The Life Of Galileo Galilei

Galileo Galilei was a pioneer of modern physics and telescopic astronomy who was born on February 15, 1564 near Pisa, Italy. As an Italian physicist and astronomer, he was the first to use the telescope to discover many undiscovered realms of space. His discoveries of sunspots, lunar mountains and valleys, and the satellites of Jupiter formed the basis of modern astronomy. His discoveries opened a gateway into the unexplored areas of the universe.

Galileo's education began in Vallambrosa where he was taught by monks, but the takeoff point of his career was when he registered at the University of Pisa at the age of seventeen. Here the power of mathematical reasoning interested him so much that he became interested in applying it to the events that occur in nature. He learned of the studies of Aristotle and studied his writings on logic, motion, and the structure of the universe. Over the years Galileo criticized and refuted many of Aristotle's views. He became one of the most relentless demolishers of Aristotle's doctrines.

Galileo's studies began in the Cathedral of Pisa one day as Galileo was watching a lamp which was swinging from the ceiling. He observed a rhythm in the swings of the lamp and noticed that the lamp always took the same time to go from one end of its swing to the other. His goal was to find out whether or not all of the swings took the same amount of time. He and a friend both made pendulums and decided to count the number of oscillations that the pendulums made in a given amount of time. They found that both pendulums made the same number of oscillations at the same time. Thus he discovered the law of isochronism, or equality of time, of oscillations. By 1586, Galileo left the University of Pisa and went back to his family in Florence.

In Florence, Galileo applied himself to geometry and from the study of Euclid he soon passed to that of other ancient mathematicians, especially Archimedes. Galileo found in Archimedes a teacher for whom he learned the power and the wide intellectual range of mathematical reasoning. Galileo studies produced two books that he wrote during this period. One, in Latin contains the theorems to determine the center of gravity of solid bodies, made him known among mathematicians of his time. The other book, called the Little Balance, was written in Italian. In this book he told how he read the story of Archimedes and the studies of bodies immersed in water.

In the fall of that year Galileo moved to Pisa where he studied while he continued to teach at the university,In this period he resumed his study of motion and wrote a short book in Latin know as De Motu (On Motion). In De Motu , Galileo tried to disprove some of Aristotle's main views about motion. One of his objections was the assertion that motion, in the absence of the direct action of a force, is maintained by the medium in which it takes place. De Motu represents Galileo's first step in his systematic study of motion and is a key point of reference in Galileo's intellectual development. It shows that Galileo had already started the deep process of original thinking and critical revision of Aristotle's principles which lasted throughout his life.

At about this time Galileo tried to disprove one particular statement of Aristotle's. Aristotle said that when bodies of the same material but of different weights fall freely, they fall with speeds proportional to their weights. To prove that lighter and heavier objects fall at the same speed, Galileo climbed to the top of the Leaning Tower of Pisa while the entire body of students gathered in the square below to watch the demonstration. From the top of the tower, Galileo let go two objects of the same substance but of different weights at exactly the same time. They reached the ground at exactly the same time. This story may or may not be true, but was also proved by the Dutch mathematician Simon Stevinus.

At the age of 28, Galileo moved to Padua. These years were said to be the best eighteen years of his life. Galileo made friends among the nobles and the rich Venetians. One of his most important friends, Giovanni Francesco Sagredo, used his position to improve Galileo's status as a scientist at the University. Following Sagredo's death, Galileo's friend lived on as a character in two of his best books, Dialogue of the Two Greatest Systems of the World and Two New Sciences. Galileo became a professor at the University of Padua and began to teach large numbers of students. During these years Galileo wrote many of his greatest books, including Fortifications, Military Constructions, and Mechanics. The last and most important was a true engineering textbook which described the action of simple machines such as the lever, pulley, screw, and inclined plane. He also dealt with problems of falling bodies which he took up again in later years.

