

The 13 Most Important Numbers in the Universe

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Some numbers, such as your phone number or your Social Security number, are decidedly more important than others. But the numbers on this list are of cosmic importance—they are the fundamental concepts that define our universe, that make the existence of life possible and that will decide the ultimate fate of the universe. In this piece adapted from his new book *Cosmic Numbers: The Numbers That Define Our Universe*, California State University, Long Beach, mathematics professor James D. Stein reveals not only the effect each number has on our lives and our universe, but also the story of the people who discovered and worked with them. Here they are, in the order in which science first became aware of them.

James D. Stein



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1. The Universal Gravitational Constant

Maybe 2011 hasn't been such a great year, but 1665 was a whole lot worse—especially if you happened to live in London. That was the year of the last great outbreak of bubonic plague, and even though Londoners didn't know a whole

about medicine, they knew that it was a good idea to get out of town. The court of King Charles II departed London for Oxfordshire, and Cambridge University shut down. One of its undergraduates, Isaac Newton, went back home to Woolsthorpe, where he spent the next eighteen months opening the door to the modern world.

We live in a technological era that would be impossible without the ability to make quantitative predictions. And the first great example of quantitative prediction was to be found in Newton's theory of universal gravitation. Starting from the hypothesis that the gravitational attraction between two masses is directly proportional to the product of the masses and inversely proportional to the square of the distance between them, Newton figured out that the orbit of a planet was an ellipse with the sun at one of the foci. Johannes Kepler had reached this conclusion from years of painstaking observations, but Newton was able to do so with no more than the assumption of gravitational attraction and the mathematical tool of calculus (which he had invented for this purpose).

Curiously, though the gravitational constant, G , was the first constant to be discovered, it is the least accurately known of all 13 constants. That is because of the extreme weakness of the gravitational force when compared with the other basic forces. Consider that though mass of the earth is approximately 6×10^{24} kilograms, by 1957—about three centuries after Newton left plague-ravaged London—humans overcame the earth's gravitational attraction by using a simple chemical-powered rocket to place Sputnik, the first artificial satellite, in orbit.

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