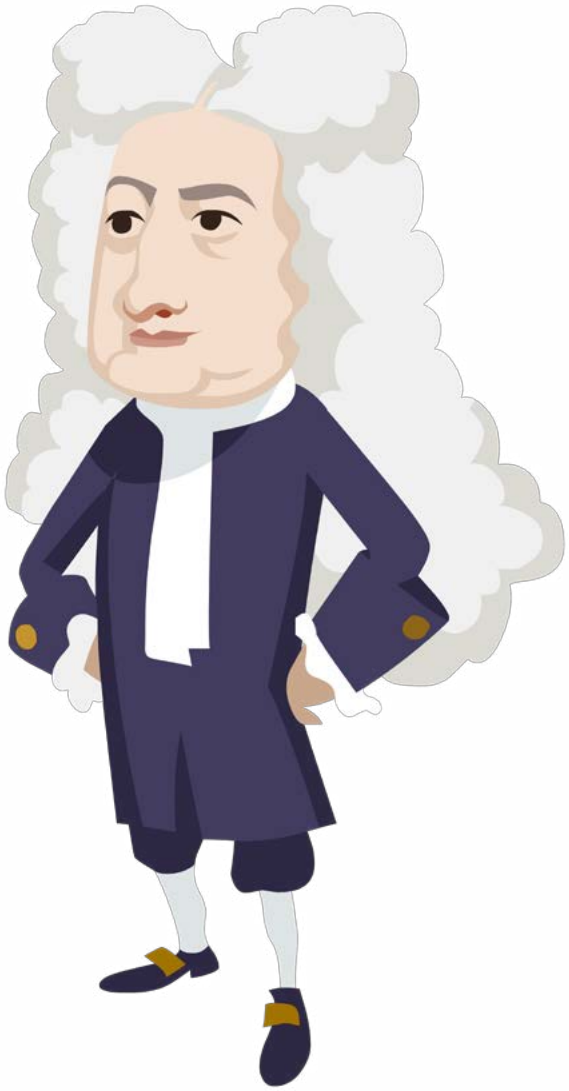
BBC TERRIFIC SCIENTIFIC

AMAZING PEOPLE SCHOOLS

Isaac Newton

1643 – 1727



An amazing story about forces

What would Issac Newton tell us if we could travel through time and ask him about his scientific discoveries?

The 16th and 17th Centuries saw huge achievements in fields such as physics, mathematics, astronomy, biology and the development of the scientific method.

It is considered by many to be the beginning of the modern age of science. I was born early into this period of great change, very weak and small. I was not expected to live long. However, not only did I survive, but I went on to fame as one of the world's greatest scientists.

My childhood wasn't easy. My mother had wanted me to become a farmer instead of going to school, but it just wasn't for me. In 1661, I went to the University of Cambridge to study law, but soon realised that what really interested me was mathematics and science. Besides my university studies, I made many scientific observations and experiments of my own and began to develop theories that would form the basis of the work that would make me famous.

By 1665, the country was hit by the bubonic plague and the university was closed, so I was sent back to my family home in Lincolnshire. These years in the countryside were a great time to develop my thoughts about forces! I was sitting in our garden one day, when I watched an apple fall from a tree. It got me thinking about why objects always fell downwards rather than floating away or falling sideways. It became clear to me that a force was acting upon the apple, pulling it towards the Earth's centre. I came to understand that this force, gravity, stops all objects from floating off into space. The force that makes the apple drop to the ground is the same constant force that keeps the Moon going around the Earth, and the Earth going around the Sun.

I was a withdrawn person and I continued working by myself on these ideas, not sharing them for many years. In fact, it wasn't until over 20 years later that I wrote a book called *Philosophiae Naturalis Principia Mathematica*, often shortened to *The Principia*, which is now regarded as one of the most important scientific books ever written. I described the force of gravity, as well as outlining my three laws of motion. These laws are still in use today, as they help to explain the way forces act upon objects in the Universe.

