



*Galileo Galilei*

# about **Birth**

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Born in Pisa (then part of the Duchy of Florence), Italy, on 15 February 1564, the first of six children of Vincenzo Galilei, a famous lutenist, composer, and music theorist, and Giulia. Galileo became an accomplished lutenist himself and would have learned early from his father a scepticism for established authority, the value of well-measured or quantified experimentation, an appreciation for a periodic or musical measure of time or rhythm, as well as the results expected from a combination of mathematics and experiment.



# about Polymath

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Astronomer, physicist, engineer, philosopher, and mathematician.

Although Galileo seriously considered the priesthood as a young man, at his father's urging he instead enrolled at the University of Pisa for a medical degree.

He created a thermoscope, a forerunner of the thermometer.

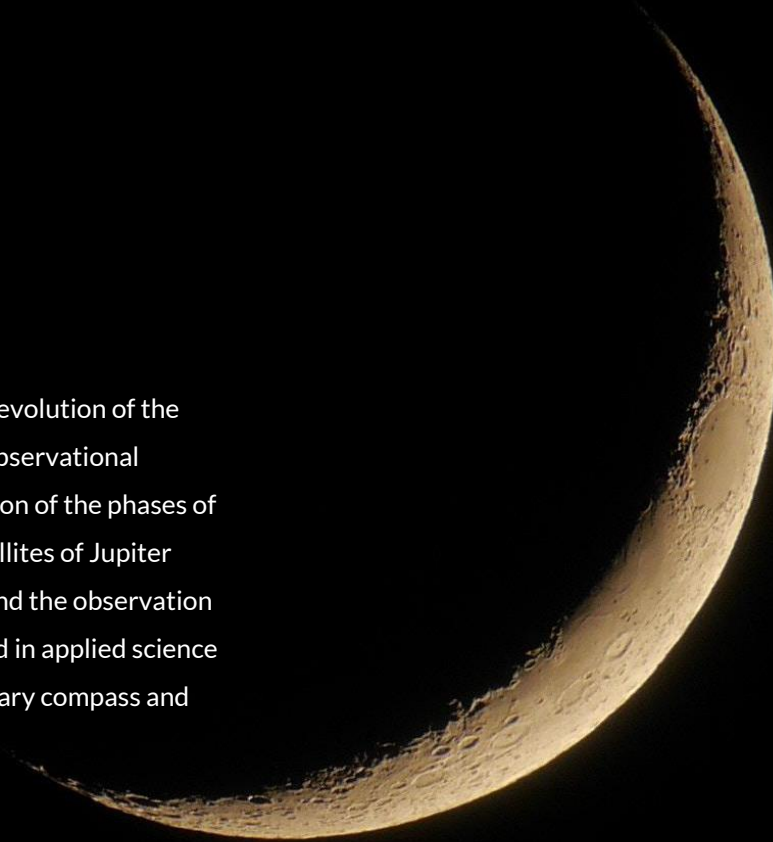
Galileo also studied *disegno*, a term encompassing fine art, and, in 1588, obtained the position of instructor in the Accademia delle Arti del Disegno in Florence, teaching perspective and chiaroscuro. In 1589, he was appointed to the chair of mathematics in Pisa. In 1592, he moved to the University of Padua where he taught geometry, mechanics, and astronomy until 1610.



# Scientific revolution

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Galileo played a major role in the scientific revolution of the seventeenth century. His contributions to observational astronomy include the telescopic confirmation of the phases of Venus, the discovery of the four largest satellites of Jupiter (named the Galilean moons in his honour), and the observation and analysis of sunspots. Galileo also worked in applied science and technology, inventing an improved military compass and other instruments.





