Isaac Newton, born on December 25, 1642 (according to the Julian calendar then in use in England) in Woolsthorpe, Lincolnshire, and died on March 20, 1727, in London, is one of the most influential scientists in history. His major contributions to physics, mathematics, and astronomy laid the foundations of modern science and profoundly transformed our understanding of the natural world.

Childhood and Education

Isaac Newton was born prematurely into a family of farmers. His father, also named Isaac Newton, died three months before his birth, and his mother, Hannah Ayscough Newton, remarried when Isaac was three years old, leaving him in the care of his grandmother. A solitary child, Newton showed an insatiable curiosity about the world around him from a young age.

He began his schooling at the village school in Grantham, where he showed exceptional talent for mathematics. At 18, he entered Trinity College at the University of Cambridge, where he was deeply influenced by the works of philosophers and scientists like René Descartes, Galileo Galilei, and Johannes Kepler.

Plague Years and Discoveries

In 1665, an outbreak of the plague forced the University of Cambridge to close, and Newton returned to Woolsthorpe for two years. These years, often called the "miraculous years," were among the most productive of his life. During this period, Newton made revolutionary discoveries in mathematics, optics, and gravitation.

He developed calculus independently but simultaneously with German mathematician Gottfried Wilhelm Leibniz, leading to a controversy over the authorship of this discovery. Newton also conducted experiments on light and colors, demonstrating that white light is composed of a spectrum of colors, which led to his major work on optics, "Opticks" (1704).

Principia Mathematica

Newton's most famous contribution is undoubtedly his work "Philosophiæ Naturalis Principia Mathematica" (1687), often abbreviated as "Principia." In this book, Newton states the three laws of motion that became the basis of classical mechanics:

1. The law of inertia: A body at rest remains at rest, and a body in motion continues to move at a constant velocity in a straight line unless acted upon by an external force.
2. The fundamental law of dynamics: The acceleration of an object is proportional to the net force acting on it and inversely proportional to its mass (F = ma).
3. The law of action and reaction: For every action, there is an equal and opposite reaction.

In "Principia," Newton also formulates the law of universal gravitation, which states that every particle of matter in the universe attracts every other particle with a force directly proportional to the product of their masses and inversely proportional to the square of the distance between them. This law explained not only the movements of planets and celestial objects but also terrestrial phenomena like the fall of bodies.

Contributions to Optics

In addition to his work in mechanics and gravitation, Newton made significant contributions to optics. He showed that white light is composed of all the colors of the visible spectrum, which he discovered using a prism to decompose sunlight. These experiments refuted the dominant idea of the time that white light was pure and simple.

His work "Opticks" explores the nature of light and color, as well as the refraction, reflection, and dispersion of light. Newton also invented the reflecting telescope, or Newtonian telescope, which uses a concave mirror instead of lenses to reduce chromatic aberrations and improve image quality.

Later Years and Legacy

In 1696, Newton was appointed Warden of the Royal Mint, and three years later, he became Master of the Mint. In this role, he oversaw a major monetary reform and fought against counterfeiting, sometimes using very rigorous means to pursue forgers.

Newton also became president of the Royal Society in 1703, a position he held until his death. He was knighted by Queen Anne in 1705, becoming Sir Isaac Newton.

Newton spent his later years in London, where he continued to work on his research and correspond with other scientists. He died on March 20, 1727, and was buried in Westminster Abbey, a rare honor for a scientist.

Newton's legacy is immense. His laws of motion and law of universal gravitation dominated the scientific view of the physical world until the advent of Albert Einstein's theory of relativity. His work in optics laid the foundations for the physics of colors and the wave theory of light. In mathematics, calculus became a fundamental tool for many scientific and engineering disciplines.

Isaac Newton not only transformed our understanding of the universe but also established a rigorous scientific method that continues to guide scientific research today.