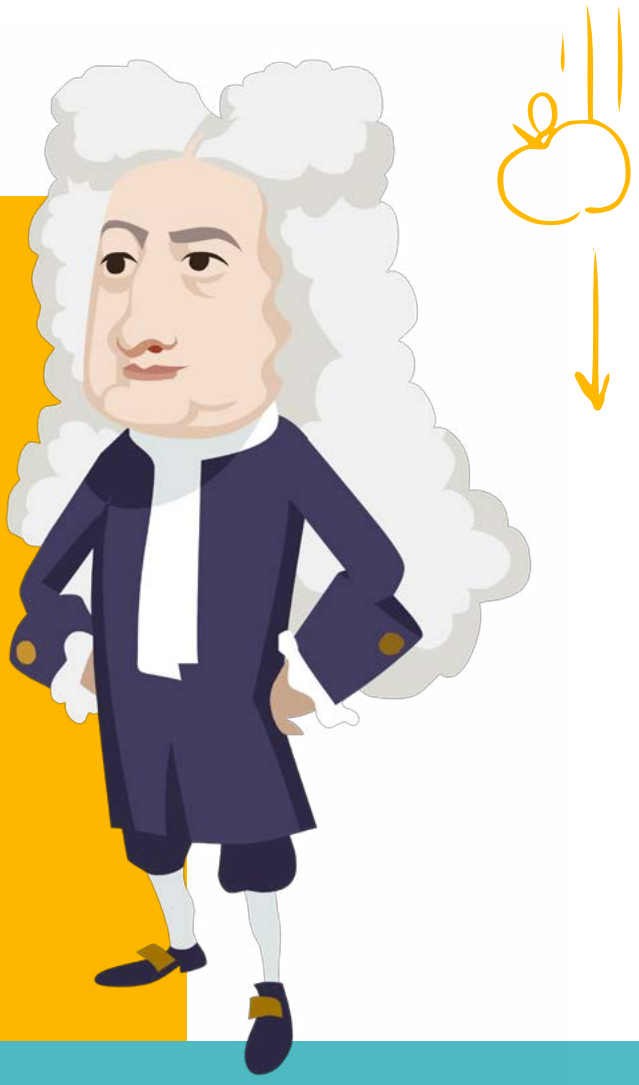
The first law of motion says that any moving object will continue to move in the same direction and at the same speed unless a force acts upon it. Think about it: when you throw a ball in the air, what stops that ball flying forever? Well, forces act to stop it! Two forces act upon the ball as it flies to slow it down and stop it moving. The first is air resistance, which slows the ball down as it travels through the air. The second is gravity, which pulls it towards the ground.

The second law of motion says that the bigger the object, the more force will be needed to move it. Imagine moving a bowling ball and a tennis ball across a table, which one would be harder to move? The heavier object will need a bigger push to move. Also, for the same object to go faster, it will need a bigger push or pull.

The third law of motion says that for every action there is an equal and opposite reaction. If you kick a ball, there is the force of your foot on the ball, which will make the ball move, but there is also the equal force of the ball pushing back upon your foot – this may feel like a 'whack' or your foot slowing down as it makes contact.

My work on forces was actually only one small part of the scientific work that I did. My other interests included the science of light. Through my research, I discovered that white light was actually made up of a rainbow of different colours known as a spectrum, which appear white when combined. Using my understanding of light, I also invented a new reflective telescope, which was ten times more powerful than other telescopes at that time. Having built my reputation as a scientist, I was invited to become Master of the Royal Mint, helping to set the standard for the coins used in Great Britain.

In honour of my work, I was elected as President of the Royal Society in 1703, a position I held for the rest of my life. In 1705, I was knighted by Queen Anne, becoming Sir Isaac Newton! There is no doubt that I left my mark on the world as a result of my ability, my determination and plenty of hard work. My work on forces and gravity helped to define modern physics and changed the way people understood the Universe – the unit of force, the newton, is named after me!



Glossary

Air resistance – the force that acts to slow down an object travelling through the air.

Force – a push or pull on an object.

Gravity – a force that attracts objects towards the centre of the earth. Gravity acts as a pulling force between all objects with mass – it keeps the Moon in orbit around the Earth and the Earth in orbit around the Sun.

Mass – a measure of how much matter an object contains.

Physics – the study of forces, matter and energy and the relationships between them.

Telescope – a piece of equipment used to look at objects in space. It magnifies what you see through it, making things appear bigger and closer.

Timeline

1642	Isaac Newton was born in rural Lincolnshire.
1665	Due to plague, Newton is sent home from university and works on mathematics, gravity, the three laws of motion and theories of light.
1671	Newton invents a new reflective telescope.
1687	His book *Philosophie Naturalis Principia Mathematica* is published after 20 years of work.
1699	Newton becomes Master of the Royal Mint.
1703	Elected President of the Royal Society, a position held for the rest of Newton's life.
1704	His *Opticks* book on light is published.
1705	Knighted by Queen Anne, becoming Sir Isaac Newton.
1727	Newton dies in London and is buried at Westminster Abbey.

Exercises

1. Can you think of three examples in your everyday life where Newton's first law of motion applies?
2. Can you think of three examples in your everyday life where Newton's second law of motion applies?
3. Can you think of three examples in your everyday life where Newton's third law of motion applies?
4. Pick one of each of your three examples for the three laws above and draw a diagram showing the forces involved. Use arrows of different sizes and directions to show the size and direction of each force.