Isaac Newton

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Isaac Newton is not only a famous mathematician; he is a house hold name. Most elementary students know his name and most know the story of the apple falling from the tree. Despite his popularity most people do not know much about his ground breaking theories. Most students probably think that he discover gravity and nothing else. Newton's works are numerous and include advance in fields such as mathematics, physics, optics and religion. The amount of texts that are written about him is very large and the texts that reference his work are uncountable. With this wealth on knowledge on this man is hard to give an account of his life in such a short paper. Newton was probably one of the greatest minds ever. His theories on mathematics and physics changed the way people looked at problems and his work greatly advanced our knowledge of the sciences.

Isaac Newton was born on Christmas day, 1642 in Lincolnshire, England. Although this was the same year that Galileo died, Newton would soon become very familiar with his work. Newton's father had died just three months before his son's birth. Newton was born very prematurely and was not expected to live. When Newton was five years old his mother remarried a rich clergy man and Newton was sent off to live with his grandmother. He despised his stepfather and never knowing his real father caused a lot of psychological harm for the rest of his life. Newton was a very curious child, and spent much of his time drawing and building things such as clocks, sundials, and kits. But he was unable to apply himself to school work and was considered a poor student by his teachers. After his stepfather died, Newton and his grandmother moved back into his mother house. Newton improved in his school work, but still was an average student when he finished. He decided to attend Trinity College, and during this time his intellectual side began to show. It was during his time at Trinity College that the famous event of the apple falling of the tree occurred, which inspired Newton to define the laws of gravity. Newton then attended Cambridge, where continued his study.

In 1669 Newton became a Lucasian Professor at Cambridge. His first work in this position was in optics. Newton wanted to prove that light was made up of a mixture of other types of light; each of which was another color on the spectrum. He was convinced of this because he could separate these colors using a prism. This theory caused him to bump head with Hooke who was also working on optics. Hooke's theory had light as waves. Within the year Newton had written on his discovery in the field of optics. This work was the basis of his lecture for the next few years. Newton presented his work on optics to the royal society in 1672 in his book of philosophical transactions. Newton discovered that white light was made up of all the other colors of light. He separated these colors by changing the angle that light exited a prism. From this he formulated a theory that could explain the color given by the angle it was refracted. Prisms were not new and had been known that different shapes crated different types of colors. The triangle seemed to be the best prism because it created the colors in an almost perfect way. Newton experimented with light by putting a small hole in the shutter of his window and letting the ray of sun light hit the prism. It had been assumed that the prism created colors but Newton wanted to know why. He later built on this by isolating a color by using a board with a hole cut into it and then letting that single color of light pas threw another prism. What he found was that the second prism never created new colors or never changed the single color back into white light. Newton had earlier speculated that he could get the white light back with the correct angle of the prisms. From this experiment he deduced color is not a modification of white light but a property of light. Also, he discovered that light is a mixture of all the colors. Newton was very interested in the fact that he could never recreate the original white light. He said that white light was a perfect mixture of the primary color in correct proportion. Also from these experiments Newton discovered that a prism does not create colors, but rather it sorts them out by the angle that they were refracted. The angle of the bend determined the color. Newton believed that light was a steady stream of particles. This was in contradiction with Hooke's wave theory of light. Hooke attacked Newton's theories on light by saying that he had already done these experiments and had proved that light was a pulse, and color was a disturbance of that pulse. Furthermore, Hooke stated that a prism add color to light. Newton argued that his theory of optics was based in rigorous mathematics and physics, he also argued that Hooke had never created any experiments. Pardies and Huygens argued with Hooke that Newton couldn't be correct. The royal society on the other hand thought Newton's work on optics was brilliant. Newton didn't publicly publish his work on optics until the year after Hooks death in 1703. During this battle Newton suffered a severe mental breakdown. This was followed shortly by the death of his mother. Newton began to distance himself from the community and secretly began studying alchemy.

Newton's interest in the field of alchemy started when he lived with the apothecary, Clark. Clark prepared remedies for his customers in a small laboratory located near his shop. Newton observed this and was later found to have many of Clarks recipes recorded in his notebooks. Newton's notebooks from the mid 1660 contained many entries from the work a group called "The Chymist". In 1669, Newton bought two furnaces and enough supplies to conduct his secrete studies. These experiments went on in secrecy during the same time as his more famous works. Sometime in the 1680's Isaac Newton hired a cousin to asset in these experiments, his name was Humphrey Newton. The quest of the alchemist was to discover the chemical compound of the "Grand Elixir". This liquid elixir had the power to change common metal into gold or silver. The alchemist also believed that one could become immortal by dinking this elixir. Newton read everything he could get his hands on in the subject of alchemy. Much of this knowledge about his secrete hobby was not known until after his death. A respected member of the royal society, Pellet, was chosen to go through Newton's unpublished work and decide what to publish. Pellet was horrified to find Newton's work on alchemy. Oddly enough Newton was probably the greatest alchemist of all time. Newton had hundreds of hand written pages and the index that contained over 5,000 references. Pallet protected the creditability of the formal president of the royal society by writing across these works “Not fit to be printed”. He probably should have burned them because they eventually surfaced. This became a big scandal about how a brilliant man be corrupted by a science that was known to be silly. Modern scholars have found that Newton was neither interested in riches or immortality; he purely believed that it was possible. Newton was more concerned with the behavior of matter. He wanted to find the smallest piece of invisible matter, in order to find out how all things in nature formed, grew, decayed, and returned to their basic elements. Newton believed if he could understand alchemy he could expand that to discover what light, gravity and magnetism really were.