In 1597, Galileo built an instrument which illustrates both his competence in mathematical calculation and his great craftsmanship. This device was known as the geometric and military compass. It was a combination of a divider and slide rule. It helped to solve a large number of mathematical and geometric problems, including the extraction of square and cubic roots. Because the end of the sixteenth century was a period of conflict, Galileo stressed military uses of this instrument. For instance, the compass was used to determine relations of weight and size of cannon balls, to regulate the front and side formations of armies, and to measure the inclination of a wall. Galileo sold so many that he could not produce enough to fit the demand. The compass later became one of the most useful and widely used inventions.

Galileo's most important scientific achievements in the period at Padua were in two fields: the study of motion and astronomy. In the field of motion he resumed the study started in Pisa with observations on pendulums and falling bodies. Galileo published these observations in 1638, in the book Two New Sciences.
Later, Galileo began to admire the work of a man named William Gilbert, who had published a book called De Magnete (Concerning the Magnet). Magnetism had been a well known property of lodestone and iron at that time and was used by navigators to make magnetic needles. Galileo, who did not accept the authority of written word, performed Gilbert's experiments himself. He wrote a new book called The Dialogue, in which he told of how he became convinced that the power of the stone is not increased by the weight of the object.
Galileo's research on magnetism was yet a minor episode in his scientific activity.

On October 9, 1604, a new star appeared in the sky. This new star emerging aroused Galileo's scientific curiosity and initiated his career as a stargazer. Shortly after the star appeared, Galileo began to make systematic observations He began to measure its height in the sky and began to check whether its position in respect to other stars varied from night to night. After having observed it for several weeks, he gave three public lectures to describe his findings and drew large crowds. A very important invention emerged in 1609. In the early summer he was in Venice when he heard that a certain Fleming had constructed an eye-glass by which distant objects were seen nearby. Galileo went back to Padua at once to think of how he could build a similar instrument. He concluded that the effect could be achieved by the combination of a convex and concave glass. Galileo mounted the two lenses at the ends of a lead tube, and his first telescope came into being.

At once he realized the great importance of his instrument, both in science and in practical life. He realized it might modify the art of war because it would permit sighting of the enemy at much greater distance that usual. Galileo must have shown the instrument to his friends or talked about it, for soon the rumor spread that he had invented it. In a letter to his brother in law Galileo stated: "And news having reached Venice...I was called by the Most Serene Signory six days ago, to whom it was my duty to show it as well as to the whole Senate, to the intense astonishment of all." Galileo indeed showed his telescope and it indeed astonished all.

Senators and noblemen gathered around in the Palazzo Ducale. The professor from Padua stood with his telescope on the marble floor. His telescope was a sheet of metal, covered by crimson sateen, of about the length of 24 inches and the diameter of about one and three quarter inches in diameter, with two glasses, one at each end. Galileo, needing more room climbed the steep stairs of the bell tower of San Marco across the Piazzetta and demonstrated its ability to represent an object fifty miles off as appearing five miles away. Galileo's telescope opened a new door to the universe.

Once more Galileo showed his craftsmanship. The first telescope he built had a magnification of three diameters, the second eight diameters and finally he built one magnifying 33 diameters. He increased the size of his lenses, stopping at the point where a further increase would result in the distortion of images. No instrument but the telescope could give Galileo the feeling of how much the power of the senses could be enlarged. For the first time he could see distant things as well as if they were close by and discover the existence of objects that up till then had been too far away to be visible. Many new things in space appeared to him.

The moon appeared very different to him, and among its new strange features were prominences and cavities in its surface. Many of these were comparable to mountains and crevices in the Earth's surface. Galileo calculated the height of lunar mountains and concluded correctly that some are as high as four miles. he calculated that these mountains were higher than any mountain on the Earth.Mount Everest is actually five and a half miles high.

The telescope still had more marvels marvels in store. Galileo soon discovered four small planets revolving around the planet Jupiter, as the moon revolves around the Earth. He named Jupiter's satellites the Medicean Satellites and this remained his favorite astronomical discovery. He observed the satellites of Jupiter and studied their motion. He used this to predict the satellite's positions so accurately that navigators would be able to rely on them to guide their ships. He spent year after year observing the Medicean planets with his telescope.