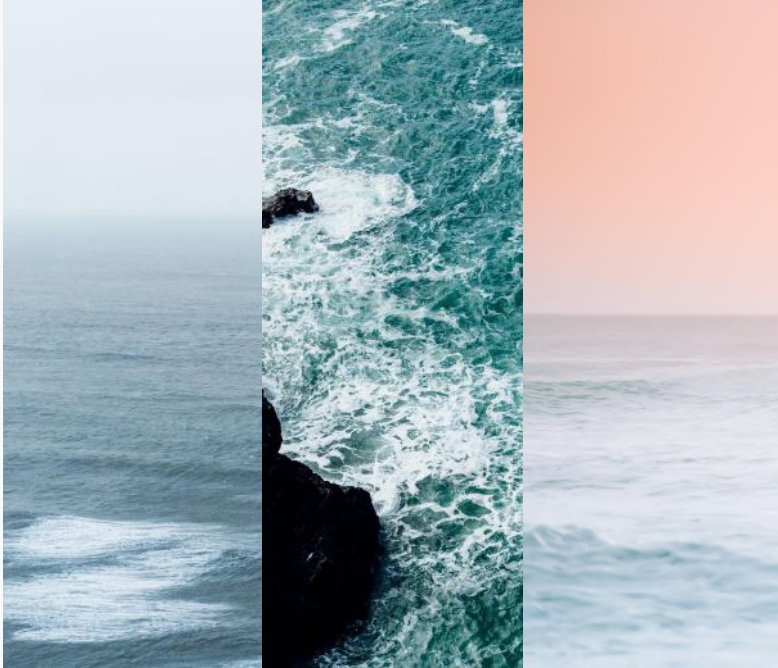
# research

# Tides

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Cardinal Bellarmine had written in 1615 that the Copernican system could not be defended without "a true physical demonstration that the sun does not circle the earth but the earth circles the sun". Galileo considered his theory of the tides to provide the required physical proof of the motion of the earth.

For Galileo, the tides were caused by the sloshing back and forth of water in the seas as a point on the Earth's surface sped up and slowed down because of the Earth's rotation on its axis and revolution around the Sun. His theory gave the first insight into the importance of the shapes of ocean basins in the size and timing of tides; however, his theory was a failure.



# research Comets

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In 1619, Galileo became involved in a controversy with Father Orazio Grassi, professor of mathematics at the Jesuit Collegio Romano. It began as a dispute over the nature of comets, but by the time Galileo had published *The Assayer* (*Il Saggiatore*) in 1623, his last salvo in the dispute, it had become a much wider controversy over the very nature of science itself.





# research Heliocentrism

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In the Christian world prior to Galileo's conflict with the Church, the majority of educated people subscribed either to the Aristotelian geocentric view that the earth was the center of the universe and that all heavenly bodies revolved around the Earth, or the Tychonic system that blended geocentrism with heliocentrism. Nevertheless, following the death of Copernicus and before Galileo, heliocentrism was relatively uncontroversial.

Opposition to heliocentrism and Galileo's writings combined religious and scientific objections and were fueled by political events.

# Tycho Brahe

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If heliocentrism were true, an annual stellar parallax should be observed, though none was. Copernicus had correctly postulated that parallax was negligible because the stars were so distant. However, Brahe had countered that, since stars appeared to have measurable size, if the stars were that distant, they would be gigantic, and in fact far larger than the Sun or any other celestial body. In Brahe's system, by contrast, the stars were a little more distant than Saturn, and the Sun and stars were comparable in size.





# Bible

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Religious opposition to heliocentrism arose from Biblical references such as Psalm 93:1, 96:10, and 1 Chronicles 16:30 which include text stating that "the world is firmly established, it cannot be moved." In the same manner, Psalm 104:5 says, "the Lord set the earth on its foundations; it can never be moved." Further, Ecclesiastes 1:5 states that "And the sun rises and sets and returns to its place."



# Inquisition

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By 1615, Galileo's writings on heliocentrism had been submitted to the Roman Inquisition by Father Niccolo Lorini, who claimed that Galileo and his followers were attempting to reinterpret the Bible, which was seen as a violation of the Council of Trent and looked dangerously like Protestantism



The Roman Inquisition, formally the Supreme Sacred Congregation of the Roman and Universal Inquisition, was a system of tribunals developed by the Holy See of the Roman Catholic Church, during the second half of the 16th century, responsible for prosecuting individuals accused of a wide array of crimes relating to religious doctrine or alternate religious doctrine or alternate religious beliefs. In the period after the Medieval Inquisition, it was one of three different manifestations of the wider Catholic Inquisition along with the Spanish Inquisition and Portuguese Inquisition.