Newton also bumped heads with another mathematician named Leibniz. Newton created what he called the theory of fluxion and inverse fluxions. At nearly the same time Leibniz was working on his ideas on calculus. The components of calculus had already been created; both men were considered geniuses of the time. In 1638, Fermont discovered a way of finding minimum and maximum of an equation. Descartes work had made it possible to represent a geometrical diagram as an equation. Archimedes used infinitely small slices to estimate the volume of a certain shape. A curve was also though of as the motion traced by a moving point. This was of interest because if solved could answer important question in celestial mechanics and philosophy. The volumes and area of complex curves was another problem that had stumped great thinkers in the past. Newton and Leibniz both advanced these ideas into the calculus we know today. Leibniz and Newton although working on the same field approached this idea from opposite ends of the spectrum. Leibniz whose interests spanned many fields was looking for a unified system of knowledge. Leibniz worked on creating a universal scientific language. Leibniz goal was to create a general method of calculus that could be used not only in motion but in other fields that he was interested in, such as philosophy. On the other hand Newton’s calculus was purely created to solve physical problem. This calculus was used to solve many physics problem in his book *Principia*. *Principia* didn't contain any problem solved using fluxions or any other calculus. It's believed that he used this form of calculus to solve a problem, but then presented the problem in this book only in geometrical terms, which was tradition of the time. In 1666, Newton wrote a paper on fluxions which were only shown to a few of his colleagues. His colleagues urged Newton to publish his paper, but he chose not to because of fear of being criticized.   Leibniz first work on calculus appeared in 1684, while Newton was using his calculus to do work on his book *Principia*. Newton must have been quite surprised when his work showed up with Leibniz's name.   Still, this didn't cause Newton to publish his work on the subject, he did hint at his method in *Principia*. Newton first official mention of his calculus was as part of a publication of Wallis's work in 1693. Newton first publication appeared as an appendix to his book optics in 1704. When finally published, Newton's ideas on calculus were almost 40 years old. Leibniz held on to his original work on calculus for almost 10 years. Leibniz's first publication on calculus contained work on differential calculus. His second paper, published two years later, was on integral calculus. Both mathematicians claimed that they had created this new method and that the other had stolen their idea. Each of the two feuding men had supporters that would prove their man created calculus and disprove the other mans supporters. Although this debate drew the attention of many people, there were also many famous mathematicians that took sides on the issue of who discovered calculus first. Such mathematicians involved included Bernoulli, L'Hopital, Malabranche and Varigon. The feud continued to escalate when Newton was appointed president of the Royal society, Leibniz was also a member.   Newton used this position as muscle in his fight against Leibniz. Leibniz on the other hand didn't have much power to influence and wasn't nearly as popular as Newton.   Leibniz died in 1716, and was buried in Hanover with a very small funereal. One account mentions that he was buried more like he was a robber than a genius and his funeral was attend by only his secretary. Newton out lived Leibniz by over ten years was given a state funeral. Today his grave is a popular tourist attraction. Historians took up the debate of who gets credit long after both had been dead. Most historians agree that Newton and Leibniz both created calculus independently. While Newton usually gets sole credit for the creation of calculus, we use Leibniz notation. Not many people are familiar with fluxions, while every scientist is very familiar with dx/dy.

