

LEVELED BOOKS

Galileo

MULTI
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P·S·V

Written by Keith and Sarah Kortemartin
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Galileo



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Focus Question

How do questions lead to new discoveries?

Words to Know

accurate

astronomy

chandelier

gravity

laws of nature

measurable

phase

published

solar system

sunspots

telescope

trial

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Level S Leveled Book

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Correlation

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DRA	34

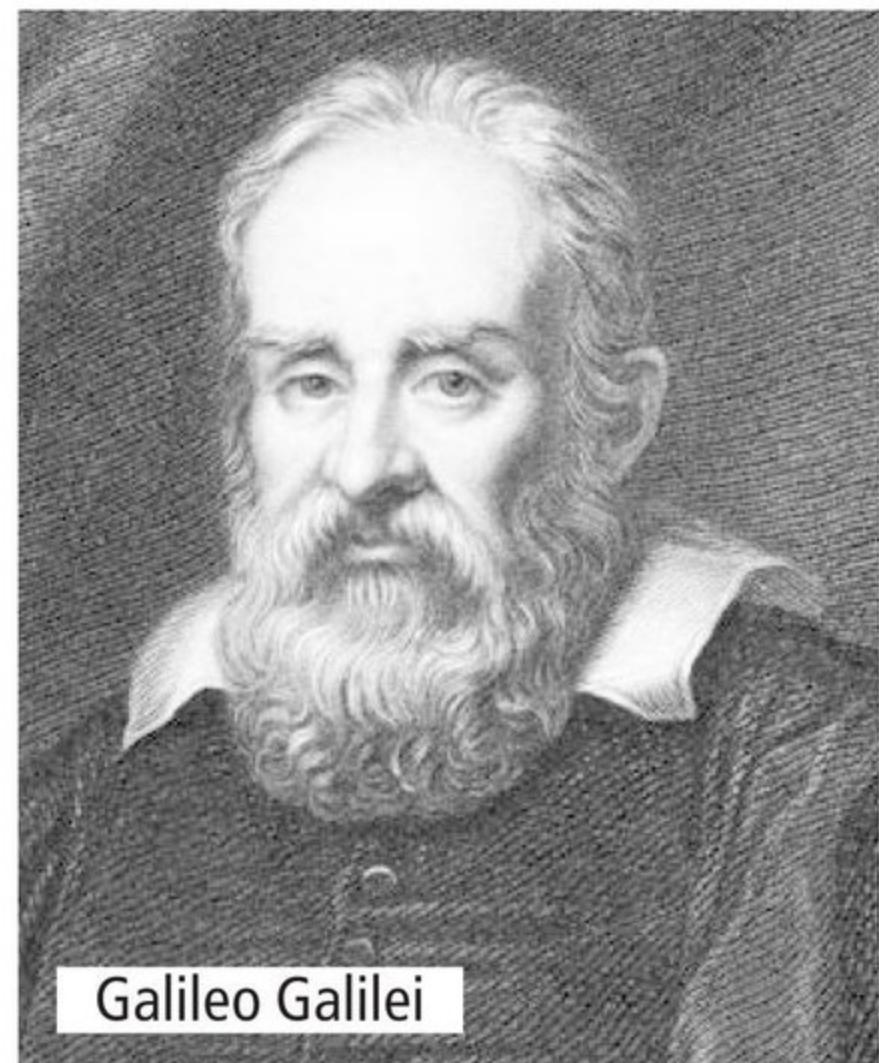


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Introduction

What do music, a **chandelier**, and the planet Venus have in common? They each played a part in the discoveries of one of history's greatest scientists, a man who lived five hundred years ago. That man was Galileo Galilei.

