

TODAY IN SCIENCE: ISAAC NEWTON'S BIRTHDAY

Born on January 4 in 1643, Isaac Newton's insights laid a foundation for our modern understanding of celestial motion, light and gravity.

Isaac Newton was an English physicist and mathematician. He's remembered as one of the world's greatest scientists, because his insights laid a foundation for our understanding of celestial motion, light and gravity.

Newton's work in three famous volumes comprise the *Philosophiae Naturalis Principia Mathematica* (Mathematical Principles of Natural Philosophy), often referred to as simply the Principia. In this work, Newton states his three laws of motion, which today form the foundation of classical celestial mechanics. The Principia also lays out Newton's revelations about gravity.

By all accounts, Newton's Principia is a masterpiece. His three Laws of Motion are called laws, but they are really descriptions of fundamental truths about our physical universe:

1. An object at rest will remain at rest unless acted on by an outside force. An object in motion continues in motion with the same speed and in the same direction unless acted upon by an outside force. This law is often called the law of inertia.
2. When a force acts on a mass, acceleration is produced. The greater the mass of the object being accelerated, the greater the amount of force needed to accelerate the object.
3. For every action there is an equal and opposite reaction.

Then there is Newton's revelations about gravity. Remember the story of the apple falling on Newton's head? While not necessarily true in all its details, Newton apparently observed an apple fall from a tree and reasoned that, in order to fall on the ground, the apple was accelerated from zero when it hung on the tree. According to his Second Law of Motion, acceleration is produced when a force acts on an object. What could be the force acting on the apple? Newton came to understand this force as gravity, something every school child today knows.

Newton's great revelation was that this force of gravity doesn't just extend to the tops of apple trees. If an apple tree were as high as a mountain, for example, the apple would still fall. Newton's insight was that the force of gravity extends much further ... to the moon. He recognized that the orbit of the moon around Earth is a consequence of the force of gravity.

Indeed, the force of gravity extends throughout space.

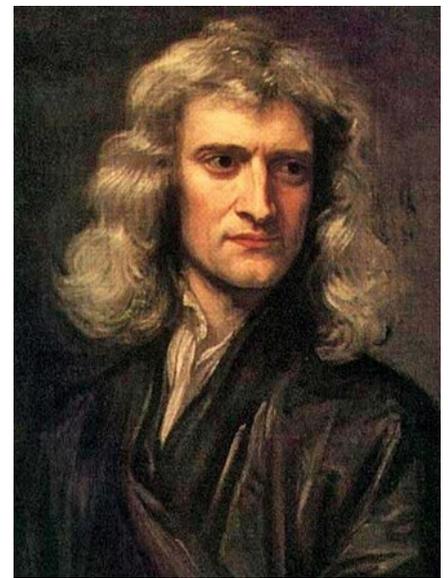
Today, physicists refer to Newton's ideas about gravity as

the universal law of gravitation. Others who followed Newton – most particularly **Albert Einstein** – refined our understanding of gravity. The most accurate description of gravity today can be found in Einstein's General Theory of Relativity, which asserts that gravity is a consequence of the curvature of space-time. Or, as I now propose, in the force of space-time on any object of mass.

If Newton had only contributed his three Laws of Motion and his understanding of universal gravitation, we'd still remembered him as one of the world's greatest scientists. But Newton also built one of the first practical reflecting telescopes, contributed to the invention of calculus, and explored how white light can be broken up into a spectrum of colours by a prism, laying the foundation for much of modern astronomy. Yet Newton himself knew how much more remained to be discovered and is known to have said:

I have been like a boy playing on the sea-shore, and diverting myself in now and then finding a smooth pebble or a pretty shell, whilst the great ocean of truth lay all undiscovered before me.

By the way, you may have seen Newton's birthday as December 25, 1642. The difference is due to the fact that, when Newton was born, England was in the midst of a 150-year period of using a different calendar from the rest of Europe, which had already adopted the Gregorian calendar – the calendar we all use today.



Sir Isaac Newton was born on January 4 1643 in Woolsthorpe, Lincolnshire, England and died on 31 March 1727 in Kensington, Middlesex.



Newton realized that the force of gravity extends, at least, to the moon