Less than a month later Galileo announced another detail noticed by him. He described the phases of Venus. He said that he began to observe Venus with his instrument and saw it was growing in size daily, keeping its roundness until it eventually arrived a great distance from the sun and started to lose its roundness on its eastern side. A few days later, it diminished to a half circle. Then it transformed into a horned shape and it became thinner until it vanished. Copernicus had been disappointed not to see the phases of Venus. The fact is that the phases of Venus are undetectable with the naked eye.

Soon afterward he made another important observation, that of sunspots. He described them as being dark spots seen in the solar disk. Some were always produced and others are being dissolved. They varied in duration from one or two days to thirty or forty. Their shapes continually changed, some quickly and violently, and some more slowly and moderately. In addition to changing shape, some of them divided into three or four, and some of them united into one. Besides all of these disordered movements they have in common a general uniform motion across the face of the sun in parallel lines. From this motion was learned that the sun was absolutely spherical, that it rotates west to east around its center, and completes its entire revolution in about a lunar month. Thus the sun had blemishes on its surface, and it rotates around its axis as the Earth and moon do.

During all of these years, the Inquisition had been observing Galileo. The Inquisition was the high tribunal of the Roman Church. During the Counter Reformation, the Inquisition played a very important role. Working in secrecy, it spotted, investigated, and prosecuted those suspected of heresy, trying to suppress it before it could spread. It exerted censorship to avoid the distortion of the Catholic doctrine, and issued the Index of Prohibited Books. To be tried by the Inquisition was something noone could take lightly.

Galileo kept talking in favor of the Copernican doctrine, and while he busied himself with this, the Inquisition went on examining his case. On February 23 a group of eleven theologians was convened to examine his beliefs in science, or at least what the Inquisition said were his beliefs. Two propositions were submitted by the theologians: 1) The Sun is the center of the world and hence immovable of local motion. 2) The Earth is not the center of the world, or immovable, but moves according to the whole itself and also with diurnal motion. Neither of these were quoted from his writings. on the Pope's instruction, Cardinal Bellarmine called Galileo to his palace and told Galileo that he was not to hold, teach, or defend the condemned opinion of Copernicus. A few days later De Revolutionibus, which the Pope had accepted, was condemned and prohibited until it be corrected.

Later, with the publish of The Dialogue, there was a clash of personalities between Pope Urban VIII and Galileo. Behind this clash were the long standing traditions and authority of the Church and the need for freedom of thought in science. The Chuch would not easily accept views that went against tradition. As it happened, the conflict between science and theology gathered so early that the Church took strong action against the founder of modern science. Galileo was summoned to Rome. He pleaded for time and clemency, but the Pope was inflexible. The trial of Galileo as a heretic had begun.

Galileo arrived in Rome in February 1633 and stayed there five months. These months were filled wit questionings by the Inquisitors. The purpose was to see whether Galileo was still holding the prohibited doctrine and whether in writing The Dialogue he had disobeyed orders. The trial turned into gradual spiritual pressure in which they tried to make Galileo believe a sin that he had not committed. On June 22, 1633, Galileo was taken to the large hall of a monastery in the center of Rome. He knelt as the sentence was read to him: "We say, pronounce, sentence and declare that you, Galileo, for the things found in the trial and confessed by you have made yourself suspected of heresy. We order that the book The Dialogue by Galileo Galilei be prohibited by public edict. We condemn you to formal prison...and we impose on you that for the next three years you say the seven penitential psalms once a week."

In the final years Galileo completed his book Two New Sciences. Galileo's eyes had bothered him for many years. He had been complaining of eye pain because of long hours of studying. He lost sight in his right eye first, then the left. During the last four years of his life he was completely blind. In November 1641 a slow fever seized Galileo and his arthritic pains had become more. This was his last illness. He died on January 8, 1642 at almost 78 years of age.