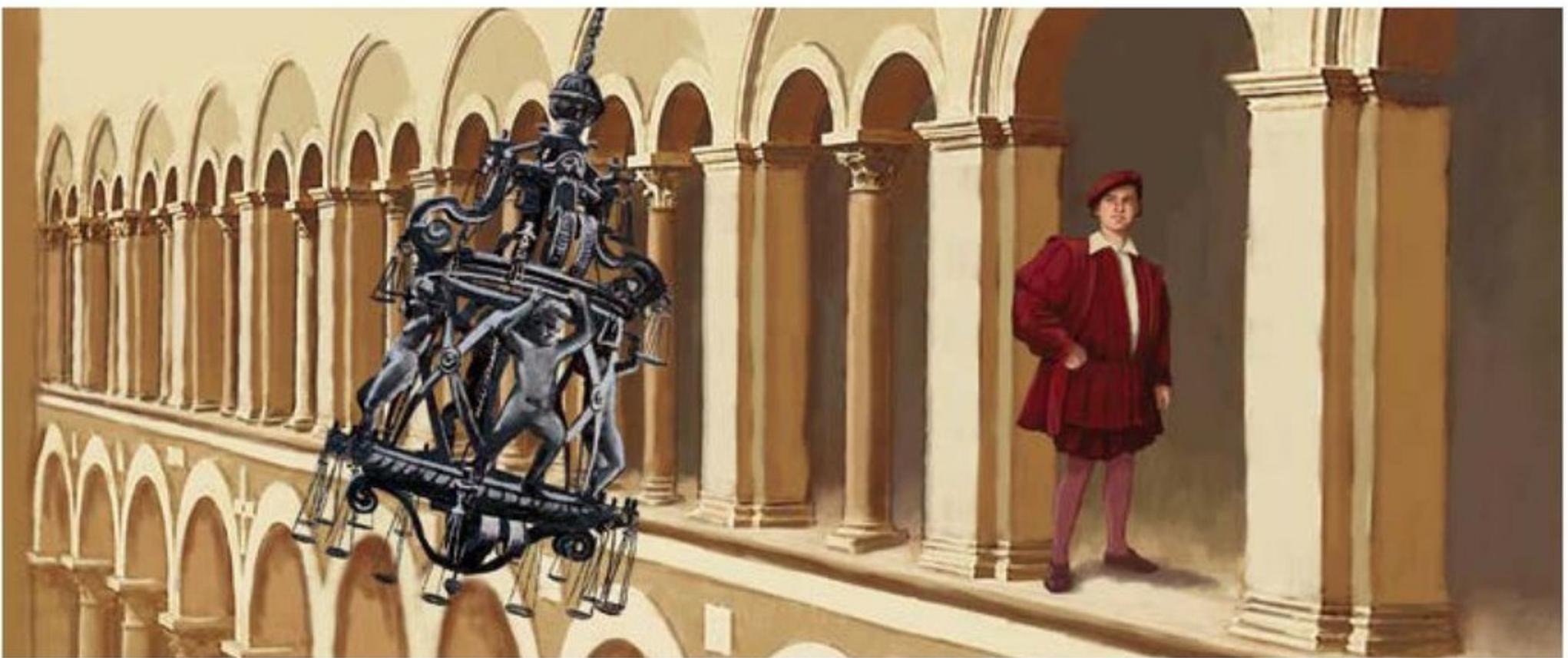


Galileo was born in Italy in 1564 during the Italian Renaissance. The Renaissance was a time of excitement and discovery. Painters, writers, mathematicians, musicians, builders, and scientists all developed new ideas during the Renaissance. Galileo was what we now call a "Renaissance man," an expert in several subjects at once. He used ideas from many areas to make scientific discoveries. Even more importantly, though, Galileo was good at asking questions. Though this habit eventually got him in trouble, Galileo's questions would change the way we understand the world.



Galileo's Childhood

Galileo was the son of Vincenzo Galilei, a musician and composer. Vincenzo was curious about how music worked. He taught young Galileo to be curious, too. Galileo would remain curious all his life. He looked closely at everything, recorded what he saw, and tried to explain what he had recorded.



The Student

As a young man, Galileo became fascinated with math and physics—the scientific study of matter, energy, and motion. In fact, he made one of his first major discoveries in physics a year before he entered university.

On a windy day in 1582, Galileo went to church. The church had a large chandelier hanging from the ceiling. Galileo noticed that the wind outside was making the chandelier swing back and forth. Sometimes the chandelier swung only a few inches from side to side. Sometimes the movement was much larger—as much as a few feet from side to side. But Galileo noticed something strange. Although some swings were much wider than others, every swing took exactly the same amount of time.

By watching the chandelier, Galileo discovered that a weight that swings back and forth can keep time. Later, he designed the first clock that used a swinging weight. Clocks like his are still in use today.

Despite his early achievements in math and physics, Galileo did not study math when he first entered the University of Pisa in 1583. His father urged Galileo to become a doctor instead. Galileo's medical studies never fascinated him as much as math and physics, though. In fact, he never finished his degree; he left university in 1585 because of money problems. For the next four years, Galileo worked as a math tutor, but he would not stay away from the university for long.