# inquisition **Roman Inquisition**

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# inquisition

## Debate

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Galileo went to Rome to defend himself and his Copernican and biblical ideas. At the start of 1616, Monsignor Francesco Ingoli initiated a debate with Galileo, sending him an essay disputing the Copernican system. According to Maurice Finocchiaro, Ingoli had probably been commissioned by the Inquisition to write an expert opinion on the controversy, and the essay provided the "chief direct basis" for the Inquisition's actions. The essay borrowed primarily from the arguments of Tycho Brahe, and it notably mentioned Brahe's argument that heliocentrism required the stars to be much larger than the Sun.



# Consequence I

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In February 1616, an Inquisitorial commission declared heliocentrism to be "foolish and absurd in philosophy, and formally heretical since it explicitly contradicts in many places the sense of Holy Scripture. Pope Paul V instructed Cardinal Bellarmine to deliver this finding to Galileo, and to order him to abandon the opinion that heliocentrism was physically true. On 26 February, Galileo was called to Bellarmine's residence and ordered

*"... to abandon completely... the opinion that the sun stands still at the center of the world and the earth moves, and henceforth not to hold, teach, or defend it in any way whatever, either orally or in writing"*

# Consequence II

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For the next decade, Galileo stayed well away from the controversy. He revived his project of writing a book on the subject, encouraged by the election of Cardinal Maffeo Barberini as Pope Urban VIII in 1623. Barberini was a friend and admirer of Galileo, and had opposed the condemnation of Galileo in 1616. Galileo's resulting book, *Dialogue Concerning the Two Chief World Systems*, was published in 1632, with formal authorization from the Inquisition and papal permission. Earlier, Pope Urban VIII had personally asked Galileo to give arguments for and against heliocentrism in the book, and to be careful not to advocate heliocentrism. He made another request, that his own views on the matter be included in Galileo's book. Only the latter of those requests was fulfilled by Galileo.

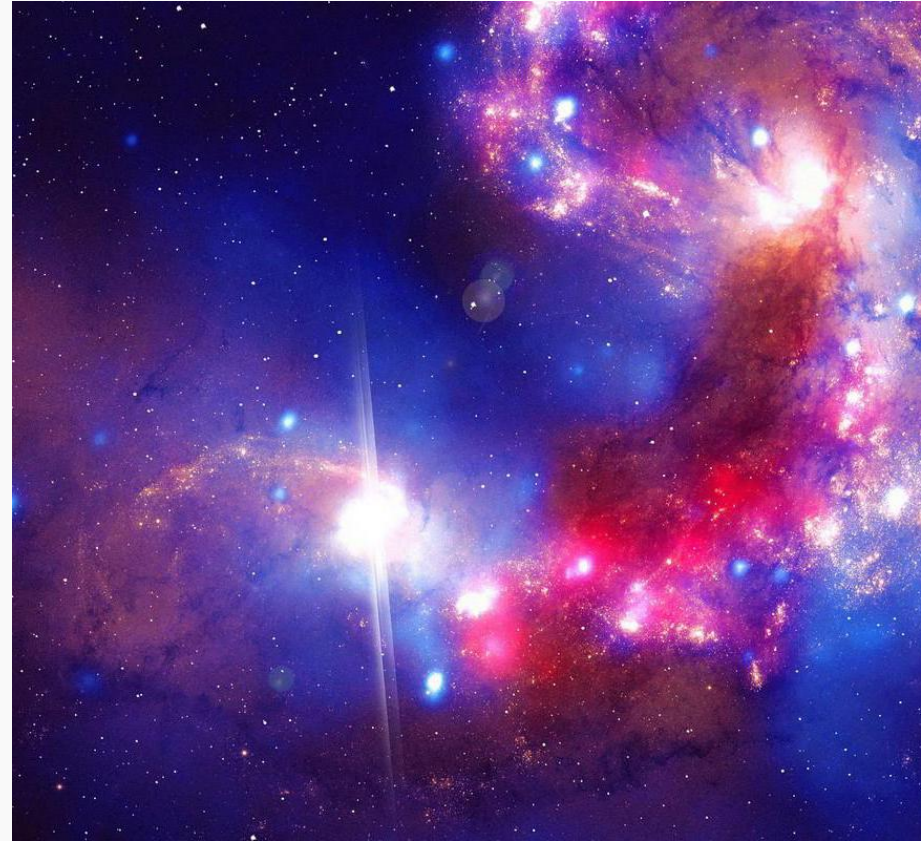
# inquisition

## Sentence

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Galileo had alienated one of his biggest and most powerful supporters, the Pope, and was called to Rome to defend his writings in September 1632. The sentence of the Inquisition was delivered on 22 June. It was in three essential parts:

1. Galileo was found "vehemently suspect of heresy"...He was required to "abjure, curse and detest" those opinions
2. He was sentenced to formal imprisonment at the pleasure of the Inquisition. On the following day, this was commuted to house arrest, which he remained under for the rest of his life.
3. His offending *Dialogue* was banned; and in an action not announced at the trial, publication of any of his works was forbidden, including any he might write in the future.