Newton famous work *Principia* was published in 1687. Book 1 was about Newton's tree laws of motion, which were based on Kepler's three laws of planetary motion. Book 2 was on fluid mechanics, but contained a little more information on the laws of motion. Book 3 was about applying the three laws of motion to everything in the real world. This is basically the universal law of gravitation. Newton began working on his theories of motion by 1666. He was interested in the work done early by Kepler. Kepler had created three laws of planetary motion but didn't know why these objects acted in such a way. Kepler believed, but couldn't prove, that the sun and the plant were connected by a magnetic force. Although Kepler wouldn't have used the word force because this term wasn't defined until Newton's work on physics. Newton submitted the first book to the royal society in 1686 and they decided to pay to publish this work. The society at the time ran out of money so a member of the royal society named Halley decided to pay out of his own pocket to publish the *Principia*. Halley then became the book editor and work closely with Newton getting the *Principia* ready to publish. Hooke attacked Newton's *Principia* and claimed that Newton had used his ideas. Halley wrote to Newton trying to calm the waters, stating that "Locke would like to be mentioned in the preface". This infuriated Newton and he threatened not publish his work at all. *Principia* was not an easy book to read. It has been called the book nobody understands. With this book Newton moved forward with may ideas on planetary motion and the idea of gravity. Newton first law "a body in motion stays in motion unless acted on," but without some other force the planet would fly off into space. There is an invisible string that tethers the planets to the sun, this invisible string is gravity. Newton went on to say that this force applies to all matter regardless of size. Ever particle is attracted to ever other particle based on the distance between them. Newton used this theory to show the mechanics of our solar system. Newton did realize that the sun wasn't the only object acing on a planet. This problem was far to complicated for Newton to figure out. But because the sun is 99% of the mass of the solar system, Newton could get fairly accurate results. Another interesting discovery in the *Principia* is the idea that planets are not perfectly spherical. For example, Earth's the diameter threw the equator is about 25 mile farther that the diameter threw the poles. This had many religious and philosophical implications. Newton's work showed that a large body of mass needs to only be represented by a single point at its center of gravity. For nonspherical objects, such as the earth, the center of its mass is not always on the axis of rotation. Hipparchus was the first to discover this, but had no way of explaining this. Newton not only explained this phenomenon, but he also set out to find its period of rotation. He found that it takes the earth 26,000 years to complete the rotation about its axis. Newton used this idea to solve the age old problem of the rising and falling tides. The solution of the problem is the gravitational force from the moon and sun. The moon is a much bigger factor because of its closeness, but Newton includes the sun because of its size. Newton was unable to predict the height of a tide at a given time, but his work on tides was a huge advance in how people thought about tides. Newton's laws also were used to predict the sharper curves of comets. Newton's friend used data and Newton's laws to predict the next return of a comet that is now named Halley's Comet and shows up every 75 years. The true value of this work is that it linked physics and astronomy, which solve many famous problems in astronomy that had stumped great astronomers such as Copernicus, Kepler and Galileo.

In 1693 he suffered another mental breakdown. After this breakdown Newton retired from research. Newton earned a position of warden at the royal mint in 1696. He hastily packed his things and move from Cambridge to London. Many of his possessions were left behind while thousands of handwritten pages were taken with him. The universities left his possessions alone even after his death and were shown to visitors as a sort of Newton museum. As warden of the mint Newton's job was to insure the integrity of the mint. This meant that he was in charge of overseeing the replacing of coins. In 1695 England decided to replace every coin with a new style. He was also in charge of determining if a coin was counterfeit. During this time Newton scientific reputation was still growing. Bernoulli sent Newton two problems, difficult problems, one of them had not been solved at the time. Newton, after working at the mint all day immediately began working on the problems 12 hours later at four in the morning Newton had solve both problem. He spent a day or two after that formalizing the answer and then he wrote a letter the president of the royal society with his results. The problem and their solution showed up in the philosophical transactions a few weeks later. This work stunted the community especially Bernoulli. For this work Newton was honored by the king. A few years latter in 1699 the master of the mint died and Newton took over his position. The wage increase was huge and made him the equivalent to a millionaire today.

The royal Society for the most part loved everything Isaac Newton did except for one member. Hooke had been one of Newton greatest adversaries. In 1703 Hooke died, six month later the royal society elected Newton as their president. At this time the Royal society was in decline, their members were half of only twenty years ago. The treasury of the society was empty and the scientific research being done wasn't valued. The society was spending much of their time talking about medicine anatomy. This was a joke compared to the topics of twenty years ago. Newton set out to bring the Royal society back to its original mission. To do this Newton needed to get new funding and he also wanted to hire four paid demonstrators that attended all the meetings and regularly submitted research. Ironically what Newton needed was a person just like his old enemy Hooke. Newton changed the rules of how member paid the admission fee and made everyone behind on their memberships pay up. Within ten years the royal society had completely turned around. The Treasury at the society now had plenty of money to accomplish the goals that Newton set out. The society was able to purchase a new building that was also in London. At the age of 84 Newton died and was placed in a tomb in the nave of the great Westminster abbey.

The world would have to wait nearly 200 years before another man would make such great advances in physics. That man was Albert Einstein and his work would have not been possible if Newton had not laid down the ground work two centuries earlier. Every science has benefited from Newton's mathematical advances. Calculus is the foundation for almost every science. Isaac Newton one said "If I have seen further than others, it is by standing upon the shoulders of giants." This was a clear reference to great scientist such as Copernicus, Kepler, Galileo and many others that he based his work. Newton is now to us one of these giants that other great thinkers have built their work from.

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