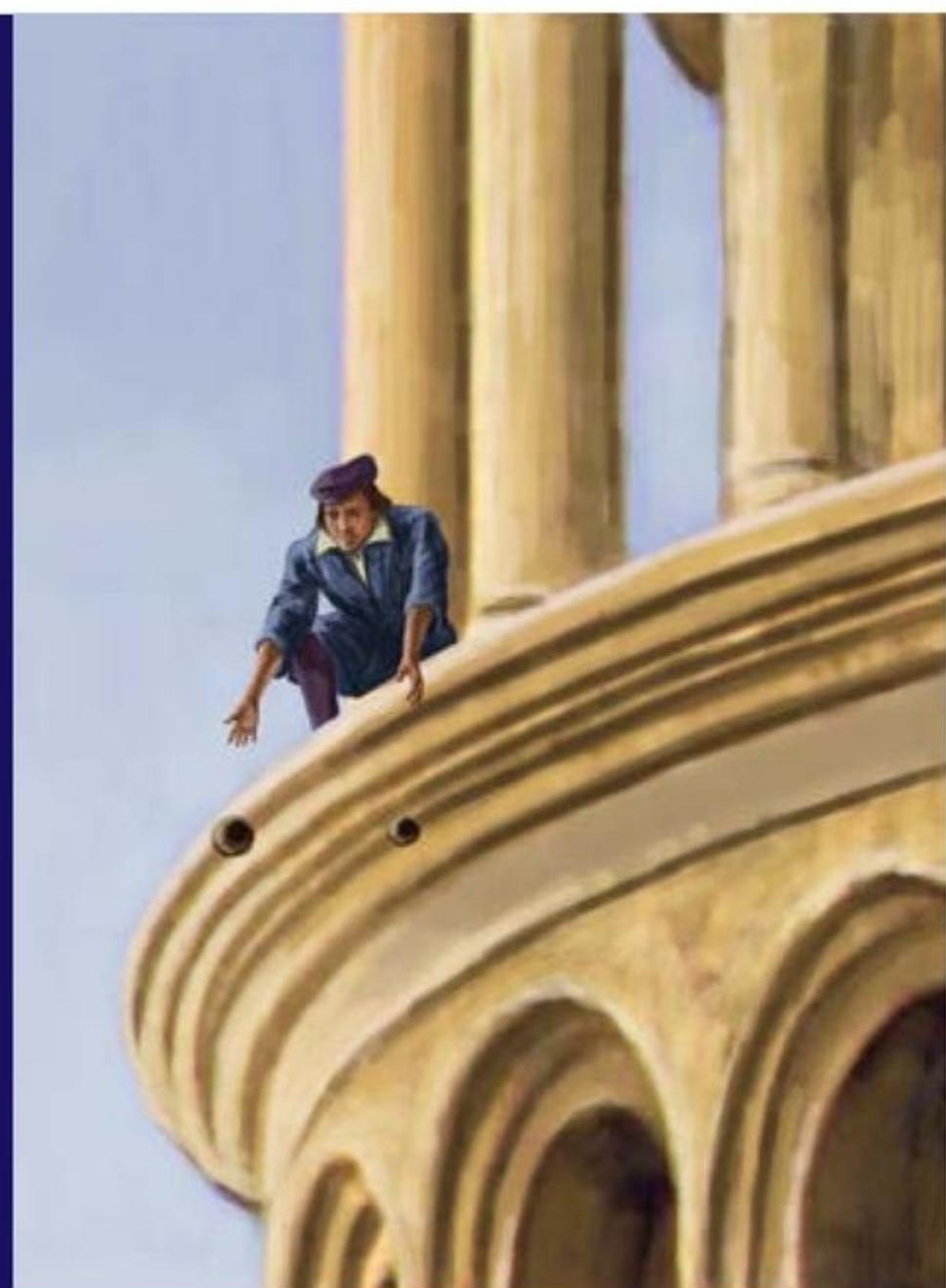
Grandfather clocks such as this one still use pendulums to keep time.

