Key words: Paradoxes, Universe

ESOcast Episode 222: Ten Fascinating Paradoxes about the Universe	
00:00 **[Visual starts]** **[Narrator]** 1. This video lets you see some of the many things we do not understand in the Universe, and the strange and surreal paradoxes in what we think we understand…	Text slate: **Ten Fascinating Paradoxes about the Universe**
00:15 **[Narrator]** 2. Normal matter — protons, neutrons, and electrons — make up just 5% of the Universe. Staggeringly, the other 95% is something which we cannot fathom, see or understand. We call it dark matter, which makes up 27% of the Universe, and dark energy, which makes up 68%; but what are these mysterious components of our Universe?	Text slate: **1. Everything we know represents just 5% of the Universe — what is the rest?**
00:47 **[Narrator]** 3. To the best of our knowledge, our Universe consists of three dimensions of space and one of time. However, some scientific theories, such as superstring theory, propose additional dimensions to the Universe. These additional dimensions would help us unify the mathematical bases of the four fundamental forces of nature: the strong nuclear force, the weak nuclear force, the electromagnetic force, and gravity. Do these higher dimensions exist? And if they do, is there a way for us to measure their	Text slate: **2. How many dimensions does the Universe have?**

presence? Or will we forever be trapped in our 4-dimensional world?	
01:36 **[Narrator]** 4. Some scientists have suggested that multiple different Universes exist and that ours is just one of them. Together, these parallel universes would comprise everything that exists. Would they be the same as ours, or would they be completely different? Could our Universe interact with another Universe? Will we ever be able to confirm their existence?	Text slate: **3. What if our Universe is just one of a multitude out there?**
02:09 **[Narrator]** 5. Time is one of the most difficult properties of our Universe to understand . Researchers say that time is a measurable period, a continuum that lacks spatial dimensions. There seems to be an obvious direction (or flow) of time and it seems we can't travel backwards in time. Why is this? Are we trapped in the "arrow of time", perpetually moving forwards? Is the passing of time intertwined with the way our Universe works? According to the theory of Big Bang, time itself began together with the rest of the Universe, about 13.8 billion years ago. Does that mean that it makes no sense to ask what was there before?	Text slate **4. What is time?**

03:02 **[Narrator]** 6. In certain situations, two particles can seemingly be in instant connection with each other, even if they are located at opposite ends of the Universe. From the theory of relativity, we know that nothing, including information, can travel faster than the speed of light, so this behavior seems to violate the "speed limit of nature" and the principle of causality. Could this feature of quantum mechanics one day allow us to send information instantaneously over large distances?	Text slate: **5. Particles violating the laws of nature?**
03:39 **[Narrator]** 7. There are at least two trillion galaxies in the observable Universe — with more stars and planets in them than all the grains of sand on planet Earth. So… where is everyone? Why haven't we encountered life from elsewhere? Is life incredibly rare? Or does it have a limited lifetime, destroying itself before it has had the chance to seek out other lifeforms? What does this tell us about the future of humankind?	Text slate: **6. Are we alone in the Universe?**
04:15 **[Narrator]** 8. We humans, are also part of the Universe we inhabit, so when we look out to study the stars and galaxies, are we really neutral observers of the Universe? When we explore the Universe, we are both observers and the subject of observation. How can we pretend to be neutral when we are deeply embedded in what we explore? Could it be that this self-reference problem affects the way we look at the Universe, and gives us an overwhelmingly wrong impression?	Text slate: **7. Does the self-reference problem distort our perception of the Universe?**
05:01 **[Narrator]** 9. The Universe seems to be perfectly made for us — but why is this? Why do the	Text slate:

fundamental constants of our Universe, such as the speed of light, have the values that they do, allowing life to exist? Could it be that there are infinite Universes with infinite possibilities, and we merely happen to live in one that is perfect for life?	**8. Why is the Universe seemingly so perfect for us?**
05:31 **[Narrator]** 10. Entropy is the amount of disorder — chaos or randomness — in a system. One can never reduce entropy — everything in the Universe slowly moves towards disorder. It's very easy to smash a window, but impossible to put it back together exactly as it was before. The principle of entropy moves the Universe from structure to chaos, from an ordered state to disorder. What does this tell us about the fate of the Universe?	Text slate: **9. Why is it easier to destroy something than to put it back together?**
06:22 **[Narrator]** 11. We have observed the effects of black holes and we have seen one directly. The gravitational force of these massive objects pulls everything towards them, even light itself. What happens in the mysterious, infinitely dense centre of a black hole? Could there exist such things as white holes, the opposites of black holes, that spew matter and time into our Universe?	Text slate: **10. Can anything escape a black hole?**
06:59	Text slate: **The Universe is full of strange and surreal paradoxes. Our quest for understanding these is only just beginning.**
07:13 **[Outro]**	*Produced by ESO, the European Southern Observatory.* *Reaching new heights in Astronomy.*