

# Einstein's Key Discoveries

## Light Quanta, 17<sup>th</sup> March 1905

Einstein argued that light was not just a wave, but a stream of particles or packets of energy that he called quanta. These are now known as photons.

## Molecule Size, 30<sup>th</sup> April 1905

Einstein worked out a way to measure the size of molecules and proved in the process that everything around us is built from tiny atoms. This discovery finally got him his doctorate: he was now Dr Einstein!

## Brownian Motion, 11<sup>th</sup> May 1905

Einstein solved a mystery that had left scientists scratching their heads for more than 80 years. He showed how thousands of water molecules cause tiny dust or pollen particles to jiggle about when viewed through a microscope. The discovery proved atoms and molecules actually exist.

## Electrodynamics, 30<sup>th</sup> June 1905

Using nothing but thought experiments, Einstein came up with a modification of the theory of space and time that would change the way we think about the universe.

## Theory of Special Relativity, 1905

The *Theory of Relativity* says that the laws of physics are the same whether you're moving or standing still. Meanwhile, light always travels at the speed of light (299,792 km/s) – not slower or faster. However, Einstein realised that there was a problem with the theory of relativity when you think about light. If you travel incredibly fast (say at 99,792km/s) alongside a beam of light, then according to the theory of relativity it should only be travelling at 200,000km/s relative to you. But that's slower than the speed of light! So, either the speed of light is wrong, or the theory of relativity is wrong. But Einstein saw another possibility: time and space aren't actually fixed in the way we might think! Time slows down the faster you travel. And, the faster an object travels, the shorter it appears to someone standing still!

## Theory of General Relativity, 1915

If nothing can move faster than the speed of light, how does gravity work instantly across vast distances? After coming up with his *Theory of Special Relativity*, Einstein spent 10 years extending his ideas to apply to objects that are accelerating (speeding up) and to gravity. What he discovered was that gravity can bend light beams and change the colour of light by altering its wavelength. He also worked out that gravity is curving space-time and that the universe is expanding.

## $E=mc^2$

In 1905, during his "Miraculous Year", Einstein realised that the mass of a particle or an object was another way of measuring the total amount of energy in it. This discovery became possibly the most famous equation in the world:  $E=mc^2$ . This means that Energy (E) is the same as the mass of an object (m) multiplied by the speed of light multiplied by itself! The discovery led to the development of nuclear power – and the atom bomb.



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Theory of Relativity

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