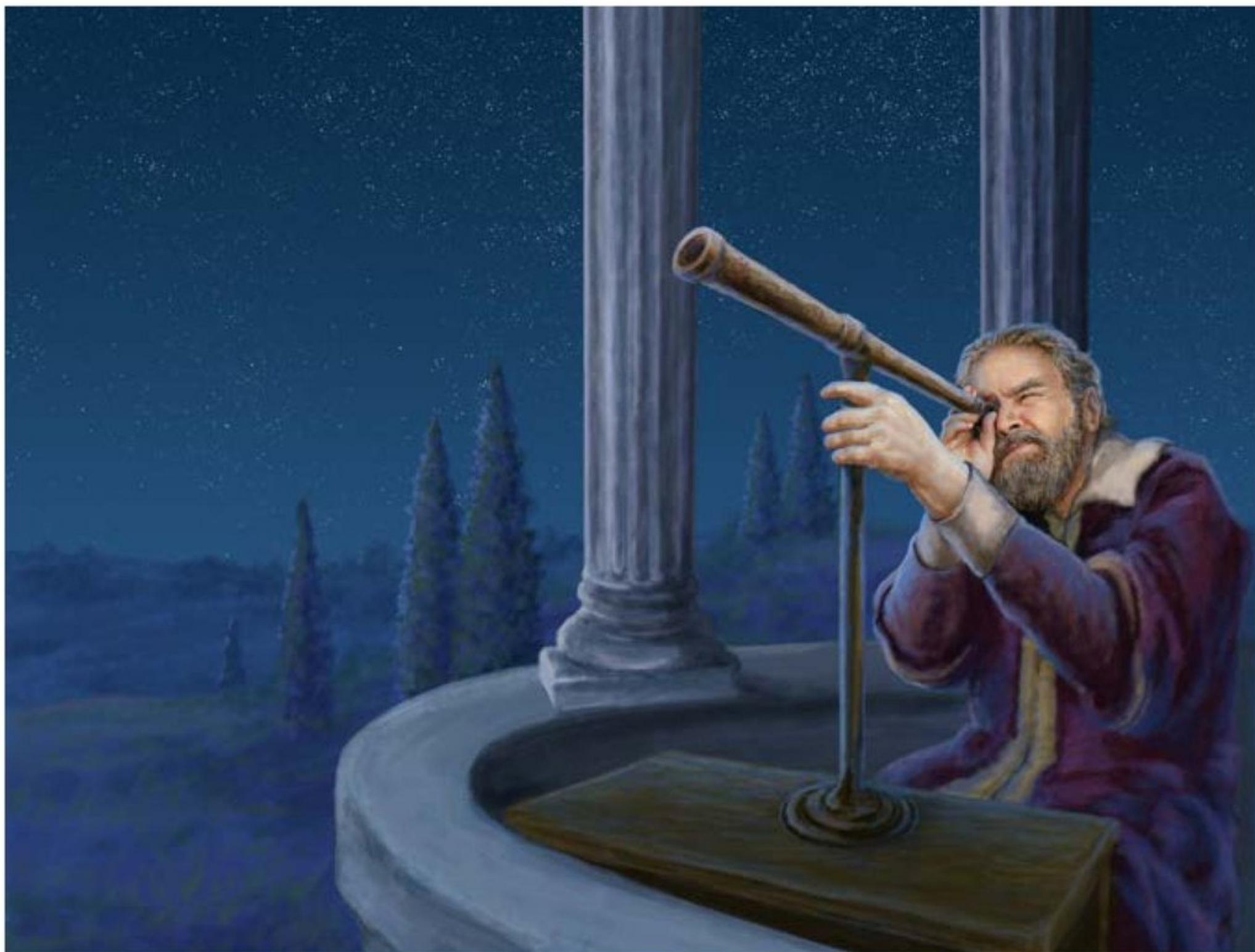
The Professor

In 1589, Galileo returned to the University of Pisa to teach mathematics. Shortly afterward, he was invited to teach math in Padua. He remained in Padua for the next eighteen years. Throughout his teaching career, Galileo continued to test his ideas. He was interested in **gravity** and conducted several experiments with falling objects. In the process, he proved that heavy objects fall at the same rate as lighter ones. However, the discoveries that would make him famous were still to come. Galileo's biggest discoveries happened when he began to study the sky.

Do You Know?

There is a famous story about one of Galileo's experiments. When he was a young professor, the story goes, he dropped two cannonballs from the Leaning Tower of Pisa. One cannonball was much heavier than the other, but they fell at the same speed. Today, it's not certain whether Galileo actually tossed cannonballs from the Leaning Tower of Pisa as part of his experiments with gravity.





The Astronomer

In 1609, Galileo heard about a “spyglass” invented in the Netherlands. When a person gazed through the spyglass, faraway objects looked much closer. Galileo had never seen a spyglass, but he figured out how to build one. He then made improvements on his original design. Soon he was able to make distant objects look thirty times bigger. He had built a **telescope**, in other words. In a fateful decision, he began to use his telescope to study the heavens. Galileo’s telescope changed his life, and **astronomy**, forever.

