

## R IS FOR RELATIVITY

In 2013, I wrote a show called *Albert Einstein: Relativitively\* Speaking*, in which I play Albert giving a ‘lecture’ about his most famous theories, and also accidentally helping to get a bomb built which ended up killing many many people in Japan. That show, which I still perform at theatres in various different countries, has six songs in it. And one of those songs is a rap about his most famous equation,  $E=mc^2$ . And I rewrote the lyrics of that rap for this show. So this is one of only two songs that (largely) existed before I wrote this show.

**RELATIVITY:** This is the name that Einstein gave to two of his theories – the Special Theory and the General Theory (see below). The name has nothing to do with relatives, as in uncles and aunts and brothers and sisters – instead, it is called relativity because it’s all about how objects behave *relative* to one another, in other words, how one object behaves if it is looked at from the point of view of another object.

**ENERGY-MASS EQUIVALENCE:** This is the concept that says that energy (the power that makes things change) is contained in mass (which means anything that is even the slightest bit heavy, even individual atoms). Einstein discovered energy-mass equivalence in a little paper he wrote as a postscript (a sort of “oh yes and another thing”) after he’d published his Special Theory. ‘Equivalent’ means ‘pretty much the same thing’, so the theory is that energy is basically the same thing as mass, and mass is basically the same thing as energy.

**THE SPECIAL THEORY OF RELATIVITY:** Before Einstein, people used to think that both space and time were fixed – that there was such a thing as an absolute upwards and an absolute downwards, and that a second or a minute would mean exactly the same thing here as anywhere else in the Universe. In his Special Theory, Einstein claimed that this isn’t true – time moves at different paces depending on how fast you’re moving, and space and time are all mixed up in this amazing new thing called space-time. And it turns out that Einstein was absolutely right (but it’s still “just a theory” – see K).

**$E=mc^2$ :** This is the equation of energy-mass equivalence. “E” stands for energy, “m” stands for mass, and “c” stands for the speed of light, which Einstein proved never changes, no matter how fast you’re travelling (it is “constant”, which is what the letter “c” actually stands for). The little <sup>2</sup>, which is pronounced “squared”, just means that in order to work out the amount of energy, you have to multiply the amount of mass by the speed of light *twice*.

**THE GENERAL THEORY OF RELATIVITY:** There was a problem with the Special Theory – it explained a lot, but it didn’t explain how gravity works. Einstein spent another ten years grumbling over this problem before coming up with the solution. He realised at last that space bends whenever there is any matter present (in sort of but not quite the same way as time bends depending on how fast you travel, which he’d already proved ten years earlier). This bending is what makes objects move closer to each other, like for example a ball falling to the ground when you drop it.

\* “Relativitively” is a deliberate spelling mistake, designed to make the show’s title extra-specially difficult for people to get right.