# inquisition

## After

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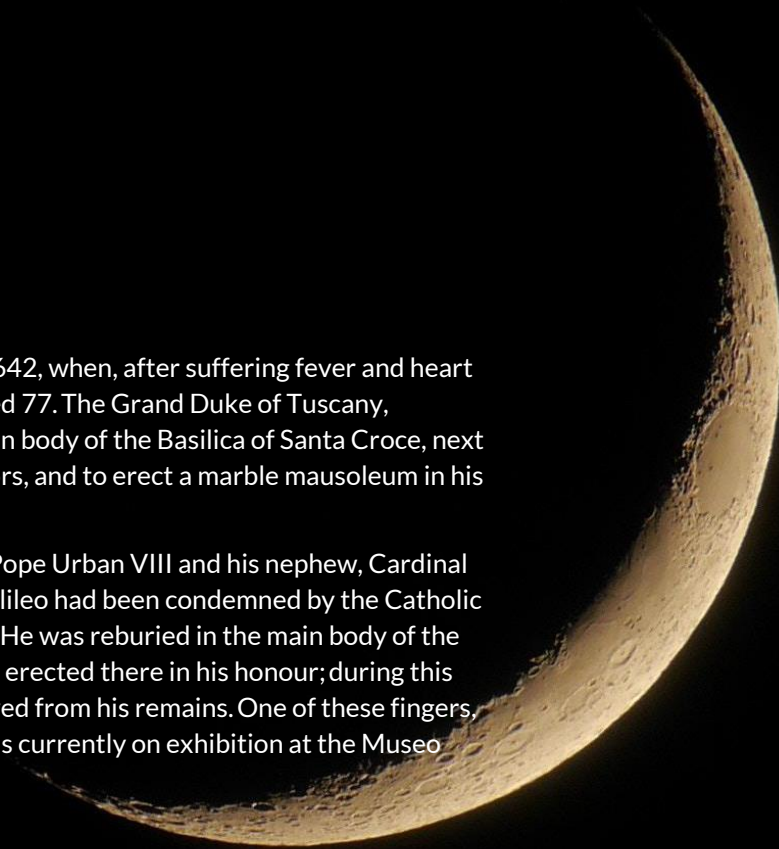
It was while Galileo was under house arrest that he dedicated his time to one of his finest works, *Two New Sciences*. Here he summarised work he had done some forty years earlier, on the two sciences now called kinematics and strength of materials, published in Holland to avoid the censor. This book has received high praise from Albert Einstein. As a result of this work, Galileo is often called the "father of modern physics". He went completely blind in 1638 and was suffering from a painful hernia and insomnia, so he was permitted to travel to Florence for medical advice.

# Death

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Galileo continued to receive visitors until 1642, when, after suffering fever and heart palpitations, he died on 8 January 1642, aged 77. The Grand Duke of Tuscany, Ferdinando II, wished to bury him in the main body of the Basilica of Santa Croce, next to the tombs of his father and other ancestors, and to erect a marble mausoleum in his honour.

These plans were dropped, however, after Pope Urban VIII and his nephew, Cardinal Francesco Barberini, protested, because Galileo had been condemned by the Catholic Church for "vehement suspicion of heresy". He was reburied in the main body of the basilica in 1737 after a monument had been erected there in his honour; during this move, three fingers and a tooth were removed from his remains. One of these fingers, the middle finger from Galileo's right hand, is currently on exhibition at the Museo Galileo in Florence, Italy.







# review Contributions

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He has been called the "father of observational astronomy", the "father of modern physics", the "father of scientific method", and the "father of science".

1. *Dialogue Concerning the Two Chief World Systems*
2. *Two New Sciences* (kinematics and strength of materials)

*Galileo Galilei*

# Questions



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*Galileo Galilei*