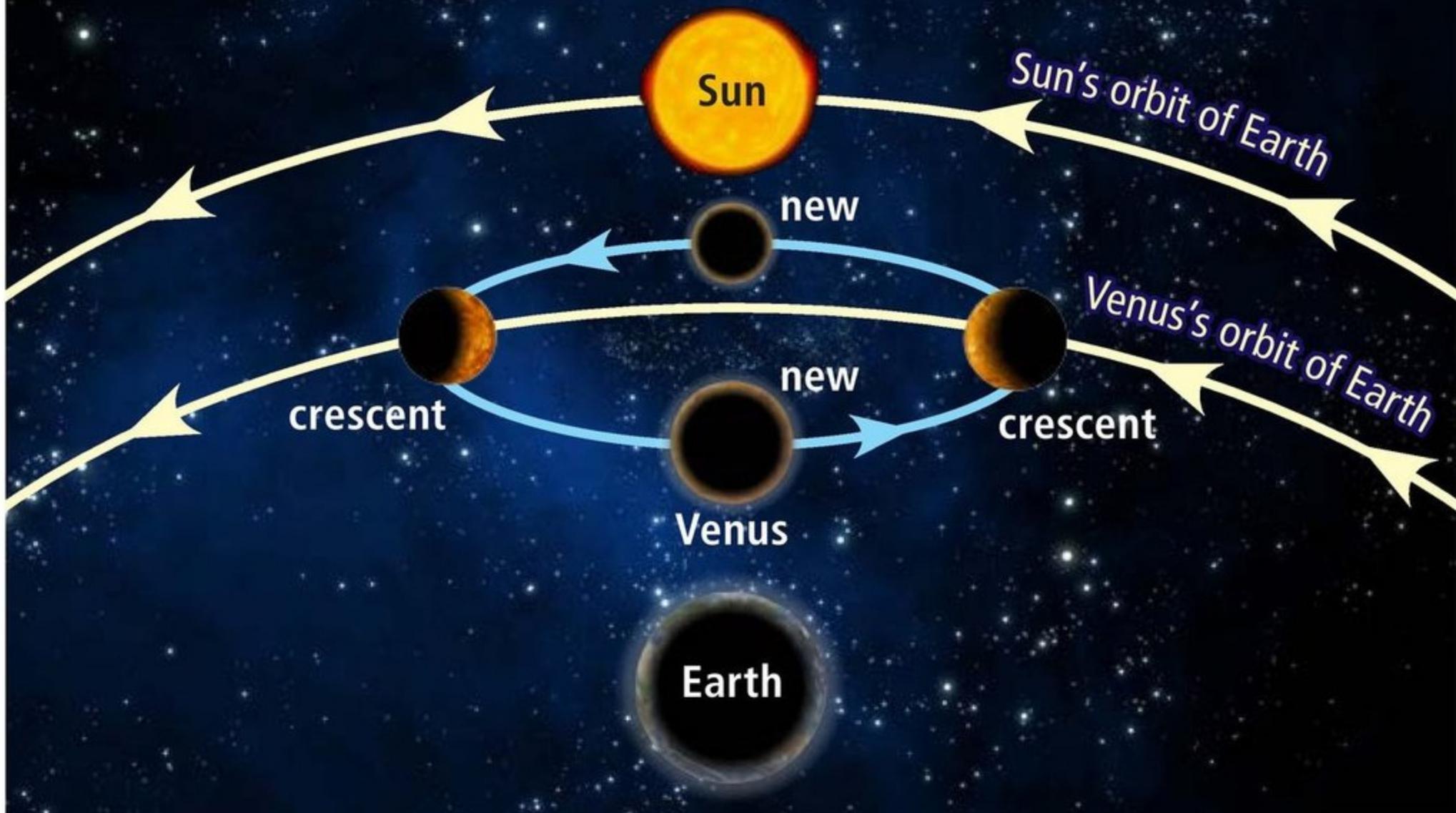
Galileo examined the **solar system** and made discovery after discovery. He was the first European to observe **sunspots**. He discovered Jupiter's four largest moons. He was also the first person to observe that Venus appears to change shape, just as the Moon does. Venus has a full **phase**, a new phase, and crescent phases.

Galileo **published** some of these discoveries in 1610 in a book called *The Starry Messenger*. The book made Galileo famous—but fame had a price.

