# Who invented Calculus, Newton, Leibniz, both or neither?

Calculus is the branch of mathematics that study rates of change of objects in the universe. There are two main branches of calculus, differentiation, and integration, these focus on limits, functions, derivatives, and integrals. Calculus has widespread applications in science, economics, and engineering and can solve many problems for which algebra alone is insufficient. The history of calculus is perhaps one of the most controversial topics in the history of mathematics. Calculus was officially invented in the 17th century by two mathematicians Sir Isaac Newton, and Gottfried Leibniz. The controversy lies in the fact of who invented Calculus first and if anyone plagiarised their fellow contemporaries. However, although quarrels were ubiquitous at the time, this one was so infamous due to the prestigious nature of the men involved. Newton is said to have invented calculus in 1665 in his personal books but was too afraid to release due to his anticipation of backlash. He later released this in his famous book called “Philosophiæ Naturalis Principia Mathematica”, published in 1687, which is also considered to be the most influential book in the history of science.

Furthermore, the argument that Newton plagiarised Leibniz is flawed as when this was written in 1655, Leibniz was 20 and thus knew little about mathematics. However, prior to this, the idea of calculus was already invented by the Ancient Greeks, most notably Archimedes. He had many great inventions that help the development of maths, science, and philosophy, but amongst these was, according to some, his greatest invention. This is the invention of “integral calculus”. Using this, he measured the section of areas surrounded by geometric figures. He broke the sections into a number of rectangles and then added the areas together. This principle is known as 'integration'.

Also a part of the discovery of 'integral calculus' is 'differential calculus'. He calculated ways to approximate the slope of the tangent lines of his figures. Further into the ages, in the Middle East, a mathematician called Alhazen derived a formula for the sum of fourth powers. He then used these results to carry out calculations that are now known as integration. Additionally, in the 14th century, Indian mathematician Madhava of Sangamagrama stated components of calculus such as infinite series and the Taylor series approximations. However, Madhava was not able to combine to two differing ideas under the two main branches of calculus, integrals, and derivatives. Furthermore, he was unable to show a distinct connection between the two, and transform calculus into what it is today. Interestingly, there are mathematicians, scientist and philosophers in Europe that predate Newton and Leibniz, amongst them are Isaac Barrow, Rene Descartes, Pierre de Fermat, Blaise Pascal and John Wallis. Notably, Fermat invented an adequality method for determining maxima’s, minima’s and tangents to various curves that were closely related to differentiation. This lead to Isaac Newton admitting that his own early

ideas about calculus came directly from Fermat’s adequality.

Moreover, the first full proof of the fundamental theorem of calculus was devised by Isaac Barrow. Newton and Leibniz both thought differently about the fundamental concepts of calculus. Furthermore, while Leibniz thought of the variables x and y as ranging over sequences or infinitely close, Newton considered variables changing with time. Leibniz introduced dx and dy as successive values of these sequences. Leibniz knew that dy/dx gives the tangent but he did not use it as a defining property. On the other hand, Newton used quantities x' and y', which were finite velocities, to compute the tangent. Of course, neither Leibniz nor Newton thought in terms of functions, but both always thought in terms of graphs.

For Newton, the calculus was geometrical while Leibniz took it towards analysis. On the other hand, Newton used quantities x' and y', which were finite velocities, to compute the tangent, and neither Leibniz nor Newton thought in terms of functions, but both always thought in terms of graphs. For Newton, the calculus was geometrical while Leibniz took a more analytical approach.

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