

Lesson 19: Galileo & Newton

Before we really start looking at **dynamics** (*the study of forces*) in depth, it would be wise to learn a little something about the two people that contributed the most to this branch of physics:

- [Galileo Galilei](#)
- [Sir Isaac Newton](#)

Galileo Galilei

Born in Pisa, Italy on February 15, 1564, died in Arcetri, Italy, January 8, 1642.

- First studied medicine in 1581 at the insistence of his parents.
- Today he is remembered mostly for his work in astronomy, mathematics, and physics.
 - He carefully constructed experiments to reduce error and ensure true observations, unlike many other "scientists" at that time.

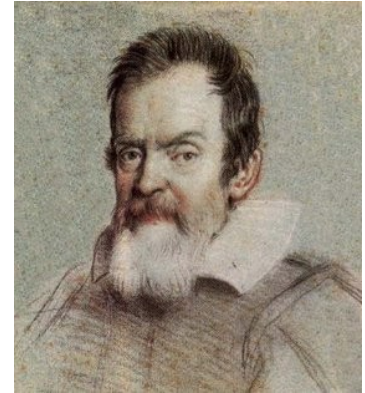


Illustration 1: Galileo Galilei

Galileo showed that falling bodies do not have velocities proportional to their weights.

- According to [Aristotle](#), heavier objects fall faster because gravity pulls on them more.
 - Drop a book and a piece of paper at the same time and you'll see what Aristotle was talking about!
- Galileo contradicted Aristotle, saying that air resistance is to blame, not gravity.
 - To prove this he (*supposedly*) climbed to the top of the Leaning Tower of Pisa and dropped two objects, one made of metal, the other of wood.
 - According to Aristotle's theory, the heavier metal weight should have hit the ground first.
 - In fact, both hit at the same time... gravity (without air resistance) acts the same on everything.
 - You can show this for the book and piece of paper you dropped by placing the paper on top of the book, and then dropping them. You got rid of the air resistance acting on the paper, so they both fall together.

In 1609, based on information from Holland, he built a telescope.

- What he saw made the Catholic Church...umm... "grumpy."
- This was because the majority of what he said either contradicted Aristotle, or in some way went against the vision of humanity at the centre of the universe.
 - Although common knowledge today, the four ideas that follow were radical in their time.

1. He found "mountains" on the [Moon](#).
"But God put it there, it should be perfect," said the Church.
2. Discovered [four of Jupiter's moons](#).
"But everything is supposed to orbit us on Earth,



Illustration 2: "Mountains" (craters) on the moon.

because God put us at the centre,” said the Church.

3. He looked at the sun (not a good idea) and saw [sun spots](#), areas where the sun appears blotchy.

“But God created the sun, so it’s perfect,” said the Church.

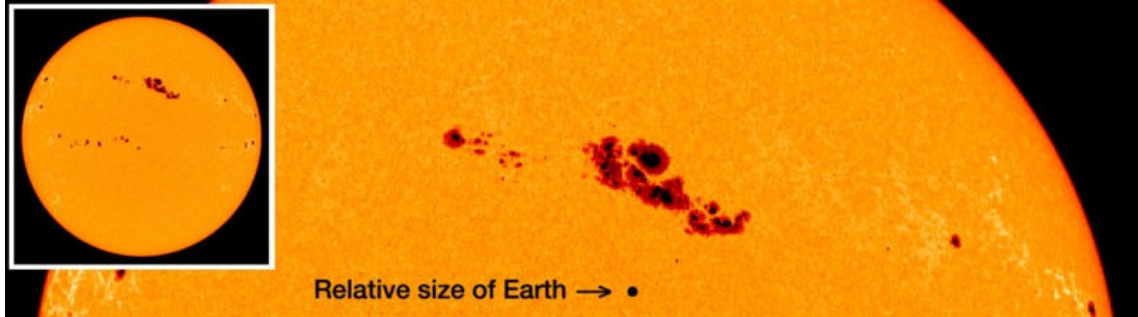


Illustration 3: A view of sun spots, with a comparison to the size of the Earth.

4. He supported the Copernican theory that the Sun is at the centre, not the Earth.

“Alright, enough’s enough, Galileo! You’re in trouble!” said the Church.

In 1633 the Inquisition (sort of like a Catholic Church courtroom trial) forced him to abjure (*renounce*) his theories

- As punishment he was placed under house arrest for the rest of his life.
- It is claimed (but often disputed) that as Galileo stood up from his recanting, he uttered "**Eppur si muove**" which is Latin for "**And yet it moves**".
 - This is a reference to his belief that the Earth was not the centre of the universe, that it actually moves in an orbit around the sun.
- In 1979 Pope John Paul II called for Galileo’s conviction to be annulled.
 - In 1992, after looking at the legal issues involved, Galileo’s conviction was reversed.

For more information...

...you can read the text of Galileo's adjuration and the annulment of Pope John Paul II by visiting the **Multimedia** page on [studyphysics.ca](#). You can also click [here](#) to read a copy of his book *Dialogue Concerning the Two Chief World Systems*.



Sir Isaac Newton

Born December 25, 1642, died March 20, 1727

- He was born in [Woolsthorpe](#), England in 1642, the same year that Galileo died.
- He was educated and taught at [Cambridge University](#), specifically Trinity College.
- He was President of the [Royal Society](#) (a “think tank” for scientists) from 1703 till his death.
- He was knighted in 1705, not for his scientific accomplishments, but for putting the Queen's face on a coin while he was head of the British Mint!

*Illustration 4:
Sir Isaac Newton*

Cambridge had closed shortly after he received his degree in 1665, due to the Plague sweeping the country.

- Luckily, Newton had already moved to Woolsthorpe (away from big towns) to live with his mother.
- It was over the next year that he did the best work of his lifetime:
 - He worked out the **Three Laws of Motion**.
 - He was “occasioned by the falling of an apple”.
 - No, he was never hit on the head by the apple, he just noticed it and wondered why things fall.
 - Because of this event he applied his three laws to describe the force of gravity
- Newton revealed very little of his work until he published the book “Philosophiae Naturalis Principia Mathematica” (*Mathematical Principles of Natural Science*) known more commonly as simply **The Principia**.

Newton was not known as a friendly person.

- He had few friends, and constantly got into arguments
- He also had two nervous breakdowns during his life, one caused by the death of his mother after which he spent six years in isolation.
- Although egotistical, he always acknowledged the work of those before him, especially Galileo.
 - “If I have seen further than other men, it is because I have stood on the shoulders of giants.” The ‘giant’ is Galileo