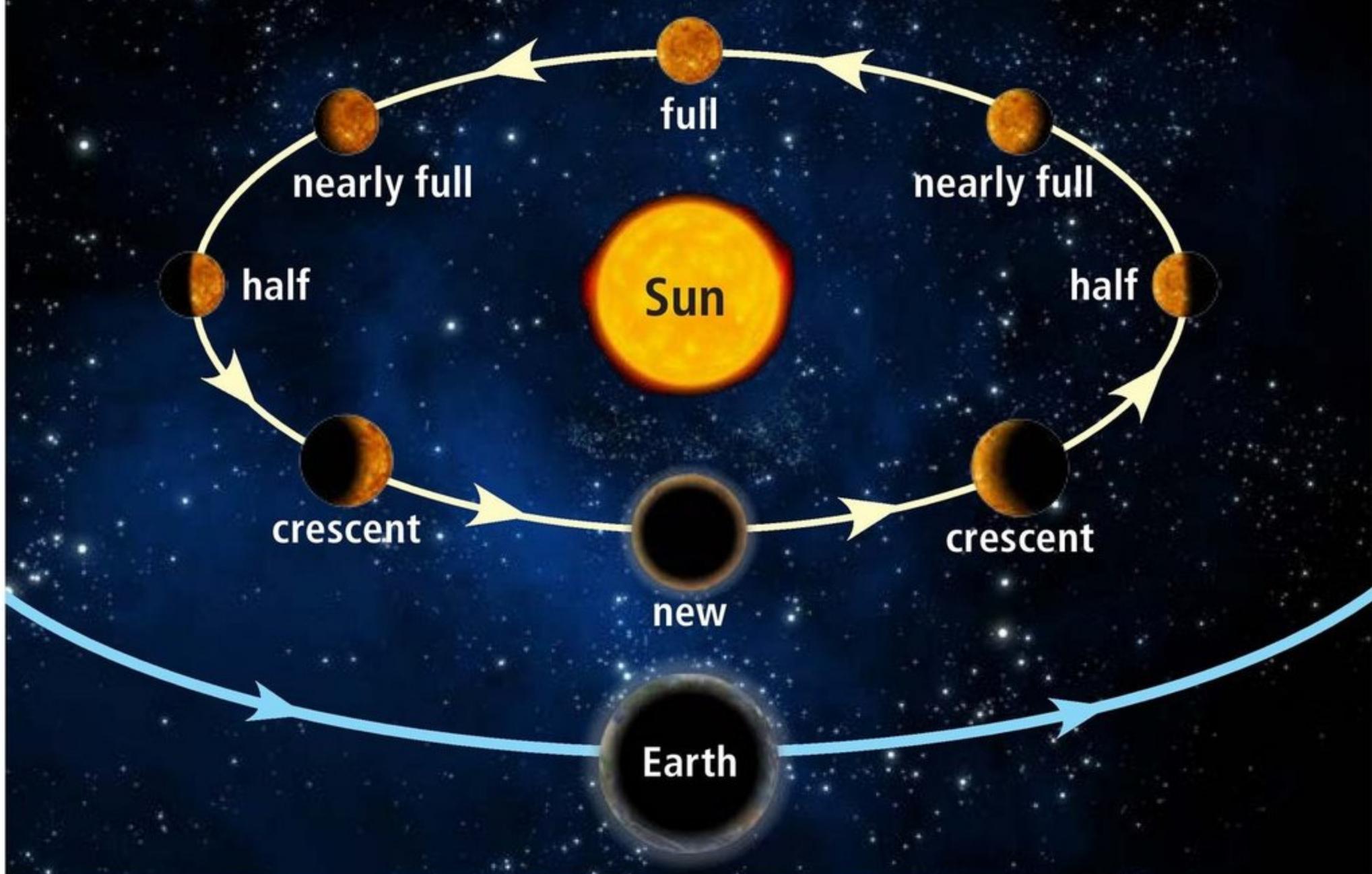


Galileo sketched the surface of the Moon (left) as he saw it through his telescope in 1610. NASA (the National Aeronautics and Space Administration) sent a probe named after Galileo to the Moon in 1992. The probe made a detailed scan of the Moon's surface (right) that clearly shows many of the same features Galileo noticed hundreds of years earlier.

During Galileo's time, many people believed that Earth was the center of our solar system and that the other planets and the Sun moved around Earth. They thought that planets such as Venus moved in small circles as they made a big circle around Earth. This would mean that Venus would only appear as a crescent shape in the night sky when seen from Earth.



Galileo saw through his telescope that Venus had many different shapes when seen from Earth. These changing shapes suggested that Venus and Earth were both moving around the Sun.

