

Ask an Astronomer

Question: "How do stars live and die?"

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The way stars live and die makes a lot of sense if you consider what a star really is.

Simply put, a star is a large amount of gas and dust that is collapsing under the force of gravity.

At first, this crush of gravity makes the inside of the star hot enough to ignite a nuclear explosion. This explosion supports the star against gravity and makes it shine.

In our Sun's case, this stage will last for about ten billion years.

But eventually, all the nuclear fuel inside the star (mostly hydrogen and helium) gets used up. After that, there's nothing to support gravity, so once again, the star starts collapsing.

What happens next depends on how much mass the star had in the beginning, and which forces of nature can finally hold up to the crush of gravity.

With stars about the size of our Sun, gravity will crush everything tightly together, but eventually, the structure of the star's atoms will hold up gravity. Those stars like our Sun will become white dwarf stars. A white dwarf is basically a big, dying cinder about the size of the Earth and with a density of an 18-wheel truck crushed into the volume of a sugar cube.

If a star is just a bit more massive than the Sun, not even the structure of the star's atoms can hold up against gravity, and everything gets crushed into one giant atomic nucleus. This forms a "neutron star," which is about ten miles across and has a density of a Mount Everest per sugar cube.

If the star is much more massive than the Sun -- say about three times more massive -- then nothing can hold up to the force of gravity. The star collapses right out of existence, and becomes a bottomless pit that we call a "black hole." Nothing can escape the gravity of a black hole. In fact, the reason we call them "black" is that the gravity is so intense it can actually pull in light itself.

So, the final death of a star depends on its mass, and what, if anything, can stand up to that final crush of gravity that began even before the star started to shine.

For "Ask an Astronomer," I'm Dr. Michelle Thaller of the SIRTf Science Center.