyasutra* in 4 *Praśnas*.
5. The *Dharmasūtra* in 4 *Praśnas* and
6. The *Śulbasūtra* in 3 *Adhyāyas*.
7. **The *Baudhāyana Śulbasūtra* is noted for containing several early mathematical results**, including an approximation of the square root of 2 and the statement of the Pythagorean theorem.