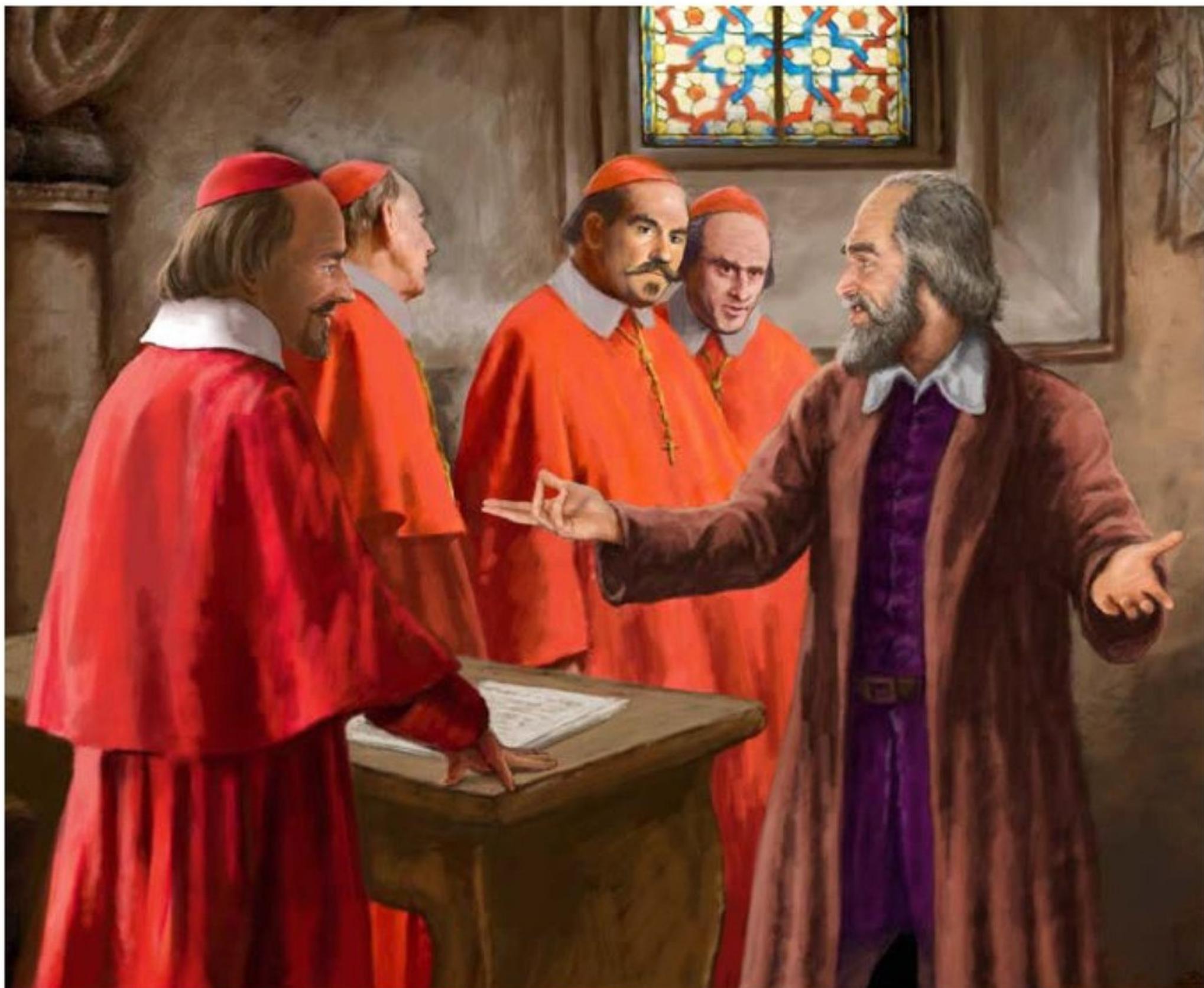




In Trouble with the Church

Galileo's discoveries about the solar system got him in a lot of trouble. The Catholic Church did not like his ideas about the solar system. Why did his discoveries upset them so much?

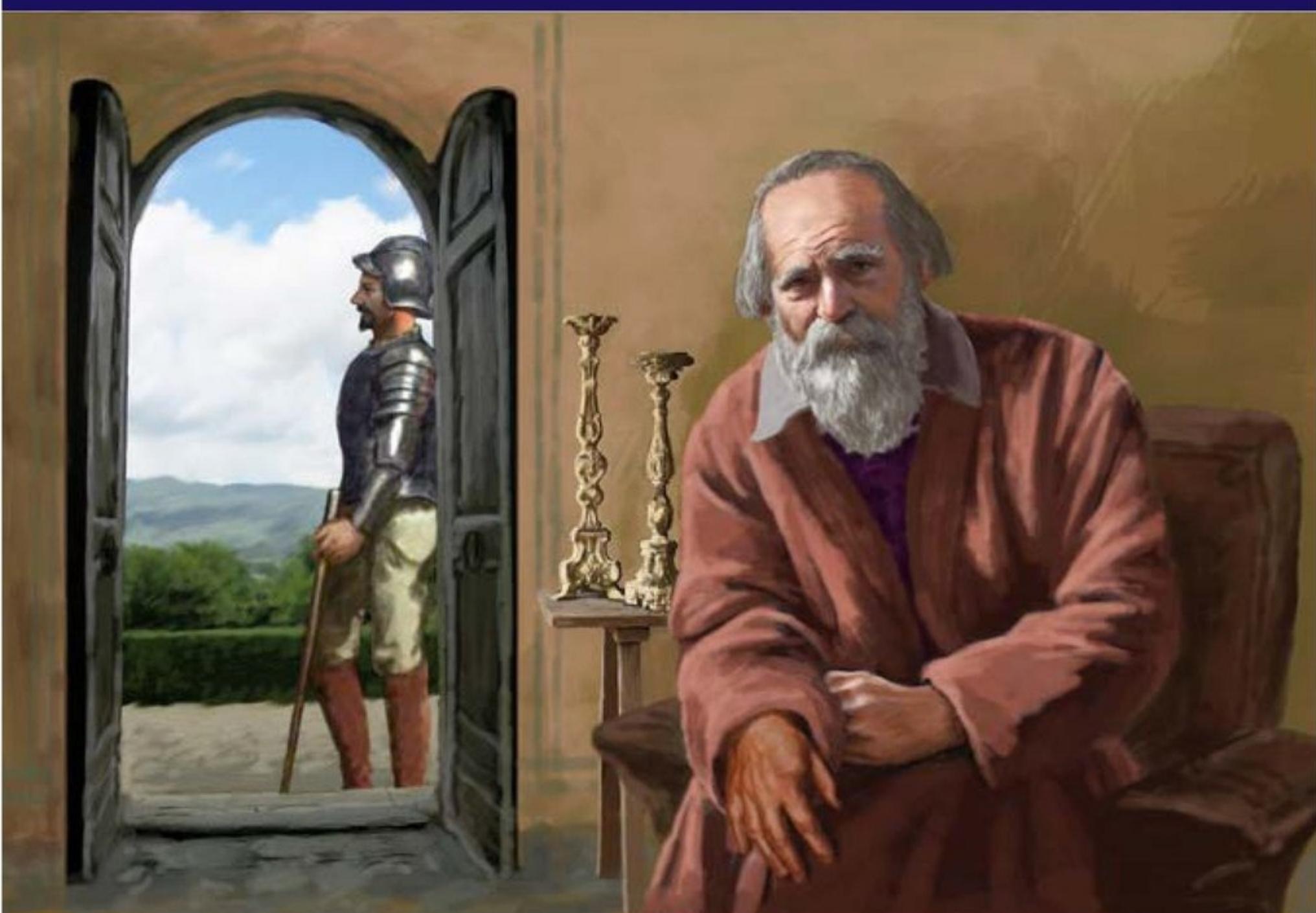
The answer lies in the religious beliefs of the time. For centuries, the Church had taught that the Sun, Moon, planets, and stars all moved around Earth. But the way that Venus changed shape was a big clue that it and the other planets in our solar system moved around the Sun instead. Galileo was not the first person to come up with this idea. However, his discoveries were the best proof yet that Earth was not the center of our solar system.