Albert Einstein, born on March 14, 1879, in Ulm, in the Kingdom of Württemberg in Germany, and died on April 18, 1955, in Princeton, New Jersey, USA, is one of the most influential and renowned theoretical physicists in history. His work revolutionized our understanding of physics, particularly with the theory of relativity, and profoundly influenced science and philosophy in the 20th century.

Childhood and Education

Einstein was born into a non-practicing Jewish family. His father, Hermann Einstein, was a salesman and engineer, and his mother, Pauline Koch, was an accomplished musician. From a young age, Einstein showed exceptional curiosity and talent for mathematics and physics.

In 1889, the Einstein family moved to Munich, where Albert attended the Luitpold Gymnasium. However, he was unhappy at school, where he often felt stifled by the strict and rigid teaching. In 1894, the family moved again, this time to Pavia, Italy, but Einstein stayed in Germany to finish his studies. In 1895, he left school without a diploma and joined his parents in Italy.

Formative Years and Early Work

In 1896, Einstein entered the Swiss Federal Polytechnic School (ETH Zurich) after passing an entrance exam. There, he focused on physics and mathematics. It was at the ETH that he met his future wife, Mileva Marić, a fellow physics student.

After graduating in 1900, Einstein struggled to find an academic position and accepted a job at the Patent Office in Bern, Switzerland, in 1902. This job gave him the time to develop his own scientific ideas. In his spare time, he worked on theories that would revolutionize physics.

Annus Mirabilis (Miraculous Year) of 1905

The year 1905, often called the "Annus Mirabilis" or "Miraculous Year," was an extraordinary year for Einstein. He published four groundbreaking papers in the scientific journal "Annalen der Physik," each having a major impact on physics:

1. Photoelectric Effect: In this paper, Einstein proposed that light is composed of quanta (later called photons) and explained the photoelectric effect, for which he received the Nobel Prize in Physics in 1921. This work was crucial for the development of quantum mechanics.
2. Brownian Motion: He explained the random motion of particles suspended in a fluid, providing experimental evidence for atomic theory.
3. Special Relativity: This paper introduced the theory of special relativity, demonstrating that the laws of physics are the same for all observers in uniform motion and that the speed of light is constant in all inertial frames.
4. $E=mc^2$: In this paper, Einstein established the equivalence of mass and energy, expressed by the famous equation $E=mc^2$, indicating that mass can be converted into energy and vice versa.

General Theory of Relativity

In 1915, after years of intense work, Einstein presented his general theory of relativity to the Prussian Academy of Sciences. This theory extended special relativity to include gravitation as a curvature of space-time caused by mass. The theory was confirmed in 1919 when observations of a solar eclipse showed the deflection of starlight by the Sun's gravitational field, as predicted by the theory.

Years of Fame and Social Activities

Einstein quickly became a worldwide celebrity. He held academic positions in Switzerland, Germany, and the United States. In 1933, due to the rise of Nazism in Germany, Einstein left his position at the University of Berlin and emigrated to the United States, where he accepted a position at the Institute for Advanced Study in Princeton.

Einstein was also a fervent advocate for peace and civil rights. He used his fame to speak out against militarism, nationalism, and racial discrimination. He was a committed pacifist, although he supported the development of the atomic bomb during World War II out of fear that Nazi Germany would develop it first.

Later Years and Legacy

Einstein spent his later years in Princeton, where he continued to work on a unified field theory, an attempt to reconcile general relativity and quantum mechanics. Although this unified theory was not realized in his lifetime, his efforts inspired much subsequent research.

He died on April 18, 1955, at the age of 76. His legacy endures through his numerous contributions to science and society. The theory of relativity transformed our understanding of the universe, influencing not only physics but also philosophy, cosmology, and engineering sciences. His work on the photoelectric effect was essential to the development of quantum mechanics, and his equation $E=mc^2$ remains one of the most famous and significant formulas in physics.

Einstein is also known for his profound thoughts on the nature of reality, knowledge, and creativity. He left behind a rich collection of scientific and philosophical writings that continue to inspire researchers and thinkers worldwide.