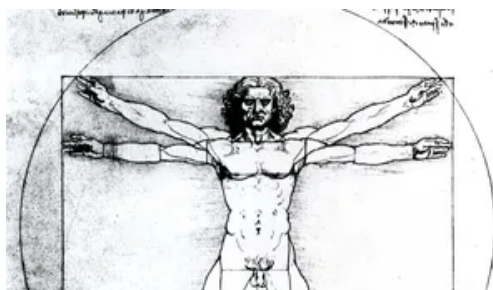


golden ratio

golden ratio, also known as the **golden section**, **golden mean**, or **divine proportion**, in mathematics, the irrational number $(1 + \text{Square root of } \sqrt{5})/2$, often denoted by the Greek letter ϕ or τ , which is approximately equal to 1.618. It is the ratio of a line segment cut into two pieces of different lengths such that the ratio of the whole segment to that of the longer segment is equal to the ratio of the longer segment to the shorter segment. The origin of this number can be traced back to Euclid, who mentions it as the “extreme and mean ratio” in the *Elements*. In terms of present day algebra, letting the length of the shorter segment be one unit and the length of the longer segment be x units gives rise to the equation $(x + 1)/x = x/1$; this may be rearranged to form the quadratic equation $x^2 - x - 1 = 0$, for which the positive solution is $x = (1 + \text{Square root of } \sqrt{5})/2$, the golden ratio.

The ancient Greeks recognized this “dividing” or “sectioning” property, a phrase that was ultimately shortened to simply “the section.” It was more than 2,000 years later that both “ratio” and “section” were designated as “golden” by German mathematician Martin Ohm in 1835. The Greeks also had observed that the golden ratio provided the most aesthetically pleasing proportion of sides of a rectangle, a notion that was enhanced during the Renaissance by, for example, the work of the Italian polymath Leonardo da Vinci and the publication of *De divina proportione* (1509; *Divine Proportion*), written by the Italian mathematician Luca Pacioli and illustrated by Leonardo.



Vitruvian man, a figure study by Leonardo da Vinci (c. 1509) illustrating the proportional canon laid down by the Classical Roman architect Vitruvius; in the Academy of Fine Arts, Venice.

Foto Marburg/Art Resource, New York

The golden ratio occurs in many mathematical contexts. It is geometrically constructible by straightedge and compass, and it occurs in the investigation of the Archimedean and Platonic solids. It is the limit of the ratios of consecutive terms of the Fibonacci number sequence 1, 1, 2, 3, 5, 8, 13,..., in which each term beyond the second is the sum of the previous two, and it is also the value of the most basic of continued fractions, namely $1 + 1/(1 + 1/(1 + 1/(1 + \dots))$.

In modern mathematics, the golden ratio occurs in the description of fractals, figures that exhibit self-similarity and play an important role in the study of chaos and dynamical systems.

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