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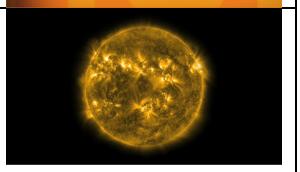
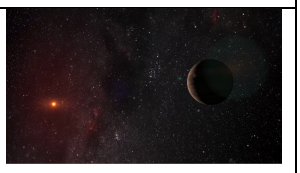
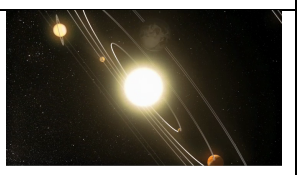
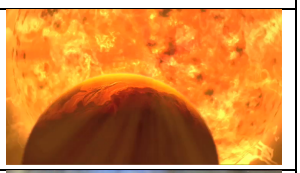
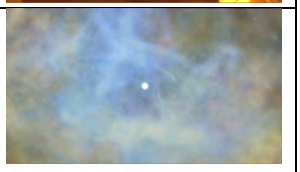
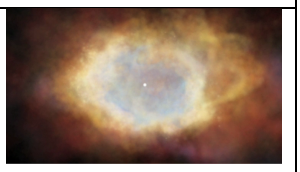
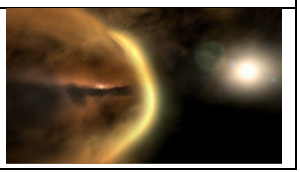
Hubblecast Episode 52: The Death of Stars		
[Narrator] 00:00 The NASA/ESA Hubble Space Telescope is famous for looking deep into the past of the Universe. But it can also predict the future. Pictures made by Hubble over the years show us the fate of the Solar System: a troubling but beautiful preview of what will happen when the Sun runs out of fuel more than five billion years from now.		
		
[Narrator] 00:49 Don't panic just yet! The Sun is about 4 ½ billion years old — that's old by most standards, but less than half way through its expected lifespan. However by observing countless stars similar to the Sun, scientists now have a good idea of what will happen to the Solar System in the very distant future.		
[Narrator] 01:12 Stars are balls of matter that produce energy mainly by fusing atomic nuclei of hydrogen, forming helium. Now, when two nuclei fuse together, their combined mass is slightly less than the sum of the two original nuclei, and the difference is released as energy.		
[Narrator] 01:35 That's where sunlight comes from… and it's also the process that powers thermonuclear bombs. But while thermonuclear bombs use up their fuel in just a fraction of a second, stars are big enough to sustain nuclear fusion for millions or indeed billions of years before they too eventually run out of fuel.		

[Narrator] 02:00 What happens next depends on the size of the star. Really big stars explode as supernovae after only a few million years…		
[Narrator] 02:24 …while the smallest stars burn slowly enough to be virtually immortal: their expected lifespan is much longer than the present age of the Universe, meaning we've never seen one die.		
[Narrator] 02:36 But for stars like the Sun, which have a lifespan measured in billions of years, astronomers have made many observations of what happens when the fuel supply runs out. They end with a whimper, not a bang. Here's how it goes — as revealed by Hubble observations of dozens of stars at different stages of evolution.		
[Narrator] 03:30 First, the star swells up and cools down a little, becoming a so-called red giant. When the Sun does this, it will destroy the inner planets of the Solar System.		
[Narrator] 03:16 Next, the outer layers are puffed out, forming a dense cloud of gas and dust that totally obscures the visible light from the star. This stage, called a pre-planetary, or protoplanetary nebula, is tough to observe as it's so faint — only dim infrared emissions from the dust cloud and reflected starlight let astronomers see anything at all. It's also a short period in stellar evolution, just a few thousand years long, so these objects are quite scarce. Hubble's images of pre-planetary nebulae show a wide variety of shapes, hinting at complex dynamics going on inside. The spiral structure of this nebula is particularly unusual, and is likely due to a binary star system shaping the cloud of gas and dust.		
[Narrator] 04:10 As the star ejects its outer layers to form the cold pre-planetary nebula, the core of the star is left behind, leaving a small but very hot remnant. Over a period of a few thousand years, radiation from this hot leftover excites the gas in the pre-planetary nebula, eventually making it light up like a fluorescent sign.		
[Narrator] 04:38 At this point, the faint *pre*-planetary nebula becomes a bright *planetary* nebula. In fact, these are bright enough that astronomers have long been able to see them, which explains their confusing name. Because they appear roughly spherical and have a greenish tinge when observed visually, astronomers using early telescopes found their appearance reminiscent of the planets of the Solar System.		

High resolution observations from modern telescopes including Hubble show that their shapes are often far from spherical, and the planet-like appearance is pretty dubious — but the name has stuck.		
[Narrator] 05:18 10. Eventually, planetary nebulae fade to nothing as the gas and dust is diffused into space. All that remains is a tiny, dense and dim white dwarf — the ultimate destination of the Sun, billions of years from now. But for stars there is life after death. The matter puffed into space by planetary nebulae forms the building blocks for new generations of stars and planets.		
[Narrator] 05:38 But for stars there is life after death. The matter puffed into space by planetary nebulae forms the building blocks for new generations of stars and planets.		

06:48 [ENDS]