Galileo published writings about his discoveries that angered the Church. During the Renaissance, the Church had the power to punish people for unacceptable beliefs. Galileo had dared to insist that the Church was wrong, and in 1633 the Church put him on trial. At the trial, he was found guilty and threatened with death. Galileo was forced to say that his earlier discoveries had been lies, even though they were **accurate**. For the rest of his life, he was not allowed to leave his home. He was also forbidden to publish.

Do You Know?

A popular, but unproven, story says that Galileo “talked back” to the judges at his trial. The legend claims that he murmured, “And yet it moves” under his breath after he was forced to say that Earth did not move around the Sun. This story is not included in the records of the trial and is probably not true. However, the words “and yet it moves” have become very famous; people quote them to this day.



Galileo continued to write about his discoveries, however. He even managed to publish, despite the Church ordering him not to. He published *Two New Sciences* in 1638. It was his final publication. At that point, Galileo had become blind.

Galileo’s health continued to fail. He died in 1642 of natural causes.

Science After Galileo

We now know that Galileo was right: Earth moves around the Sun. Galileo's gift for asking important questions helped him make some of the greatest discoveries of his time. Scientists are still following many of Galileo's ideas. For example, he was the first to say that **laws of nature** could be described using math. He was also one of the first scientists to insist on using **measurable** data in his experiments. By doing so, he made it easier for other scientists to test his ideas. Galileo set an important example for many scientists who followed him, including Isaac Newton and Albert Einstein. Today, we call him the father of modern science.

Science and the Catholic Church

In 1757, the Catholic Church removed Galileo's book from a list of banned books. In 1992, the Church formally cleared Galileo of any wrongdoing. The modern Church accepts proven scientific facts and has supported scientific research for centuries.

Glossary

accurate (<i>adj.</i>)	correct or exact; precise (p. 13)
astronomy (<i>n.</i>)	a field of science involving the study of the stars, planets, comets, and other things found in space (p. 9)
chandelier (<i>n.</i>)	a fancy light fixture that hangs from the ceiling, often with branches for holding lights (p. 4)
gravity (<i>n.</i>)	the natural force that tends to pull objects toward each other, such as objects being pulled toward the center of Earth (p. 8)
laws of nature (<i>n.</i>)	scientific truths or principles that explain how nature works (p. 15)
measurable (<i>adj.</i>)	able to have a size or amount determined in measured units (p. 15)
phase (<i>n.</i>)	any of the possible ways that a planet or moon appears as viewed from Earth (p. 10)
published (<i>v.</i>)	made writing available to the public (p. 10)
solar system (<i>n.</i>)	a group of objects in space that orbit a star (p. 10)
sunspots (<i>n.</i>)	dark patches that sometimes appear on the Sun's surface (p. 10)
telescope (<i>n.</i>)	an instrument used to make distant objects look closer (p. 9)
trial (<i>n.</i>)	a legal process by which a person or group accused of wrongdoing is found innocent or guilty in a court of law (p. 13)

Galileo

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Word Count: 1,044

Connections

Writing

Research to learn more about one of Galileo's discoveries. Write at least one paragraph describing the discovery and how it changed people's understanding of the world.

Science

Draw a diagram or create a model of the solar system. Include details that Galileo discovered. Share your work with your class.

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